INDUSTRIAL RESEARCH

SESAR Solution PJ02-01 SPR-INTEROP/OSED for V3 - Part I

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Authoring & Approval

Authors of the document

Name/Beneficiary	Position/Title	Date
Charles MORRIS/NATS	PJ02-01 Member	31/01/2020
Valerio CAPPELLAZZO/ECTL	PJ02-01 Member	13/01/2020
Sebastian KAUERTZ/AIRBUS	PJ02-01 Member	29/04/2019
Frank HOLZAEPFEL/AT-ONE	PJ02-01 Member	07/01/2019
Cedric RAHATOKA/THALES	PJ02-01 Member	17/03/2017
Cristina MORALES/INDRA	PJ02-01 Member	17/03/2017

Reviewers internal to the project

Name/Beneficiary	Position/Title	Date
Charles MORRIS/NATS	PJ02-01 Member	07/11/2019
Aurora SIMONETTI/NATS	PJ02-01 Solution Lead	05/06/2019
Valerio CAPELLAZZO/ECTL	PJ02-01 Member	07/11/2019
Sebastian KAUERTZ/AIRBUS	PJ02-01 Member	04/11/2019
Frank HOLZAEPFEL/AT-ONE(DLR)	PJ02-01 Member	07/10/2019
Jonathan TWIGGER/THINK (on behalf of NATS)	PJ02-01 Solution Lead	31/01/2020
Grigory ROTSHTEYN/AT-ONE(DLR)	PJ02-01 Member	31/10/2019

Approved for submission to the SJU By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date
Jonathan TWIGGER/Think (on behalf of NATS)	PJ.02-01 Solution leader	11/11/19
Frederique AYACHE/EUROCONTROL	PJ.02-01 Deputy Project Manager	15/11/19
Claire PUGH/NATS	PJ.02-01 Member/Task leader	14/11/19
Valerio CAPPELLAZZO/EUROCONTROL	PJ.02-01 Member	13/11/19
Sebastian KAUERTZ/AIRBUS	PJ.02-01 Member	14/11/19
Frank HOLZAEPFEL/AT-ONE(DLR)	PJ.02-01 Member	12/11/19
Cedric RAHATOKA/THALES	PJ.02-01 Member	14/11/19
Pablo FUENTES DE FRUTOS/INDRA	PJ.02-01 Member	15/11/19

Alan GROSKREUTZ/CRIDA	PJ.02-01 Member	
Sebastian KAUCZOK/LEONARDO GmbH	PJ.02-01 Member	14/11/19
Francois NEGRE/DSNA	PJ.02-01 Member	13/11/19
Tim ROBINSON/SEAC(HAL)	PJ.02-01 Member	14/11/19
Wilfred ROUWHORST/AT-ONE(NLR)	PJ.02-01 Member	14/11/19
Christian KERN/AUSTROCONTROL	PJ.02-01 Member	15/11/19
Peter ERIKSEN/NAVIAIR	PJ.02-01 Member	

Each of the representatives listed above were approached for written approval of this document, however some were not received in time for submission.

Rejected By - Representatives of beneficiaries involved in the project

Name/Beneficiary	Position/Title	Date

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				Requirements. Small number of editorial corrections.
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00.00.09	05/11/2018	Draft	Charles MORRIS/NATS Valerio CAPPELLAZZO/ECTL	Updated BIMS. Corrected Front Sheet. Added Copyright Statement and updated Document History contributors to ensure all contributors are recorded. Incorporated updates to the SESAR 2020 Concept of Operations, 2017 Edition and to the PJ19 Validation Targets (2018). Restructured and supplemented Section 3.2.4 on the applicable standards and regulation to clarify reference and solution wake separation standards for both arrivals and departures. Updated Section 3.3.2.1 on the Arrivals Concepts Solutions with the ECTL additions and changes including the addition of Appendix B on the A-WDS-Xw Methodology. Updated Section 3.3.2.2 on the Departures Concepts Solutions with the NATS and ECTL changes and additions including the addition of Appendix C on the ECTL OSD Tool for Departures. Updated Section 3.3.2.5.1 Use Cases for the Arrivals

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				the SAR Part II Transferred Appendix C to the TS/IRS
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00.01.02	31/01/2020	Final version update	Charles MORRIS/NATS	Added requirements generated by SE-DMF OSED report.

	Addressing partner review feedback.

Copyright Statement

EARTH

INCREASED RUNWAY AND AIRPORT THROUGHPUT

This SPR-INTEROP/OSED Part I is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 731781 under European Union's Horizon 2020 research and innovation programme.

Abstract

This Part I of the SPR-INTEROP/OSED presents the concepts that contribute to Wake Turbulence Separation Optimisation:

- Arrivals Concepts Solutions
- Departures Concepts Solutions
- Wake Risk Monitoring Concept Solution
- Wake Decay Enhancing Concept Solution

The PJ02-01 Solution has aimed to optimise wake turbulence separation minima for arrivals and departures to enhance airport runway throughput. It has focused on the development and validation of:

- Wake turbulence separations based on static aircraft characteristics and weather dependent reductions
- Separation delivery support tools for ATCOs
- Wake risk monitoring function
- Wake decay enhancing devices

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The SPR/INTEROP-OSED Template includes the following parts:

- ***SPR/INTEROP-OSED Template – Part I (this volume)***
- SPR/INTEROP-OSED Template – Part II Safety Assessment Report (SAR)
- SPR/INTEROP – OSED Template – Part III Security Assessment Report (SeAR)
- SPR/INTEROP – OSED Template – Part IV Human Performance Assessment Report (HPAR)
- SPR/INTEROP – OSED Template – Part V Performance Assessment Report (PAR)

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1 Executive Summary

This Part I of the SPR-INTEROP/OSED presents the concepts that contribute to Wake Turbulence Separation Optimisation:

- Arrivals Concepts Solutions
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The PJ02-01 Solution has aimed to optimise wake turbulence separation minima for arrivals and departures to enhance airport runway throughput. It has focused on the development and validation of:

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- Separation delivery support tools for ATCOs
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- Wake decay enhancing devices

Arrivals Concepts Solutions

The arrivals concepts solutions consist of Wake Turbulence Separations for Arrivals based on Static Aircraft Characteristics (PWS-A), Optimised Runway Delivery on Final Approach (ORD) and Weather-Dependent Reductions of Wake Turbulence Separations for Final Approach (WDS-A).

ORD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between arrival pairs on final approach to the runway landing threshold through providing Target Distance Indicators (TDIs) to the controllers.

PWS-A is the efficient aircraft type pairwise wake separation rules for final approach consisting of both the 96 x 96 aircraft type based pairwise wake separation minima and the twenty wake category (20-CAT) based wake separation minima for arrival pairs involving other aircraft types.

WDS-A is the conditional reduction or suspension of wake separation minima on final approach, applicable under pre-defined wind conditions, so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on final approach, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft.

The wake separation minima on final approach are defined as both distance-based minima and time-based minima, and so may be applied as either distance-based minima or time-based minima.

Revising the wake separation minima aims to increase arrival runway capacity, efficiency, predictability and resilience while maintaining or increasing safety.

ORD, PWS-A and WDS-A are all V3 mature. WDS-A has ended in Wave 1. For PWS-A additional activities are planned in Wave 2 as further refinement of the 96x96 matrix for inclusion of additional and new aircraft types. For ORD refinements/new functionalities will be encompassed in a new OI AO-0334 in Wave 2.

Departures Concepts Solutions

The departures concepts solutions consist of Wake Turbulence Separations for Departure based on Static Aircraft Characteristics (PWS-D), Optimised Separation Delivery for Departure (OSD) and Weather-Dependent Reductions of Wake Turbulence Separation for Departure (WDS-D).

OSD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between departure pairs on the initial departure path.

PWS-D is the efficient aircraft type pairwise wake separation rules for departure operations currently consist of the time-based seven wake category (7-CAT) based wake separation minima, or the distance-based 96 x 96 aircraft type based pairwise wake separation minima in conjunction with the twenty wake category (20-CAT) based wake separation minima for departure pairs involving other aircraft types.

In SESAR 2020 Wave 1 draft aircraft type pairwise time-based wake separation minima and refined wake category time-based wake separation minima were established and employed in the validation exercises in order to support assessment of the Human Performance, Safety and Performance validation objectives.

WDS-D is the conditional reduction or suspension of the wake separation minima for departure operations, applicable under pre-defined wind conditions so as to enable a runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either crosswind transported out of the path of the follower aircraft on the initial departure path, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft on the initial departure path.

The wake separation minima on the initial departure path are defined as both distance-based minima and time-based minima, and so may be applied as either distance-based minima or time-based minima.

OSD, PWS-D and WDS-D increase departure runway capacity, and improve the efficiency, predictability and resilience of departure operations, while maintaining safety.

OSD, PWS-D and WDS-D are all V3 mature. OSD has ended in Wave 1. For PWS-D, planned for Wave 2 is an activity to develop the aircraft type pairwise time-based wake separation minima for departures and the refined wake category time-based wake separation minima. This is subject to having sufficient departure aircraft data for carrying out the wake risk analysis and a flight simulation campaign to provide confidence in the acceptable levels of severity metric for departing aircraft for use in the supporting safety case. For WDS-D, planned for Wave 2 is the development and validation of procedures that could increase the benefits of WDS-D such as early lateral displacement procedures and differentiated rotation position and climb profile procedures.

Wake Risk Monitoring Concept Solution

This wake risk monitoring concept and solution that has been developed and validated is an improved detection and monitoring of wake turbulence encounters occurring in day-to-day operation.

The detection and monitoring are an automated and objective means to identify wake turbulence encounters in daily operations in the post execution phase, based on the analysis of recorded operational data available from on-board the aircraft, and additional traffic information from ADS-B Out messages. This analysis can be complemented by additional ground-based direct measurements of wake vortices during the approach or departure phases.

This tool provides objective and statistically meaningful information about the frequency of occurrence of wake turbulence encounters, both within the operating method proposed by this SESAR Solution PJ02-01 as well as under pre-SESAR operating methods. It furthermore allows to identify severe wake turbulence encounters (those which are expected to lead e.g. to an associated Reportable Occurrence) as well as non-severe wake encounters which normally cause no disruption of the normal flight. This new capability will facilitate in-service safety monitoring of the wake turbulence encounter risk of the deployed new wake turbulence separation optimisation regulations.

Wake Decay Enhancing Concept Solution

The highest risk of encountering wake vortices prevails during final approach in ground proximity, where the vortices cannot descend below the glide path but tend to rebound because of the interaction with the ground surface. This is aggravated by the fact that the possibilities of the pilot to recover from a vortex encounter are limited by the low flight altitude. A method has been developed and demonstrated at an international airport that accelerates wake vortex decay in that critical height range. The installation of so-called plate lines beyond the runway tails improves safety by reducing the number of wake vortex encounters and increase the efficiency of wake vortex advisory systems.

The individual plates are aligned parallel to the runway direction and are 9m long and 4.5m high. A plate line consists of 8 plates with a separation of 20m. The plate line is displaced by at least 300m from the threshold. While descending the vortices interact with the plates generating disturbances that propagate in and against flight direction. These disturbances reduce the lifetime of the longest lived and potentially most hazardous wake vortices by at least 20%.

A technical design of the plate lines has been elaborated that is compatible with airport requirements (e.g. stability, frangibility) and approval of authorities for the installation of the plate line has been obtained. A measurement campaign has been conducted at Vienna airport employing several LiDARs for wake vortex measurements supplemented by a suite of advanced meteorological sensors to determine the atmospheric conditions and especially the wind conditions which have a major impact on the wake vortex decay and wake displacements which have been measured with high accuracy.

The measurement data has been analysed to quantify the acceleration of the decay of the wake vortices close to the ground. This work has earned DLR second place for plate lines at the Air Traffic Management Awards 2019. The measurement data will also be used to estimate the corresponding flight safety benefits and capacity gains to be achieved by different arrival concept solutions in SESAR

2020 Wake 2 VLD3. Finally, comprehensive documentation has been elaborated to form the basis for the preparation of regulations to be endorsed by competent authorities.

2 Introduction

2.1 Purpose of the document

This document[1] provides the requirements specification, covering functional, non-functional and interface requirements related to SESAR Solution PJ02-01.

The SESAR Solution Development Life Cycle aims to structure and perform the work at project level and progressively increase SESAR Solution maturity, with the final objective of delivering a SESAR Solution data-pack for industrialisation and deployment. The Part I of the SPR-INTEROP/OSED represents one of the key parts of this SESAR Solution data-pack.

2.2 Scope

This is the Part I of the SPR-INTEROP/OSED for SESAR Solution PJ02-01 for the V3 pre-industrial development & integration maturity phase.

This SPR/INTEROP/OSED covers safety, performance, operational aspects as well as the interoperability aspects related to a specific technology to support the SESAR Solution PJ02-01 Wake Turbulence Separation Optimisation for the following concepts solutions:

- Arrivals Concepts Solutions
- Departures Concepts Solutions
- Wake Risk Monitoring Concept Solution
- Wake Decay Enhancing Concept Solution

2.3 Intended readership

The intended readership is the SESAR Solution PJ02-01 project members, the other solutions in SESAR Project PJ02 Increased Runway and Airport Throughput, the related solutions in SESAR Project PJ01 Enhanced Arrivals and Departures, the related solutions in SESAR Project PJ04 Total Airport Management, the related solutions in SESAR Project PJ09 Advanced Demand & Capacity Balancing, the related transversal SESAR Projects PJ19 and PJ22, and all impacted and interested stakeholders.

[1] The opinions expressed herein reflect the authors view only. Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.

2.4 Background

2.4.1 Arrivals Concepts Solutions

For the arrivals concept and the development of ATC support tool prototypes previous work from SESAR 1 Project P6.8.1 and SESAR 1 OFA 01.03.01 is relevant. SESAR 1 Project P6.8.1 Flexible and Dynamic Use of Wake Turbulence Separations focused on separation delivery of arriving aircraft, which led to the operational deployment of a Time Based Separation(s) (TBS) tool at Heathrow. Other relevant research is RECAT-EU and RECAT-EU-PWS. RECAT-EU and RECAT-EU-PWS are optimisations of ICAO wake turbulence categories scheme, developed by EUROCONTROL in consultation with European stakeholders. RECAT-EU for arrivals is currently deployed at five European airports (Paris CDG, Le Bourget, Leipzig Halle (partial application to some aircraft pairs), London Heathrow and Toulouse Blagnac airports).

2.4.2 Departures Concepts Solutions

The Wake Turbulence Separations for Departures based on Static Aircraft Characteristics is to utilise the more efficient wake separations developed by the RECAT-EU-PWS activities under the re-categorisation programme and in SESAR 1 Project P06.08.01 and under approval by EASA [40]. RECAT-EU for departures is currently deployed at one European airport (London Heathrow).

The Weather Dependent Reductions of Wake Turbulence Separations for Departures is to be based on the Crosswind Reduced Separation for Departures concept developed by the CREDOS Project in the European Commission 6th Framework Programme (EC 6th FP) from 2006 to 2010 [61], and further developed and validated in SESAR 1 Project P06.08.01 and which included the wind speed related "Total Wind" criteria concept [56].

The Optimised Separation Delivery for Departures and the associated controller tool support is to be based on the controller tool support developed in the CREDOS Project [63], taking into account the operational practitioner feedback at the end of the CREDOS project [65].

2.4.3 Wake Risk Monitoring Concept Solution

Previous work in SESAR1 Project P09.11 is relevant. The project focused on on-board prediction of wake turbulence encounters, and also performed some preliminary work on detection of wake turbulence encounters based on air-to-air data exchange.

2.4.4 Wake Decay Enhancing Concept Solution

The plate line principle has been investigated within DLR internal projects employing different devices [50] to [53]. First, fundamental research was conducted employing a towing tank through which a simplified aircraft model was towed and the flow was visualized with dye. Quantitative measurements were conducted with particle image velocimetry. For this initial work a massive obstacle was installed at the ground. Large eddy simulations were used to better understand the underlying vortex dynamics, to optimize the obstacle shape and to investigate the impact of crosswind and headwind. As a result a plate line with optimized plate shape, plate number and plate separation was designed. Finally, flight experiments were conducted with the DLR research aircraft HALO (Gulfstream G550) at special airport Oberpfaffenhofen where the vortex plate interaction was studied employing LiDAR measurements. The LiDAR measurement results indicate that the lifetime of the longest lived and thus potentially most hazardous vortex could be reduced by one third.

2.5 Structure of the document

The SPR-INTEROP/OSED consists of five parts:

- Part I, this part, providing the Safety and Performance Requirements (SPR) and Interoperability Requirements (INTEROP) related to SESAR Solution PJ02-01 Wake Turbulence Separation Optimisation, that have been developed and validated during the validation activities of SESAR 2020 Solution PJ02-01 to a V3 maturity level. They are presented in the context of the Operational Service and Environment Definition (OSED) which describes the environment, assumptions and other issues that are applicable to the SPR and INTEROP requirements.
- Part II: The Safety Assessment Report which describes the results of the safety assessment work for the SESAR Solution PJ02-01 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I.
- Part III: The Security Assessment Report which describes the results of the security assessment work for the SESAR Solution PJ02-01 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I.
- Part IV: The Human Performance Assessment Report which describes the results of the Human Performance Assessment Report which describes the results of the Human Performance assessment work for the SESAR Solution PJ02-01 concepts solutions that justify the associated SPR and INTEROP requirements in the Part I.
- Part V: The Performance Assessment Report (PAR) that consolidates the performance results obtained across the different validation activities at the SESAR Solution PJ02-01 concepts solutions level.

This part of the SESAR Solution PJ02-01 SPR-INTEROP/OSED (Part I) consists of five main sections and an appendix. Each section, and the appendix, addresses each of the SESAR Solution PJ02-01 Wake Turbulence Separation Optimisation concepts solutions; the Arrivals Concepts Solutions, the Departures Concepts Solutions, the Wake Risk Monitoring Concept Solution, and the Wake Decay Enhancing Concept Solution.

- Section 1: Executive Summary of the brief description of the concepts solutions and the associated research needs gaps and issues.
- Section 2: Introduction covering the purpose of the document, the scope, the intended readership, the background to the V2 feasibility maturity level of the concepts at the end of SESAR 1, the glossary of terms and the list of acronyms.
- Section 3: The Operational Service and Environment Definition detailing the concepts solutions and the improvements, expected benefits, allocated validation targets, key features and capabilities, any dependencies on other SESAR 2020 solutions, operational characteristics, roles and responsibilities, technical characteristics, applicable standards and regulations, previous operating method, new operating method, use cases, and differences between the new and previous operating methods.
- Section 4: The Safety, Performance and Interoperability Requirements (SPR-INTEROP) established in the V3 maturity validation activities of SESAR 2020 Solution PJ02-01.
- Section 5: References and Applicable Documents

- Appendix A: Costs and Benefits Mechanisms including stakeholders identification and expectations, benefits mechanisms and costs mechanisms.

2.6 Glossary of terms

Term	Definition	Source of the definition
DBS	Refers to applying wake separations on final approach which are based on distances. This is how wake separations are applied in the majority of current operations.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [56]
In-trail aircraft pair	Refers to consecutive aircraft pairs that are landing on the same runway.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [56]
Not-in-trail aircraft pair	Refers to consecutive aircraft pairs that are landing on different parallel runways.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [56]
ORD	Refers to the Optimised Runway Delivery concept which intends to provide additional tool support to show the Controller the required spacing on the approach to take into account the effect of compression primarily caused by aircraft decelerating to land.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [56]
S-PWS	A wake separation concept where wake separations are optimised by defining them between aircraft type pairs rather than between wake categories.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [56]
TBS	Refers to the generic TBS concept that was developed in SESAR 1 Project P06.08.01 which included tool support to show the Controller the required separation.	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [56]
WDS (arrivals)	There are two versions: WDS (total wind) and WDS (crosswind). WDS (total wind) aims to allow reduced Wake Turbulence (WT) separations based on the	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final

Term	Definition	Source of the definition
	argument that WT is more rapidly decayed as the wind magnitude increases. WDS (crosswind) aims to allow the reduction of WT separations based on the argument that WT is transported out of the path of follower aircraft.	Step 1 OSED [56]
WDS (departures)	A concept that allows the reduction of wake separations between departures when the wind is above a certain threshold based on the argument that WT is more rapidly decayed as the wind magnitude increases. *Note that within SESAR 2020 there are two main versions: WDS (total wind) and WDS (crosswind).* *WDS (total wind) aims to allow reduced Wake Turbulence (WT) separations based on the argument that WT is more rapidly decayed as the wind magnitude increases.* *WDS (crosswind) aims to allow the reduction of WT separations based on the argument that WT is transported out of the path of follower aircraft.* *Also note that a third version of differentiated rotation positions and climb profiles is under consideration in SESAR 2020.*	OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [56]

Table 1: Glossary of terms

2.7 List of Acronyms

Acronym	Definition
3-CAT	Three Wake Category
6-CAT	Six Wake Category
7-CAT	Seven Wake Category
14-CAT	Fourteen Wake Category
20-CAT	Twenty Wake Category (Fourteen Wake Category with Six Wake Category)
A-CDM	Airport Collaborative Decision Making
A-SMGCS	Advanced Surface Movement Guidance and Control System
ACC	Area Control Centre
ADI	Average Departure Interval

Acronym	Definition
ADS-B	Automatic Dependent Surveillance Broadcast
AFTN	Aeronautical Fixed Telecommunication Network
AIP	Aeronautical Information Publication
AO	Aircraft Operations
AOCC	Aircraft Operations Control Centre
AoR	Area of Responsibility
AMAN	Arrival Manager (System)
APOC	Airport Operations Centre
AROT or aROT	Arrival Runway Occupancy Time
ATC	Air Traffic Control
ATCo	Air Traffic Controller
ATCO	Air Traffic Control Officer
ATFCM	Air Traffic Flow and Capacity Management
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATS	Air Traffic Service
ATSA	Air Traffic Services Assistant
CAP	Capacity
CAT	Category (for aircraft classification for wake)
CAT <n>	Category of ILS System (CAT I, CAT II, CAT III)
CBA	Cost Benefit Assessment
CDM	Collaborative Decision Making
CNS	Communication Navigation and Surveillance
CONOPS	Concept of Operations
CR	Change Request
CREDOS	Crosswind-Reduced Separation for Departure Operations
CTOT	Calculated Take Off Time
CWP	Controller Working Position
D-ATIS	Digital Automatic Terminal Information Service
DBS	Distance Based Separation
DC	Data Collection

Acronym	Definition
DDI-D	Dynamic Departure Indicator - Distance
DDI-T	Dynamic Departure Indicator - Time
DER	Departure End of the Runway
DF	Deceleration Fix (for landing stabilisation)
DLR	Deutsches Zentrum für Luft- und Raumfahrt
DMAN	Departure Manager (System)
DME	Distance Measuring Equipment
EASA	European Aviation Safety Agency
EATMA	European ATM Architecture
E-ATMS	European Air Traffic Management System
EC 6FP	European Commission 6th Framework Programme
EFPS	Electronic Flight Progress Strip
EU	European Union
EXE	Exercise
FAF	Final Approach Fix
FAP	Final Approach Point
FOC	Flight Operations Centre
FPL	Flight Plan
ft	feet
FTD	Final Target Distance
FTS	Fast Time Simulation
GH	Ground Handlers
GMC	Ground Movement Controller
GMP	Ground Movement Planner
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GWCS	Glideslope Wind Conditions Service
HEAVY	ICAO Heavy Wake Category
HMI	Human Machine Interface
HPAR	Human Performance Assessment Report
Hz	Hertz

Acronym	Definition
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organisation
IAS	Indicated Air Speed
ILS	Instrument Landing System
INTEROP	Interoperability Requirements
ITD	Initial Target Distance
kg	kilograms
KIAS	Knots Indicated Air Speed
KPA	Key Performance Area
kt or kts	knots
KTAS	Knots True Air Speed
LiDAR	Light Detection and Ranging
LIGHT	ICAO Light Wake Category
LT	Live Trial
m	metres
m/s	metres per second
MDI	Minimum Departure Interval
MEDIUM	IACO Medium Wake Category
MET	Meteorological
MHz	Megahertz (1,000,000 Hz)
MLS	Microwave Landing System
MRS	Minimum Radar Separation
MTOM	Maximum Take Off Mass
MTOW	Maximum Take Off Weight
N/A	Not applicable
NDB	Non Directional Beacon
NM	Nautical Mile (1852m)
NMF	Network Management Function
NPR	Noise Preferential Route
OFA	Operational Focus Area
OI	Operational Improvement

Acronym	Definition
OM	Outer Marker (final approach)
OPAR	Operational Performance Assessment Report
ORD	Optimised Runway Delivery (arrivals)
OSD	Optimised Separation Delivery (departures)
OSED	Operational Service and Environment Definition
PANS	Procedures for Air Navigation Services
PAR	Performance Assessment Report
PCP	Pilot Common Project
PFS	Paper Flight Strip
PIRM	Programme Information Reference Model
PJ	Project
PSR	Primary Surveillance Radar
PWS	Pair Wise Separation
PWS-A	Pair Wise Separation for Arrivals
PWS-D	Pair Wise Separation for Departures
QoS	Quality of Service
R&D	Research & Development
R/C	Radio Communications
RBT	Reference Business Trajectory
RECAT	Re-categorisation (wake scheme)
RECAT-EU	RECAT Europe
RECAT-EU-PWS	RECAT Europe Pair Wise Separation
REQ	Requirement
RMT	Reference Mission Trajectory
ROT	Runway Occupancy Time
RSVA	Reduced Separation in the Vicinity of the Aerodrome
RT (or R/T)	Radio Telephone or Radiotelephony
RTS	Real-Time Simulation
s	seconds
S-PWS	Static Pair Wise Separation
S-PWS-A	Static Pair Wise Separation for Arrivals

Acronym	Definition
SAC	Safety Criteria
SAR	Safety Assessment Report
SBT	Shared Business Trajectory
SecAR	Security Assessment Report
SESAR	Single European Sky ATM Research Programme
SESAR 1	SESAR from 2010 to 2016
SESAR 2020	SESAR from 2016 (to 2020)
SID	Standard Instrument Departure
SJU	SESAR Joint Undertaking
SME	Subject Matter Expertise
SMT	Shared Mission Trajectory
SPR	Safety and Performance Requirements
SSR	Secondary Surveillance Radar
STAR	Standard Terminal Arrival Route
SWIM	System Wide Information Model
TAS	True Air Speed
TB	Time Based
TBA	To be added
TBD	To be determined
TBS	Time Based Separation
TBS-A	Time Based Separation for Arrivals
TDI	Target Distance Indicator
TIS-B	Traffic Information Services - Broadcast
TOBT	Target Off Blocks Time
TMA	Terminal Manoeuvring Area
TS	Technical Specification
TSAT	Target Start-up Approval Time
TT	Target Time
TTOT	Target Take-Off Time
UTC	Universal Coordinated Time
V APP	Approach Speed

Acronym	Definition
VCR	Visual Control Room
VOR	VHF Omnidirectional Range
V_R	Rotation Speed (for Take Off)
WDS	Weather Dependent Separation
WDS-A	Weather Dependent Separation for Arrivals
WDS-D	Weather Dependent Separation for Departures
WT	Wake Turbulence
WTC	Wake Turbulence Category
WTE	Wake Turbulence Encounter
WVE	Wake Vortex Encounter

Table 2: List of acronyms

3 Operational Service and Environment Definition

3.1 SESAR Solution PJ02-01: Wake Turbulence Separation Optimisation

3.1.1 Introduction

SESAR Solution PJ02-01 has aimed to optimise wake turbulence separation minima for arrivals and departures to enhance airport runway throughput. SESAR Solution PJ02-01 encompasses the following concepts solutions:

- Arrivals Concepts Solutions
- Departures Concepts Solutions
- Wake Risk Monitoring Concept Solution
- Wake Decay Enhancing Concept Solution

SESAR Solution PJ02-01 has focused on the development and validation of:

- Wake turbulence separations based on static aircraft characteristics and weather dependent reductions
- Separation delivery support tools for ATCOs
- Wake risk monitoring function
- Wake decay enhancing devices

SESAR Solution PJ02-01 is part of the High Performing Airport Operations Project PJ02.

As airports remain one of the most significant bottlenecks in the ATM, the wake turbulence separation optimisation solutions represent great potential for system-wide improvements.

3.1.2 Arrivals Concepts Solutions

The arrivals concepts solutions that have been developed and validated are:

- AO-0328: Optimised Runway Delivery on Final Approach (ORD)
- AO-0306: Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics (PWS-A)
- AO-0310: Weather Dependent reductions of Wake Turbulence Separations for final approach (WDS-A)

ORD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between arrival pairs on final approach to the runway landing threshold through providing Target Distance Indicators (TDIs) to the controllers.

PWS-A is the efficient aircraft type pairwise wake separation rules for final approach consisting of both the 96 x 96 aircraft type based pairwise wake separation minima and the twenty wake category (20-CAT) based wake separation minima for arrival pairs involving other aircraft types.

WDS-A is the conditional reduction or suspension of wake separation minima on final approach, applicable under pre-defined wind conditions, so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on final approach, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft.

The wake separation minima on final approach are defined as both distance-based minima and time-based minima, and so may be applied as either distance-based minima or time-based minima.

ORD, PWS-A and WDS-A increase arrival runway capacity, and improve the efficiency, predictability and resilience of arrival operations, while maintaining or increasing safety:

- **Runway Capacity:** The reduction of wake separation minima through the application of the more efficient PWS-A, and the application of the conditional reduction or suspension of WDS-A, facilitated by the ORD ATC support tool, has a direct impact on runway throughput and therefore capacity. **Efficiency:** The ORD ATC support tool enhances operational efficiency by reducing over conservative spacing delivery, allowing the ATCOs to more accurately deliver to the PWS-A and WDS-A wake separation minima.
- **Predictability:** The ORD ATC support tool, by facilitating delivery to the optimised arrival wake separation minima (PWS-A, WDS-A), especially when time-based, helps to maintain runway throughput in adverse final approach headwind conditions. Additionally, where the reduction of separation (PWS-A) is not translated 100% into an increase in the declared capacity, the additional spare capacity allows for the more efficient delivery of any peak over-demand, thus reducing delay.
- **Flexibility:** PWS-A can be used to refine delivered separations to either increase capacity or to provide additional resilience in the runway throughput schedule. WDS-A as a conditional separation reduction, can be used tactically when conditions allow, to provide additional resilience to the arrival throughput.
- **Resilience:** The ORD ATC support tool and the use of PWS-A and WDS-A under different modes of operation (segregated, mixed mode) supports ATC to be able to more flexibly manage the runway mode of operation, and so provide added resilience to disruption events such as a temporary unserviceable runway.
- **Environment/Fuel Efficiency:** Through reducing delay and disruption there is a positive impact on fuel efficiency and the associated emissions impact on the environment.
- **Human Performance:** The ORD ATC support tool helps to manage the complexity of employing the efficient PWS-A and WDS-A wake separation minima, facilitating efficient and consistent delivery to the wake separation minima, and mitigating the associated impact on ATC workload.
- **Safety:** Efficient and consistent separation delivery to the PWS-A and WDS-A rules facilitated by the ORD ATC support tool enables the simultaneous reduction in the overall wake separation that is required to be delivered and also improves conformance to the required wake separation minima. This means that the rate of under spacing delivery is significantly reduced, which improves safety related to wake separation delivery conformance, but also

improves spacing related delivery consistency with respect to runway occupancy time related spacing.
- **Cost Efficiency:** For airports deploying TBS (PCP), runway throughput increases made available through PWS-A and WDS-A will be at relatively low cost because the ORD ATC support tool support can be implemented as an enhancement to the already deployed TBS ATC support tool. For other airports, the expected increase of capacity will largely compensate for the associated cost of deploying the ORD ATC support tool to enable the employment of the efficient PWS-A and WDS-A wake separation minima.

More details on the benefits results from the validation exercises are detailed in the VALR and PAR documents.

For the arrivals concepts solutions there are no major dependencies to other SESAR Solutions.

3.1.3 Departures Concepts Solutions

The departures concepts solutions that have been developed and validated are:

- AO-0329: Optimised Separation Delivery on Departure (OSD)
- AO-0323: Wake Turbulence Separations (for departures) based on Static Aircraft Characteristics (PWS-D)
- AO-0304: Weather Dependent reductions of Wake Turbulence Separations for departure (WDS-D)

OSD is the ATC support tool to enable consistent and efficient delivery of the required separation or spacing between departure pairs on the initial departure path.

PWS-D is the efficient aircraft type pairwise wake separation rules for departure operations currently consist of the time-based seven wake category (7-CAT) based wake separation minima, or the distance-based 96 x 96 aircraft type based pairwise wake separation minima in conjunction with the twenty wake category (20-CAT) based wake separation minima for departure pairs involving other aircraft types.

Planned for SESAR 2020 Wave 2 is an activity to develop the aircraft type pairwise time-based wake separation minima for departures and the refined wake category time-based wake separation minima. This is subject to having sufficient departure aircraft data for carrying out the wake risk analysis for the supporting safety case. In SESAR 2020 Wave 1 draft aircraft type pairwise time-based wake separation minima and refined wake category time-based wake separation minima were established and employed in the validation exercises in order to support assessment of the Human Performance, Safety and Performance validation objectives.

WDS-D is the conditional reduction or suspension of wake separation minima for departure operations, applicable under pre-defined wind conditions, so as to enable a runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either crosswind transported out of the path of the follower aircraft on the initial departure path, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft on the initial departure path. Two pre-defined wind conditions were proposed for consideration, a 10 knots wind speed in any direction (Total Wind concept), and a 6 to 10 knots crosswind to the initial departure track (Crosswind concept), of which the Crosswind concept has been the primary focus of development and validation in PJ02-01.

A third WDS-D concept was also under consideration, this is the wake avoidance of the wake generated by the lead aircraft through the follower aircraft employing an earlier differentiated rotation position and a steeper climb profile than the lead aircraft. However initial analysis of recorded operational data has indicated that the current operations differentiated rotation positions and climb profiles at London Heathrow are not sufficiently consistent to ensure wake avoidance.

The wake separation minima on the initial departure path are defined as both distance-based minima and time-based minima, and so may be applied as either distance-based minima or time-based minima.

OSD, PWS-D and WDS-D increase departure runway capacity, and improve the efficiency, predictability and resilience of departure operations, while maintaining safety:

- **Runway Capacity:** The reduction of wake separation minima through the application of the more efficient PWS-D, and the application of the conditional reduction or suspension of WDS-D, facilitated by the OSD ATC support tool, has a direct impact on runway throughput and therefore capacity.
- **Efficiency:** The OSD ATC support tool enhances operational efficiency by enabling the ATCOs to safely, efficiently and consistently deliver to the PWS-D and WDS-D wake separation minima.
- **Predictability:** The OSD ATC support tool, by facilitating delivery to the optimised departure wake separation minima (PWS-D, WDS-D), will help to maintain runway throughput in adverse departure operations conditions. Additionally, where the reduction of separation (PWS-D) is not translated 100% into an increase in the declared capacity, the additional spare capacity allows for the more efficient delivery of any peak over-demand, thus reducing delay.
- **Flexibility:** PWS-D can be used to refine delivered separations to either increase capacity or to provide additional resilience in the runway throughput schedule. WDS-D as a conditional separation reduction can be used tactically when conditions allow providing additional resilience to the departures throughput.
- **Resilience:** The OSD ATC support tool and the use of PWS-D and WDS-D under different modes of operation (segregated, mixed mode) supports ATC to be able to more flexibly manage the runway mode of operation, and so provide added resilience to disruption events such as a temporary unserviceable runway.
- **Environment/Fuel Efficiency:** Through reducing delay and disruption there is a positive impact on fuel efficiency and the associated emissions impact on the environment.
- **Human Performance:** The OSD ATC support tool helps to manage the complexity of employing the efficient PWS-D and WDS-D wake separation minima, facilitating safe, efficient and consistent delivery to the wake separation minima, and mitigating the associated impact on ATC workload.
- **Safety:** The OSD ATC support tool enables the efficient and consistent separation delivery to the PWS-D and WDS-D rules, thus enabling a safe reduction in the overall amount of wake separation that is required to be delivered.

- **Cost Efficiency:** The expected increase of capacity will largely compensate for the associated cost of deploying the OSD ATC support tool to enable the employment of the efficient PWS-D and WDS-D wake separation minima.

More details on the benefits results from the validation exercises are detailed in the VALR and PAR documents.

For the departures concepts solutions there are no major dependencies to other SESAR Solutions.

3.1.4 Wake Risk Monitoring Concept Solution

The wake risk monitoring concept solution that has been developed and validated is:

- AO-0327: Reduction of Wake Turbulence Risk through Wake Risk Monitoring

This wake risk monitoring concept and solution that has been developed and validated is an improved detection and monitoring of wake turbulence encounters occurring in day-to-day operation.

The detection and monitoring are an automated and objective means to identify wake turbulence encounters in daily operations in the post execution phase, based on the analysis of recorded operational data available from on-board the aircraft, and additional traffic information from ADS-B Out messages. This analysis can be complemented by additional ground-based direct measurements of wake vortices during the approach or departure phases.

This tool provides objective and statistically meaningful information about the frequency of occurrence of wake turbulence encounters, both within the operating method proposed by this SESAR Solution PJ02-01 as well as under pre-SESAR operating methods. It furthermore allows to identify severe wake turbulence encounters (those which are expected to lead e.g. to an associated Reportable Occurrence) as well as non-severe wake encounters which normally cause no disruption of the normal flight. This new capability facilitates in-service safety monitoring of the wake turbulence encounter risk of the deployed new wake turbulence separation optimisation regulations.

3.1.5 Wake Decay Enhancing Concept Solution

The wake decay enhancing concept solution that has been developed and validated is:

- AO-0325: Reduction of Wake Turbulence Risk considering Acceleration of Wake Vortex Decay in Ground Proximity

The highest risk of encountering wake vortices prevails during final approach in ground proximity, where the vortices cannot descend below the glide path but tend to rebound because of the interaction with the ground surface. This is aggravated by the fact that the possibilities of the pilot to recover from a vortex encounter are limited by the low flight altitude. In SESAR a method is developed and demonstrated at an international airport that accelerates wake vortex decay in that critical height range. The installation of so-called plate lines beyond the runway tails may improve safety by reducing the number of wake vortex encounters and increase the efficiency of wake vortex advisory systems.

The individual plates are aligned parallel to the runway direction and are 9 m long and 4.5 m high. A plate line consists of 8 plates with a separation of 20 m. The plate line is displaced by at least 300 m from the threshold. While descending the vortices interact with the plates generating disturbances that propagate in and against flight direction. These disturbances reduce the lifetime of the longest lived and potentially most hazardous wake vortices by at least 20%.

A technical design of the plate lines has been elaborated that is compatible with airport requirements (e.g. stability, frangibility) and approval of authorities for the installation of the plate line has been obtained. A measurement campaign has been conducted at Vienna airport employing several LiDARs for wake vortex measurements supplemented by a suite of advanced meteorological sensors to determine the atmospheric conditions and especially the wind conditions which have a major impact on the wake vortex decay and wake displacements which have been measured with high accuracy.

The measurement data has been analysed to quantify the acceleration of the decay of the most critical and long-lived wake vortices close to the ground with respect to local small scale atmospheric conditions. The measurement data will also be used to estimate the corresponding flight safety benefits and capacity gains to be achieved by the different arrivals concepts solutions in SESAR 2020 Wake 2 VLD3 . Finally, comprehensive documentation has been elaborated to form the basis for the preparation of regulations to be endorsed by competent authorities. There is an output dependency to SESAR Solution PJ18-04. Findings of the PJ02-01 LT10 validation exercise could spawn requirements with respect to atmospheric monitoring and short term forecasting in order to enhance the usability of the concepts for separation reduction.

3.1.6 Validation Targets Allocated to SESAR Solution PJ02-01

From the PJ19 Validation Targets (2018) [26] the following validation targets were allocated to SESAR Solution PJ02-01:

- Airport Capacity

SOL CODE	Solution Validation Target	APT CAP Target per Sub-OE		
		APT Very Large	APT Large	APT Medium
Solution PJ.02-01	2,160%	2,160%	2,160%	2,160%

- Predictability

SOL CODE	Solution Validation Target	PRD1 Target per Sub-OE			
		Terminal Very High Complexity	Terminal High Complexity	Terminal Medium Complexity	Terminal Low Complexity
Solution PJ.02-01	0,800%	0,494%	0,104%	0,098%	0,104%

- Environment/Fuel Efficiency (saving kg/flight)

SOL CODE	Solution Validation Target	FEFF Target per Sub-OE					
		Terminal Very High Complexity	Terminal High Complexity	Terminal Medium Complexity	APT Very Large	APT Large	APT Medium
Solution PJ.02-01	20,643	7,035	1,481	1,389	4,443	3,703	2,592

- Safety

SOL CODE	Solution Validation Target	Safety		
		APT Very Large	APT Large	APT Medium
Solution PJ.02-01	-0.86%	-3.68%	-3.68%	-3.68%

3.1.7 Scope and Related OI Steps and Link to CONOPS

SESAR Solution ID	SESAR Solution Title	OI Steps ID ref. (coming from EATMA)	OI Steps Title (coming from EATMA)	OI Step Coverage
PJ02-01	Wake Turbulence Separation Optimization	AO-0328	Optimised Runway Delivery on Final Approach	**Fully (V3)** (Refinements/new functionalities will be encompassed in a new OI AO-0334 in Wave 2.)
PJ02-01	Wake Turbulence Separation Optimization	AO-0306	Wake Turbulence Separations (for Arrivals) based on Static Aircraft Characteristics	**Fully (V3)** (Maintenance process and analysis of the PWS-A matrix allowing inclusion of additional and new aircraft types identified as activity for Wave 2)
PJ02-01	Wake Turbulence Separation Optimization	AO-0310	Weather-Dependent Reductions of Wake Turbulence Separations for Final Approach	**Fully (V3)**
PJ02-01	Wake Turbulence Separation Optimization	AO-0329	Optimised Separation Delivery for Departure	**Fully (V3)**
PJ02-01	Wake Turbulence Separation Optimization	AO-0323	Wake Turbulence Separations (for Departures) based on Static Aircraft	**Fully (V3)** (Planned for Wave 2 is an activity to develop the safety case for the aircraft type pairwise time-based

			Characteristics	wake separation minima and the refined wake category time-based wake separation minima for departures for regulatory approval)
PJ02-01	Wake Turbulence Separation Optimization	AO-0304	Weather-Dependent Reductions of Wake Turbulence Separations for Departures	**Fully (V3)** (Procedures that could increase the benefits such as early lateral displacement procedures and differentiated rotation position and climb profile procedures identified as an activity for Wave 2)
PJ02-01	Wake Turbulence Separation Optimization	AO-0327	Reduction of Wake Turbulence Risk through Wake Risk Monitoring	**Fully (V2)**
PJ02-01	Wake Turbulence Separation Optimization	AO-0325	Reduction of Wake Turbulence Risk considering Acceleration of Wake Vortex Decay in Ground Proximity	**Fully (V3)** (VLD planned in Wave 2)

Table 3: SESAR Solution PJ02-01 Wake Turbulence Separation Optimisation Scope and related OI steps

The High Level Requirements applicable to PJ02.01 from the SESAR 2020 Concept of Operations Edition 2017 [5] are provided in Table 4.

High Level CONOPS Requirement ID	High Level CONOPS Requirement	Reference to relevant CONOPS Sections e.g. Operational Scenario applicable to the SESAR Solution
S02-01-HLOR-01	The Optimisation of Wake Turbulence Separation shall: • increase runway throughput • ensure more refined and efficient wake separation than current ICAO rules • ensure consistent and efficient management of spacing compression on final approach and the initial departure phase of flight by automatically managing the complexity of applying the required wake separation between each aircraft pair through: • the implementation of S-PWS and WDS • the use of the associated ATC support	Airport Operational Scenario Execution Phase: Arrival (Scope: Approach, Final Approach, and Landing) Airport Operational Scenario Execution Phase: Departure (Scope: Take-Off) Airport Operational Scenario Post Execution phase: Arrival (Scope: Approach, Final Approach, and Landing) Airport Operational Scenario Post Execution phase: Departure (Scope: Take-Off)

	tools while: • supporting passive wake vortex decay devices	

Table 4: Link to CONOPS

3.1.8 Deviations with respect to the SESAR Solution(s) definition

3.1.8.1 Arrivals Concepts Solutions

No deviations.

3.1.8.2 Departures Concepts Solutions

No deviations.

3.1.8.3 Wake Risk Monitoring Concept Solution

No deviations.

3.1.8.4 Wake Decay Enhancing Concept Solution

No deviations.

3.2 Detailed Operational Environment

3.2.1 Operational Characteristics for SESAR Solution PJ02-01 Wake Turbulence Separation Optimisation

3.2.1.1 Introduction

SESAR Solution PJ02-01 aims to optimise wake turbulence separation minima for arrivals and departures in Very Large Airports, Large Airports and Medium Airports, and Terminal Very High Complexity, Terminal High Complexity and Terminal Medium Complexity sub operational environments. These operational environments are defined in PJ19 Validation Targets (2018) [26] and extracted into Table 5 below.

OEs	Sub Operating Environments	Definition
Terminal	Terminal Very High Complexity	Very High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of equal or more than 10
	Terminal High Complexity	High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of between 6 and 10
	Terminal Medium Complexity	High complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of between 2 and 6
	Terminal Low Complexity	Low complexity ATC operational unit mainly providing Approach Control Services in a part of the airspace under control has a complexity score of less than 2
En-route	En-route Very High Complexity	Very High complexity ACCs have a complexity score of equal to or greater than 10
	En-route High Complexity	High complexity ACCs have a complexity score of between 6 and 10
	En-route Medium Complexity	Medium complexity ACCs have a complexity score of between 2 and 6
	En-route Low Complexity	Low complexity ACCs have a complexity score of less than 2
Airport	Very Large Airport	Airports with more than 250k movements per year
	Large Airport	Airports with more or equal than 150k and less or equal than 250k movements per year
	Medium Airport	Airports with more or equal than 40k and less than 150k movements per year
	Small Airport	Airports with more or equal than 15k and less than 40k movements per year
	Other	Airports with less than 15k movements per year

Table 5: Overview of Operating Environments (OEs) and Sub-OEs

The runway configurations and modes of operations employed at Very Large Airport, Large Airports and Medium Airports include:

- Single runway operating in mixed mode operations
- Independent parallel runways operating in segregated mode operations
- Dependent parallel runways operating in segregated mode operations with the option of some arrival aircraft landing on the designated departure runway
- Closely spaced parallel runways operating in segregated mode operations
- Closely spaced parallel runways operating in mixed mode operations

3.2.1.2 Arrivals Concepts Solutions – Final Approach Characteristics

Final approach segment is described in ICAO Doc 8168 [42]. For precision approach, the final approach segment begins at the Final Approach Point (FAP). This is a point in space on the final approach track where the intermediate approach altitude / height intercepts the Instrument Landing System (ILS) / Microwave Landing System (MLS) glide path elevation angle.

Typically, the intermediate approach altitude / height generally intercepts the ILS / MLS glide elevation angle at heights from 300m (1,000ft) to over 1,200m (4,000ft) above runway elevation. In this case, for a 3° ILS / MLS glide path angle, interception occurs between 6km (3 NM) and 37km (20 NM) from the runway landing threshold.

In TMA controlled airspace, runway glideslope interception by arrivals can occur up to over 4,000ft and up to 20 NM from runway threshold.

Figure 1 provides an illustration of a typical final approach segment with different possible altitudes of glide path interception and approach speeds.

A variety of local procedural airspeed profiles are employed on final approach as illustrated for the specimen final approach segment below. These are typically between 220 KIAS and 160 KIAS on joining the final approach localizer, reducing to between 180 KIAS and 160 KIAS to the start of landing speed stabilization, with landing speed stabilization starting from between 6 NM and 4 NM from the runway landing threshold.

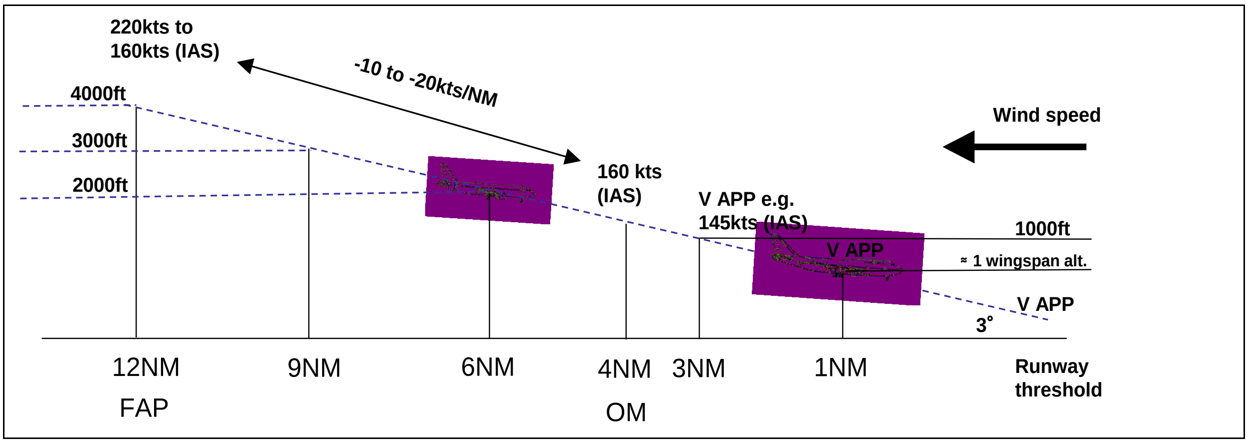

Figure 1: Example Final Approach

The landing stabilization speed profiles, starting from around 6 NM to 4 NM from the runway landing threshold until touchdown, vary considerably depending on aircraft type, landing weight, stabilization altitude, stabilization mode, and the associated airline operator cockpit procedures. The range of stabilization airspeeds varies from under 100 KIAS for some Light wake category aircraft types to over 160 KIAS for some Heavy wake category aircraft types.

During the final approach phase all distance separations tend to reduce due to the global reduction of the arrival aircraft airspeed from the interception of the glideslope until crossing the runway landing threshold to touchdown.

In a first phase covering interception of the glideslope until commencing the landing stabilization procedures starting at the Deceleration Fix (DF) usually at 4 NM from the runway landing threshold, the airspeed variations are coherent for all aircraft and dictated by the procedural airspeed profiles. In this phase the compression is relatively predictable. The final approach controller anticipates the compression to reach the initial spacing at the DF. During this phase, there is no or very limited time separation variation.

In a second phase, the separation distances continue globally to reduce but in different proportions as a function of the leader and follower final approach airspeed profiles. The time separations may vary significantly in this phase. The follower is gaining or loosing time compared to the leader aircraft. At the first order, the time lost or gained is driven by the final approach airspeeds of the leader and follower and therefore by the pair of aircraft types. However, if one observes the time variation for a given pair for a large range of headwind profiles along the glide, it appears that the wind has a second order effect that cannot be neglected.

As well as considering the applicable separation (WT or MRS) and the effect of compression, the final approach controller may also need to allow for addition spacing due to the ROT (for example A380-A380 pairs will be constrained by ROT).

3.2.1.3 Departures Concepts Solutions – Departure Environment Characteristics

The departures concepts solutions PWS-D and WDS-D wake separations are applicable immediately after take-off, on a predetermined extent during climb-out on the initial straight-out common departure path of the standard instrument departures (SIDs).

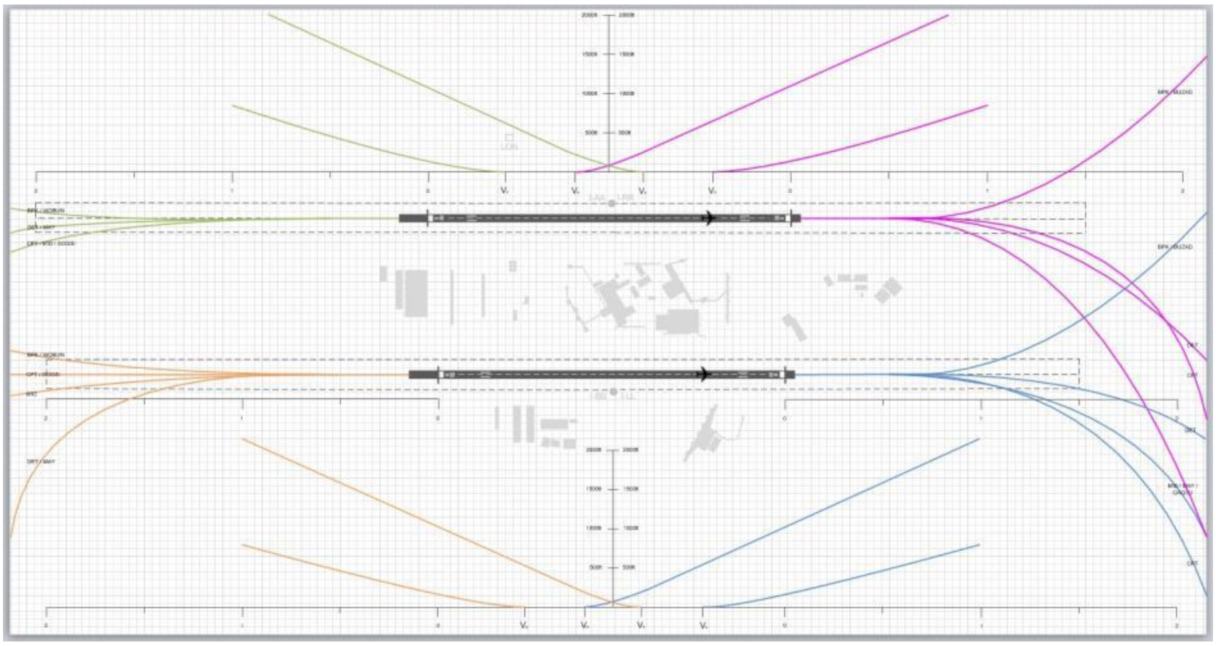

Figure 2: Illustrated Initial Departure Paths and Climb Profiles for Parallel Runway Operations

The rotation and initial airborne positions, the vertical climb profiles, and the airspeed profiles of the departing aircraft vary depending on the wake category and aircraft type of the departing aircraft and the performance / economy mode in which the departing aircraft are being flown. The A380 and Heavy wake category aircraft types tend to become airborne later and climb slower than the Medium and Light wake category aircraft types.

A SID is a departure procedure normally developed to accommodate as many aircraft categories as possible. There are two basic types of SID including straight departures and turning departures. SIDs are based on the track guidance acquired:

- Within 20.0 km (10.8 NM) from the departure end of the runway (DER) on straight departures; and
- Within 10.0 km (5.4 NM) after completion of turns on departures requiring turns.

A straight departure is one in which the initial departure track is within 15° of the alignment of the runway centre line. When a departure route requires a turn of more than 15° it is called a turning departure. Straight flight is assumed until reaching an altitude / height of at least 120m (394ft). Procedures normally cater for turns at a point 600m from the beginning of the runway.

The SIDs route structure is locally dependent for each runway and reflects the noise preferential routes. Where the common path of a lead and follower aircraft extends beyond the initial departure track there may be a need to apply SID separation requirements of 1 minute, 2 minutes and sometimes 3 minutes, with in some SID route combinations the need to add 1 minute additional separation when the lead aircraft type is in a slower speed group than the follower aircraft type with either none, one or two intervening speed groups depending on the SID route combination. In addition, for a complex TMA with several aerodromes, there may be a need to impose a minimum departure interval (MDI) or an average departure interval (ADI) to reduce the number of aircraft following a particular SID route. SID route separations and MDI and ADI are defined as distance-based constraints at aerodromes that apply distance-based separation and spacing constraints for departures.

An ATC slot time is generated for some departing flights by the Network Manager Operations Centre (NMOC) in Brussels. These slot times are generated for some flights to avoid any particular sector becoming overly congested. The ATC slots are 15 minutes windows, where the flight must depart (time of becoming airborne) between 5 minutes before the slot time and 10 minutes after the slot time, as shown on the flight progress strip. If a flight misses the window defined by the slot time a call is made to Brussels and a new slot time is requested. The slot time is the Calculated Take-Off Time (CTOT) for the associated flight.

When formulating and optimising the departure sequence there is a need to take into consideration:

- Wake turbulence separations
- Route (SID) separations
- Slot times
- Minimum departure intervals (or sometimes average departure intervals)

Airport Collaborative Decision Making (A-CDM) brings together information from Aircraft Operations (AO), Ground Handlers (GH) and Air Traffic Control (ATC) to facilitate more accurate decision making with regard to aircraft start and taxi times, as well as better adherence to the Calculated Take-Off Time (CTOT). A-CDM information includes landing time and on-stand time as well as expected turn-around time, all of which are used to calculate a Target Off-Blocks Time (TOBT).

The A-CDM TOBT are provided as an input to the DMAN system, which are then used alongside a number of other inputs (see Figure 3) to derive both a Sequence Order and to issue Target Start-up Approval Times (TSAT). If the TOBT is updated this is likely to result in a new TSAT being issued; however the TSAT time is fixed at TSAT minus <n> minutes (e.g. 10 minutes) to provide an element of stability. A change to departure separations or other parameters (e.g. weather minima criteria) can be entered in DMAN by the Tower Supervisor; such a change will trigger an update in DMAN and a possible change to both the departure sequence order and TSAT times.

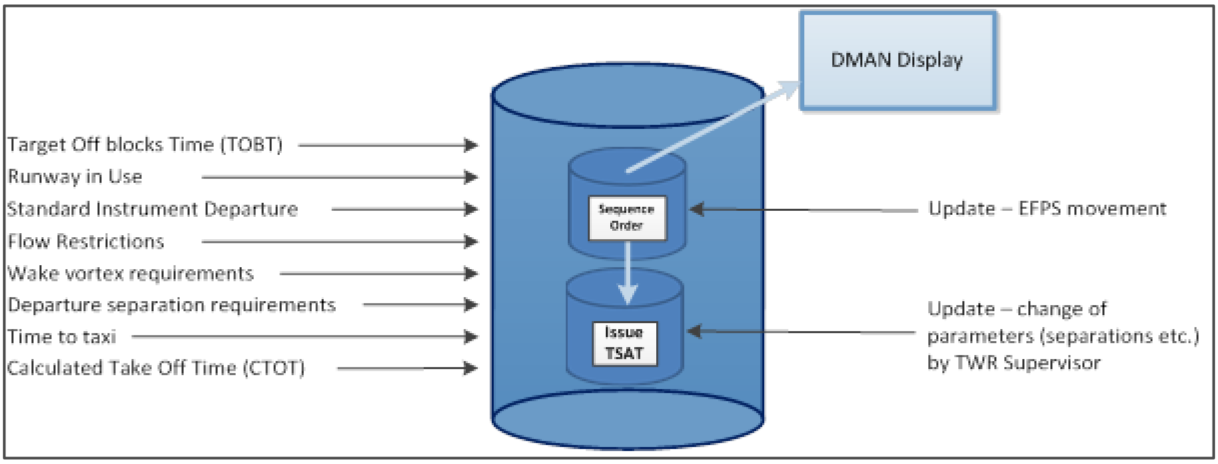

Figure 3: Example DMAN - Inputs, Outputs and Updates

Although some of the data used to derive the DMAN sequence order uses simple parameters (e.g. fixed taxi times) the order may be updated at various stages during the aircraft's transit from stand to runway holding point to ensure better accuracy. Updates may be triggered by the movement of an aircraft's Electronic Flight Progress Strip (EFPS) from one controller to the next or within the bays on a controller's EFPS display. The update points may be when the Ground Movement Planner (GMP) hands an aircraft to a Ground Movement Controller (GMC) position; when the GMC controller moves an EFPS from the 'Started' to 'Pushback' bay; when the GMC controller moves the EFPS from the 'Pushback' to 'Taxi' bay; and when the GMC hands the aircraft to the Air Departures controller. This is illustrated in Figure 4, where each movement, shown by a red arrow, indicates a possible DMAN update point.

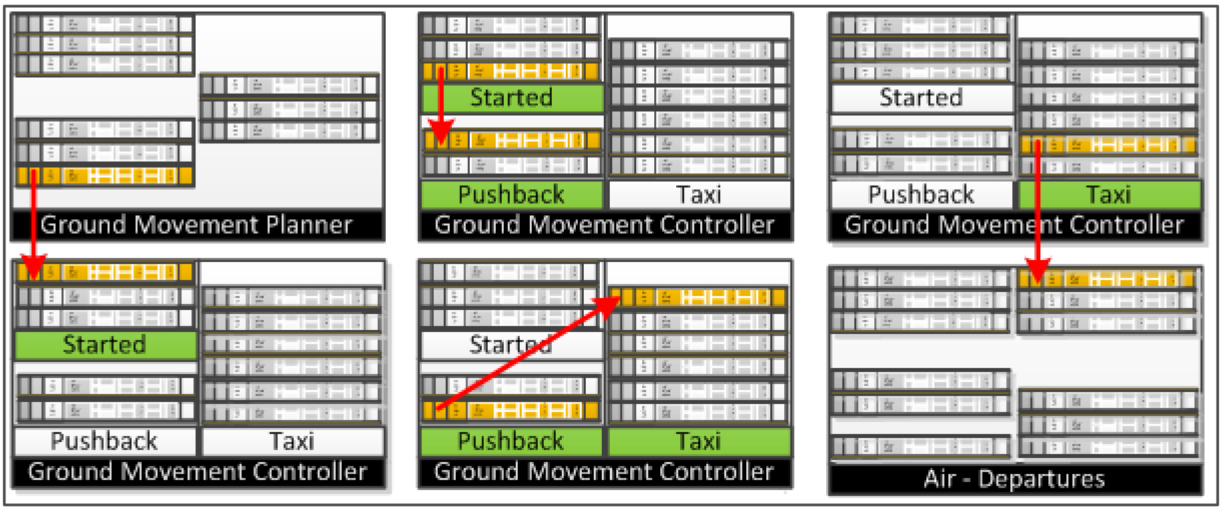

Figure 4: Representative Electronic Flight Progress Strip Bays

'Radar Gate' data may also be used as input into DMAN. Various radar gates may be positioned around the airfield and when taxiing departure aircraft pass through each gate the aircraft's remaining taxi time can be updated in DMAN. Receipt of the gate data may provoke a sequence order update in DMAN and a corresponding update (if applicable) in the DMAN sequence order.

Visibility of the DMAN sequence order may be limited to the GMP controller position. Provision may also be made for the GMC positions and also the Tower Runway Controller position to being provided with the DMAN sequence order and/or the Target Take-Off Time (TTOT) on the EFPS of each flight.

When the Tower Runway Controller is provided with the optimised DMAN sequence order, this is the order usually followed for the departure aircraft to line-up and take-off. However, it should be noted that some departure aircraft at the holding point may still be awaiting pre-flight information from their airline operations centre, or may have not completed all of the pre-flight activities such as for example passenger safety briefing, and so are unready to line-up. When this happens the Tower Runway Controller may need to tactically determine an alternative departure sequence order for the departure aircraft to line-up and take-off.

When the Tower Runway Controller is not provided with the optimised DMAN sequence order they take into account the departure aircraft positioning at the runway holding point, and the readiness of the departure aircraft to line-up and take-off, to tactically determine the order for the departure aircraft to line-up and take-off. This includes consideration of SID route separations when tactically optimising the order.

The departure separation minima may be applied as either time-based or distance-based.

When applying time-based separation minima, the time separation criteria are applied by measuring the successive airborne times of the departure aircraft (“airborne time” to “airborne time”). To deliver the airborne time separation criteria local procedural approaches are employed. These local procedural approaches include determining the take-off clearance time for the follower aircraft from the recorded “start of take-off roll time” of the lead aircraft, or determining the take-off clearance time of the follower aircraft from the recorded “airborne time” of the lead aircraft.

To achieve the time-based separation minima in practice when applying the recorded “start of take-off roll time” of the lead aircraft, take-off clearance may be issued to the follower aircraft once the required time separation has elapsed after the lead aircraft recorded “start of take-off roll time”. The recorded “start of take-off roll-time” is the time the aircraft is recorded as commenced rolling beyond the line-up and wait position.

To achieve the time-based separation minima in practice when applying airborne times, take-off clearance may be issued to the follower aircraft, with an allowance for the anticipated follower aircraft take-off roll time on the runway. Take-off clearance may be issued once the required time separation minus the anticipated follower aircraft take-off roll time has elapsed after the lead aircraft recorded “airborne time”.

When applying distance-based separation minima, once airborne, departure aircraft are subject to the wake turbulence radar separations, therefore the Tower Runway Controller may apply a distance based clearance such that the required distance-based wake turbulence radar separation is set up when the follower aircraft becomes airborne. A distance based clearance can be issued as long as the Tower is equipped with radar surveillance.

On handover of separation responsibilities to the TMA Departure Radar Controller there is a need to have achieved the associated radar separation minima employed in the TMA, where the minimum radar separation is 3 NM horizontal or 1,000ft vertical, and where distance-based wake separation minima apply.

There is a requirement to take into account terrain features and obstacles that may impact the wind field when developing and validating the WDS-D concepts. The local topography such as hanger buildings, terminal buildings and high ground in the vicinity of the aerodrome may impact both surface winds and winds aloft.

Aircraft ATM capabilities such as the rotation position on the runway, climb profile performance during climb-out, lateral navigational performance during climb-out, and airspeed performance during climb-out, all need to be taken into consideration in the development and validation of the departures concepts solutions.

There is a need to take into consideration the impact of the departures concepts solutions on the departure planning processes and procedures on the ground and on the systemised airspace processes and procedures in the TMA.

3.2.1.4 Wake Risk Monitoring Concept Solution

The solution for wake turbulence encounter detection and monitoring is designed to work in all flight phases. However, it can be complemented by ground-based Lidar measurement of wake vortices only within the airport environment.

3.2.1.5 Wake Decay Enhancing Concept Solution

The plate lines are thought to accelerate the decay of wake vortices generated by aircraft landing at major airports. Because the series of plates will be installed at the runway tails no beneficial effects are expected for take-off. Plate lines are a *passive* means that reduces the lifetime of the most critical and long-lived wake vortices close to the ground. It reduces the frequency of encounters during landing and thus contributes to increase the safety level. The plate lines can be considered as a device that may compensate increased encounter risks brought along by reduced separations of landing aircraft. Alternatively, a fraction of those safety gains could also be used to increase capacity gains that can be achieved by optimizing separations of landing aircraft. For this latter however, it may be necessary to closely monitor and forecast atmospheric conditions.

3.2.2 Roles and Responsibilities

3.2.2.1 Arrivals Concepts Solutions

The EATMA Node and Node Instances impacted by the arrivals concepts solutions are:

- En-Route/Approach ATS
    - Approach Supervisor
    - Final Approach Control
    - Intermediate Approach Control

- Aerodrome ATS
    - Tower Runway Supervisor
    - Tower Runway Control
- Flight Deck
    - Flight Deck

The applicable roles and responsibilities for the arrivals concepts solutions include:

- Tower ATC Roles
    - Tower ATC Supervisor
    - Tower Runway Controller
- Approach ATC Roles
    - Approach Supervisor
    - Final Approach Controller
    - Intermediate Approach Controller
- Flight Crew Roles
    - Flight Crew
- System Roles
    - Operation Technicians / System Engineers

These roles and the specific/additional role responsibilities are detailed below.

Role	Current Responsibility	Specific/additional role
Tower ATC Supervisor	Has overall responsibility for the planning of the tower operation. Monitors operations. Decides on arrival rates. Decides on staffing and manning of CWPs in accordance with expected traffic demand. Proposes runway configuration. Gives permission for maintenance, etc.	Is aware of the wind conditions, and for determining and deciding on the application (if required) of the arrivals concept (TBS-A, PWS-A, WDS-A) in consultation with the Approach Supervisor. Responsible for ensuring the duty runways-in-use information, and the separation policy information, and planned changes to these, is available, set up, and maintained consistently in the arrival Separation Delivery tool support for Tower ATC. Responsible for ensuring runway conditions, and planned and forecast changes to the runway conditions, are reflected in the separation policy information.
Tower Runway Controller	The Tower Runway Controller is responsible for the provision of air traffic services to aircraft within the control zone,	Uses the Separation Delivery tool to monitor that separation / spacing remain consistent as aircraft descend on final approach, so as to

	or otherwise operating in the vicinity of controlled aerodromes (unless transferred to Approach Control/ACC, or to the Tower Ground Controller), by issuing clearances, instructions and permission to aircraft, vehicles and persons as required for the safe and efficient flow of traffic.	enable timely intervention action to be taken when there is separation infringement. Monitors runway occupancy, and runway conditions, and ensures separation policy is consistently maintained to support the runway conditions, and changes to the runway conditions. Receives, from different sources, and disseminates to the flight deck, critical WT and weather information, when needed.
Approach Supervisor	Plans and monitors operation in the TMA.	Is aware of the wind conditions, and for deciding and agreeing to the application (if required) of the applicable arrivals concept (TBS-A, PWS-A, WDS-A), in consultation with the Tower Supervisor. Responsible for ensuring the duty runways-in-use information, and the separation policy information, and planned changes to these, is available, set up, and maintained consistently in the arrival Separation Delivery tool support for Approach ATC. Responsible for ensuring that flight crew are informed of the application of the applicable arrivals concept (TBS-A, PWS-A, WDS-A), for example, through D-ATIS.
Final / Intermediate Approach Controller	Are in charge of safe and efficient processing of arrivals to the runway.	Responsible for ensuring that the arrival aircraft information used by the Separation Delivery tool to calculate the TDIs is correct. This includes the arrival sequence order intent, and the flight specific aircraft information such as the aircraft type, the landing speed intent, and in the case of parallel active duty runways-in-use, the landing runway intent of each aircraft. Uses the Separation Delivery tool to ensure final approach separations are set up consistently and efficiently. Uses the Separation Delivery tool to monitor that separations remain consistent as aircraft descend on final approach, so as to enable timely intervention action to be taken when there is separation infringement.
Flight Crew	The Flight Crew remains ultimately responsible for the safe and orderly operation of the flight.	Is aware of the applicable arrivals concept (TBS-A, PWS-A, WDS-A) in operation and the impact on the distance separation set up on final approach. Is informed of when the applicable arrivals concept (TBS-A, PWS-A, WDS-A) is being employed on final approach, for example,

		through D-ATIS. Reports critical weather and WT information to ATC.
Operation Technicians / System Engineers	Monitors the health of the systems used to provide air traffic control services and restore them in case of failure.	Monitors the health and when necessary, restores the Separation Delivery Tool support, and the associated support tools and system services, such as the glideslope wind conditions service.

Table 6: Applicable Roles and Responsibilities for the Arrivals Concepts Solutions

3.2.2.2 Departures Concepts Solutions

The EATMA Node and Node Instances impacted by the departures concepts solutions are:

- Aerodrome ATS
  - Tower Runway Supervisor
  - Tower Runway Control
- Flight Deck
  - Flight Deck

The applicable roles and responsibilities for the departures concepts solutions include:

- Tower ATC Roles
  - Tower ATC Supervisor
  - Tower Runway Controller
  - Tower Ground Controller
  - Tower Clearance Delivery Manager

  [Note that Air Traffic Services Assistants (ATSAs) may assist the above roles, with respect to checking and amending the departure aircraft SID route and aircraft type information, so as to assist in ensuring the required integrity of this information]
- TMA ATC Roles
  - TMA Supervisor
  - TMA Planning Controller
  - TMA Executive Controller (Departure Radar Controller)
- Flight Operations Centre & Flight Crew Roles
  - Flight Crew
  - FOC ATC Flow Manager
- Airport Roles
  - Airport CDM Project Manager
  - Apron Manager

- System Roles
    - Operation Technicians / System Engineers

These roles and the specific/additional role responsibilities are detailed below. There may also be an indirect impact on some Network Roles such as the Network Manager, Flow Manager and Local Traffic Manager.

Role	Current Responsibility	Specific/additional role
Tower ATC Supervisor	The Tower Supervisor is responsible for the safe and efficient provision of air traffic services by Tower ATC. Has overall responsibility for the planning of the Tower operation. Monitors operations. Decides on departure rates. Decides on staffing and manning of CWPs in accordance with expected traffic demand. Proposes runway configuration. Gives permission for maintenance, etc. Represents Tower ATC when coordinating with the Airport Operator on operational issues.	Responsible for ensuring the duty runways-in-use information, and the separation policy information, and planned changes to these, is available, set up, and maintained consistently in the Separation Delivery ATC tool support for Tower ATC (e.g. A-CDM System & DMAN System). Responsible for ensuring runway conditions, and planned and forecast changes to the runway conditions, are reflected in the separation policy information. Is aware of the wind conditions, and for determining and deciding on the application (if required) of the departures separations solutions concepts (PWS-D, WDS-D) in consultation with the TMA Supervisor or TMA Planner Controller, and the TMA Departure Radar Controller. Responsible for ensuring that flight crew are informed of the application of WDS (departures), for example, through D-ATIS.
Tower Runway Controller	The Tower Runway Controller is responsible for the provision of air traffic services to aircraft within the control zone, or otherwise operating in the vicinity of controlled aerodromes (unless transferred to Approach Control/ACC, or to the Tower Ground Controller), by issuing clearances, instructions and permission to aircraft, vehicles and persons as required for the safe and efficient flow of traffic. The Tower Runway Controller will be assisted by departure and surface management systems, where available.	Responsible for employing the efficient departure wake separations for enabling the safe and efficient flow of departure traffic. Uses the Separation Delivery ATC tool support to determine and provide for the safe and efficient flow of departure traffic. Informs departure aircraft when the WDS (departure) concept is being employed. Monitors safe separations and the efficient spacing and sequence for departures when using the reduction of WT separations. Receives, from different sources, and disseminates to the flight deck, critical WT and weather information, when needed.
Tower	The Tower Ground Controller is part of the	Responsible for adjusting to the additional

Ground Controller	controller team responsible for providing an Air Traffic Service (ATS) at controlled aerodromes. Their main task is the provision of ATS to aircraft and vehicles on the manoeuvring area. They must also ensure that airport maintenance vehicles carrying out necessary improvements on an active manoeuvring area do not interfere with the movement of aircraft. They will be assisted by an Advanced Surface Movement Guidance and Control System (A-SMGCS)	capacity and sequencing opportunities and for employing efficient sequencing for departures. Uses DMAN (or similar) information based on the WDS (departure) concept or adjusts manually to the capacity and sequencing opportunities. Informs departure aircraft when the WDS (departure) concept is being employed.
Tower Clearance Delivery Controller	The Clearance Delivery Controller is part of the controller team responsible for providing an Air Traffic Service at controlled aerodromes. Their main task is the verification of Flight data (e.g. FPL, Stand, TSAT etc.) and the delivery of ATC Clearance (Departure Clearance) and Start-Up Approval. They are assisted by a departure management system (DMAN). It is important to note that, according to the aerodrome environment (e.g. airport complexity, traffic density, etc.) and the local regulations at a specific airport, the tower positions may share tasks and responsibilities. To this respect, control areas and responsibilities are clearly defined in local documents and agreements at each airport.	Responsible for adjusting to the additional capacity and sequencing opportunities and for employing efficient sequencing for departures. Informs departure aircraft when the WDS (departure) concept is being employed.
TMA Supervisor	The TMA Supervisor is responsible for the general management of all activities in their respective Operations Room. They decide on staffing and manning of CWPs in accordance with expected traffic demand. Supported by simulations of traffic load and of traffic complexity, and assisted by the NMF, they take decisions concerning the dynamic adaptation of sector configurations to balance capacity to forecast demand.	Is aware of the additional departure capacity resulting from employing the more efficient departure wake separation minima and the weather dependent reduced wake separation minima. Is aware of the wind conditions, and for deciding and agreeing to the application (if required) of the WDS (departures) concept, in consultation with the Tower ATC Supervisor. Responsible for ensuring the duty runways-in-use information, and the separation policy information, and planned changes to these, is available, set up, and maintained consistently in the Separation Delivery tool support (departure) for TMA Controllers.
TMA Planning Controller	Mainly responsible for planning and coordination of the traffic entering, exiting or existing within the ATC Sector.	Responsible for planning and coordination of the traffic entering, exiting or existing within the ATC Sector, taking into account the increase in the departure traffic rate as a result of using the more efficient departure wake separation minima (PWS-D) and the weather dependent reduced wake separation minima (WDS-D)

TMA Executive Controller TMA Departure Radar Controller	Responsibility for traffic management within the sector/AoR and for the tactical tasks. They are responsible for the safe and expeditious flow of all flights operating within their area of responsibility. Their principal tasks are, compliance with the ICAO Rules of the Air, other relevant ICAO (e.g. Doc. 4444) and European/National provisions to separate known flights operating within their area of responsibility and to issue instructions to pilots for conflict resolution and segregated airspace circumnavigation. To separate aircraft on radar after departure.	Monitors the transition from the efficient wake separation minima (PWS-D) and the weather dependent reduced separation minima (WDS-D) employed on the initial departure path by Tower ATC, to the radar separation minima (minimum radar separation & wake separation minima) applied in the TMA. Monitors WDS (departure) availability and application per flight. Receives and disseminates critical WT and weather information.
Flight Crew	During the planning phase: the Flight Crew receives the planning restrictions from the FOC and specific instructions for the flight ("fly as filed" or try to adhere to planning TTs, in function of business model for the specific flight). The Flight Crew also receive their planned Take Off time, if leaving from an airport inside the horizon from destination AMAN – or as in planning. The Flight Crew is informed when the SBT/SMT becomes RBT/RMT. The Flight Crew is involved in different CDM processes (just with controlling ATCO or with several actors). The Flight Crew may perform new types of manoeuvres/procedures. The Flight Crew will integrate in their decision process new information resulting from increased situational awareness on the ground. The Flight Crew will integrate in their decision process new information resulting from increased situational awareness during the flight. The Flight Crew remains ultimately responsible for the safe and orderly operation of the flight.	Is aware of the applicable concept (PWS-D, WDS-D) in operation and the impact on the time separation and/or distance separation minima set up on climb out on the initial departure path. Is informed of when the applicable concept (PWS-D, WDS-D) is being employed on climb-out on the initial departure path, for example, through D-ATIS. Reports critical weather and WT information to ATC.
FOC ATC Flow Manager	In charge of tactical coordination (e.g. from H-3 to H). It covers Network Manager Regulation monitoring / Runways in use / slot swapping etc.	Takes into account the increased departures rate as a result of the employment of the PWS-D and WDS-D concepts. Is informed of when the WDS-D concept is being employed.
Airport CDM Project Manager	The Airport CDM Project Manager is responsible for ensuring and improving communication between all stakeholders, including data-management of CDM relevant data. This includes the dissemination of airport information like landing time, constraints, turn-round time, "Departure Planning Information" and received	Takes into account the increased departures rate as a result of the employment of the PWS-D and WDS-D concepts. Is informed of when the WDS-D concept is being employed.

	"Flight Update Messages", etc. Airport Collaborative Decision Making (A-CDM) is a concept which aims at improving Air Traffic Flow and Capacity Management (ATFCM) at airports by reducing delays, improving the predictability of events and optimising the utilisation of resources. Implementation of Airport CDM allows each Airport CDM Partner to optimise their decisions in collaboration with other Airport CDM Partners, knowing their preferences and constraints and the actual and predicted situation. The decision making by the Airport CDM Partners is facilitated by the sharing of accurate and timely information and by adapted procedures, mechanisms and tools.	
Airport Apron Manager	The Apron Manager is responsible for guidance of aircraft to and from the stands (e.g. providing push-back approval), ensuring the safe and efficient movement of aircraft and vehicles within his/her area of responsibility according to local procedures. The Apron Manager also maintains close coordination with Tower Ground Controller, AOCC and APOC on planned aircraft movements. Normally, control of the activities and the movement of aircraft and vehicles rest with ATC with respect to the manoeuvring area. In the case of aprons, such responsibility sometimes rests with the apron management. Apron Manager's main responsibilities are the guidance of aircraft to and from the stands, ensuring the safe and efficient movement of aircraft and vehicles within his/her area of responsibility according to local procedures, and maintaining close coordination with other actors on planned aircraft movements using CDM. Airlines may hire third party services for apron management service under the supervision of the airport authority, in compliance with its regulations or through airlines own regulations (ICAO, EASA).	Takes into account the increased departures rate as a result of the employment of the PWS-D and WDS-D concepts. Is informed of when the WDS-D concept is being employed.
Operation Technicians / System Engineers	Monitors the health of the systems used to provide air traffic control services and restore them in case of failure.	Monitors the health and when necessary, restores the Separation Delivery Tool support, and associated support tools and system services, such as the departures runway surface and initial departure path wind conditions services.

Table 7: Applicable Roles and Responsibilities for the Departures Concepts Solutions

3.2.2.3 Wake Risk Monitoring Concept Solution

The EATMA Node and Node Instances impacted by the departures concepts solutions are:

- ATS Operations
  - ANSP
- En-Route/Approach ATS
  - Air Traffic Controller
- Airport Ops Support
  - Airport Operator
- Airspace User Operations
  - Aircraft Operator
- Flight Deck
  - Flight Deck

These nodes and responsibilities are detailed below.

Node	Responsibilities
ATS Operations	Air traffic service (ATS) include variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service). Air Traffic control service is provided for the purpose of preventing collisions between aircraft, and on the manoeuvring area between aircraft and obstructions. Furthermore it's provided for expediting and maintaining an orderly flow of air traffic. (based on ICAO Doc 4444)
En-Route/Approach ATS	Performs all the En-route and approach ATS operations. [RELATED ACTORS/ROLES] Executive controller, planning controller, etc.
Airport Ops Support	Perform all the airport ops support activities, including analysis of airport resources, long term planning of infrastructures, coordination of airport slots, management of airport resources on the day of operation (gates, vehicles, stands, de-icing...), information sharing and CDM, etc. [RELATED ACTORS/ROLES] Airport Operator, Airport Slot Negotiator
Airspace User Operations	Airspace User Operations represent all the activities undertaken by those organisations and individuals who have access to and operate in the airspace which is managed for ATM purposes in accordance with ICAO and national procedures. For the purpose of this document only those actors directly involved in ATM operations are described. The main types of civil Airspace User Operations are: • Scheduled Airline Operations / Organisation (A). The most extensive organization for Airspace User Operations is run by Airlines with a worldwide network. The daily operations of these Airlines, with up to thousands of flights per day all over

	the world, require a lot of flexibility. In order to give the best possible service to their passengers, maintaining punctuality and a high quality of service, Airlines have to run and to maintain a complex organization. This category regroups Cargo, Regional, Network, Charter and Low Cost operators. • Business Aviation Operations / Organisation (BA). Another important segment of Airspace Users is Business Aviation, which concerns the operation or use of aircraft by companies for the carriage of passengers or goods as an aid to the conduct of their business. • Military Aviation Operations / (MA). Determined by strategic objectives dealing with National and International security and defence policies and commitments, the operation or use of military/State aircraft (combat aircraft, military air transport aircraft, tankers, AWACS, training aircraft, helicopters…) concern Air defence and policing flights, Search and rescue, instructional and training flights, combined air operations as part of complex scenarios and UAS operations for which special use of airspace may be needed. · General Aviation Operations / Organisation (GA), which operates civilian aircraft for purposes other than commercial passenger transport, including personal, business, and instructional flying, represents another type of Airspace Users.
Flight Deck	Performs all the on-board AU operations including flight execution/monitoring according to agreed trajectory, compliance with ATC clearances/instructions, etc. [RELATED ACTORS/ROLES] Flight Crew

Table 8: Applicable Nodes and Responsibilities for the Wake Risk Monitoring Concept Solution

3.2.2.4 Wake Decay Enhancing Concept Solution

Because the Wake Decay Enhancing Concept Solution consist of purely passive means to increase safety there are no roles and responsibilities during operations once the plate lines are installed. It is sufficient to check the plates from time to time for their structural integrity. There are no associated human factors aspects.

3.2.3 Technical Characteristics

3.2.3.1 Arrivals Concepts Solutions

This section describes the technical characteristics and constraints that define the context in which the technical requirements are applicable, for the Arrival phase.

3.2.3.1.1 Approach Arrival Sequence Service

The Separation Delivery tool requires a reliable Approach Arrival Sequence Service that is updated upon any change in the sequence in order to allow the tool to correctly display TDIs. The service must use the sequence as planned / implemented by the Approach controllers. Options for such a service include an AMAN, AMAN plus an HMI solution to enable controllers to modify the sequence tactically, an auto sequence detection solution (EFPS).

3.2.3.1.2 Departures Sequence Service Support for Mixed-Mode

The Separation Delivery tool might require inputs from the Departure Sequence Service. In case of a mixed-mode runway assessment, the Arrival Separation Delivery tool might need to be aware of the planned departing aircrafts in the sequence.

3.2.3.1.3 Wind Forecasting and Monitoring

The TBS, ORD, S-PWS and WDS concepts rely on wind forecasting and monitoring at the surface and along the final approach path. The reliability, accuracy and stability of the wind forecasting solutions available to a local implementation determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

For TB S-PWS with ORD for arrivals, both for calculating the TB S-PWS distance and for calculating the ORD anticipated distance spacing compression, a glideslope wind conditions profile is required with a forecast horizon of the flying time from the follower aircraft turning on from downwind to base until the follower aircraft crosses the runway landing threshold. This is typically between 15 NM and 25 NM flying distance to the runway landing threshold which equates to around 7 to 10 minutes flying time. If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 10 minutes forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

For WDS for arrivals, both for the total wind concept and the crosswind concept there is a need to establish the wind forecasting and monitoring requirements which may include both landing runway 10m anemometer wind speed measurements and a full final approach glideslope wind profile. One aspect to consider is sufficient forecast notification of when the wind conditions will drop below the minimum criteria. There is a need to stop the wake separation reduction in good time before the wind conditions change below the minimum criteria. This should be at least the flying time of the follower aircraft from downwind until crossing the runway landing threshold so as to provide assurance that the minimum criteria will be prevalent until the follower aircraft crosses the runway landing threshold. If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 10 minutes forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required. There may be a need for a longer forecast horizon to support avoiding switching in and out of employing WDS for arrivals in variable or unstable wind conditions and also to support the arrival flow management decisions with respect to committing to a higher arrival flow rate into the TMA and on to approach.

3.2.3.1.4 Arrivals Concepts Solutions OI

Individually for each Arrivals Concepts Solutions OI the following technical characteristics have been identified.

AO-0328 - Optimised Runway Delivery on Final Approach (ORD)

The ORD concept is intended to assist Controllers in coping with the effect of compression by providing additional tool support to show them what spacing needs to be delivered at the Deceleration Fix (DF) in order to achieve the required separation / spacing. This spacing can be built into the same Separation Delivery tool that is used for the wake separation concepts S-PWS and WDS. In SESAR 2020 work the concept evolved by:

- providing functionalities from SESAR Solution PJ02.02 (Enhanced Approach Procedures)
- providing refined pairwise constraints from SESAR Solution PJ02.08 (Runway Occupancy Time)
- working for different set of runway operations, procedures and constraints

AO-0306 – Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics (PWS-A)

The S-PWS concept is intended to optimise wake separations between arrivals on final approach by moving from schemes defined by wake categories to a scheme defined between aircraft type pairs. It uses:

- ATCO delivery tool support

AO-0310 – Weather-dependent reductions of Wake Turbulence separations for final approach (WDS-A)

The WDS-A concept allows conditional reduction or suspension of separation minima for most aircraft pairs by using total or cross wind:

- If it is based on a total wind then as the magnitude of the wind increases, the decay rate of wake turbulence increases allowing a reduction of wake turbulence separations. This would be a reduction in time separations as the total wind increases when the total wind is above a certain threshold. These time separations can then be used as input into the Separation Delivery tool.
- If it is based on a cross wind, then when the cross wind exceeds a certain value the WT can be shown to have been transported out of the path of arrivals allowing for the reduction of WT separations. This would be a reduction in time separations as the cross wind increases when the cross wind is above a certain threshold. These time separations can then be used as input into the Separation Delivery tool.

The concept needs:

- ATCO delivery tool support for arrivals
- Local environment weather information and wind forecasting capabilities
- Coordination between Approach and Tower Supervisor for using the wind information to activate/deactivate the WDS. If the wind were to drop below the required threshold unexpectedly then the Supervisors and Controllers shall need to be alerted to allow for a transition to a different separation mode.

3.2.3.2 Departures Concepts Solutions

This section describes the technical characteristics and constraints that define the context in which the technical requirements are applicable, for the Departures Concepts Solutions.

3.2.3.2.1 Departures Technical Environment

The Departures Concepts Solutions require:

- ATCO Delivery Tool support for departures
- Local environment weather information and wind forecasting and monitoring capabilities
- Coordination between Approach and Tower Supervisor for using the wind information to activate/deactivate the WDS-D and for authorising/ending the use of the weather-dependent reduction of the wake turbulence separations. If the wind were to drop below the required threshold unexpectedly then the Supervisors and Controllers shall need to be alerted to allow for a transition to a different separation mode.

The technical characteristics of the Departures Concepts Solutions encompass:

- ATC Delivery Tool support
- Departure Manager (DMAN) System
- Airport Collaborative Decision Making (A-CDM) System
- Advanced Meteorological Information Provision
- Flight Data Processing System
- Surveillance System for Surface Movement (e.g. Advanced Surface Movement Guidance and Control System (A-SMGCS)) including some coverage of the straight-out initial common departure path
- Primary & Secondary Radar Surveillance System for the TMA and SIDs including the straight-out initial common departure path
    - Elementary Mode-S Surveillance (ELS) or Mode A/C
    - Enhanced Mode S Surveillance (EHS) (for UK Airports)
- Tower CWPs (Airport Tower Supervisor, Tower Runway Controller, Tower Ground Controller, Tower Clearance Delivery Controller or Apron Manager)
    - Electronic Flight Progress Strips
    - Traffic Situation View Display
    - Meteorological Information Display
    - A-CDM and DMAN HMI & Information Display
    - ATC Voice Communications
- TMA CWPs (TMA Supervisor, TMA Planning Controller, TMA Executive Controller (TMA Departure Radar Controller)
    - Flight Progress Strips (Either electronic or paper)
    - Radar Situation View Display
    - ATC Voice Communications

3.2.3.2.2 Departures Concepts Solutions OI

Individually for each Departures Concepts Solutions OI the following technical characteristics have been identified.

AO-0329 – OSD Optimized Separation Delivery for Departure PWS-D

The OSD concept is intended to assist Controllers in efficiently deliver airborne separation in time or distance after departure using:

- ATCO Separation Delivery tool support (OSD tool support) for departures
- Departure aircraft trajectory event time information in support of OSD concept
- Aircraft performance information in support of OSD concept
- Local environment weather information and wind forecasting and monitoring capabilities
- HMI support

AO-0323 – Wake Turbulence Separations (for departures) based on Static Aircraft Characteristics

The S-PWS concept is intended to optimise wake separations between departures on the initial departure path by moving from schemes defined by a small number of wake categories (4 to 7 wake categories) to a scheme defined between aircraft type pairs for the 96 aircraft types frequently at European major airports, together with a scheme defined by a larger number of wake categories (20-CAT (6-CAT + 14-CAT)) for other aircraft type combinations. It uses the ATCO delivery support tool of AO-0329.

AO-0304 – Weather-dependent reductions of Wake Turbulence separations for departure (WDS-D)

The WDS (departures) concept is conditionally applied as a function of the weather forecasting and of the local wind conditions. These two factors will impact the concept implementation. Consequently, the safe application of the concept requires the wind conditions to be monitored in the area surrounding the aircraft departure path.

The concept needs:

- ATCO Separation Delivery Tool support (OSD tool support enhanced to support WDS-D)
- Local environment weather information and wind forecasting and monitoring capabilities
- Supervisor Wind Conditions Monitoring Tool support (WDS-D tool support)
- Coordination between Tower Supervisor and the Tower ATCOs for using the wind information to activate/deactivate the WDS-D and for authorising/ending the use of the weather-dependent reduction of the wake turbulence separations. If the wind were to drop below the required threshold unexpectedly then the Supervisors and Controllers shall need to be alerted to allow for a transition to a different separation mode.
- Coordination between Tower Supervisor, Airport Ops Support (Airport CDM Project Manager, Airport Apron Management) and Flight Ops Support (FOC ATC Flow Manager) with respect to changes in the departure rate as a result of authorising/ending the use of the wake turbulence separation reductions is taken into account in the A-CDM and DMAN related processes.

3.2.3.2.3 Wind Forecasting and Monitoring

The OSD, S-PWS and WDS concepts rely on wind forecasting and monitoring at the runway surface and along the initial departure path. The reliability, accuracy and stability of the wind forecasting solutions available to a local implementation determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

For S-PWS with OSD for departures, there is a need to consider the departures path wind profile requirements for adequately managing the transition to the TMA Departure Radar Controller separations (radar and wake), and for adequately managing airspeed profile differences between the lead and follower aircraft. There is potentially a requirement for a full wind profile over the initial departure path until aircraft turn onto their respective SIDs, and potentially extended to common paths beyond the first SID turn. This will be required with a forecast horizon from take-off clearance to the departing aircraft turning on to their respective SIDs, which is potentially around 60s (to becoming airborne) to 120s (to SID turn) forecast horizon over the initial departure path (15s to react to take-off clearance, 30s to 60s aircraft type related take-off roll to becoming airborne, around 45s for the 2 NM flying time from rotation to SID turn), and may be for a longer time horizon, if needing to be extended to common paths beyond the first SID turn. If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 60s (to becoming airborne) to 120s (to SID turn) forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

For WDS for departures, both for the total wind concept and the crosswind concept there is a need to establish the wind forecasting and monitoring requirements which may include both departure runway 10m anemometer wind speed measurements at the initial airborne positions of the departure aircraft (and not the departure line-up end or stop end of the runway), and a full initial departure path wind profile. One aspect to consider is sufficient forecast notification of when the wind conditions will drop below the minimum criteria. There is a need to stop the wake separation reduction in good time before the wind conditions change below the minimum criteria. This should be at least the roll time plus flying time of the follower aircraft over the common initial departure path so as to provide assurance that the minimum criteria will be prevalent until the follower aircraft is either on a wake independent SID route to the lead aircraft SID route, or the standard TMA wake separation has been set up. If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 60s (to becoming airborne) to 120s (to SID turn) forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required. There may be a need for a longer forecast horizon to support avoiding switching in and out of employing WDS for departures in variable or unstable wind conditions and also to support the departure flow management decisions with respect to committing to a higher departure flow rate on taxi-out to the runway holding points.

For WDS for departures, based on differentiated rotation positions and climb profiles, either alone or combined with the crosswind concept, similar requirements to the crosswind component also apply to the headwind component of the wind profile over the initial departure path due to the risk of the wake vortices being transported towards the initial airborne positions and climb profile of the follower aircraft. This potentially just applies to the rotation and initial climb portion of the initial departure path and so a shorter time horizon of around 60s (to becoming airborne) to 90s (initial climb). If the available service is a persistent forecast of the latest measured profile there is a need to establish through multi-season multi-year analysis how much the wind conditions can change in the 60s to 90s forecast horizon to determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

3.2.3.3 Wake Risk Monitoring Concept Solution

The wake turbulence detection and monitoring solution relies on the availability of ADS-B Out transmitted by all mainline aircraft, in particular those susceptible to produce significant wake turbulence to be considered by other aircraft (i.e. ICAO Medium category and larger). Otherwise standard avionics data currently available on most mainline aircraft are used. The solution furthermore relies on ground-based collection and storage of this data for subsequent analysis by the detection and monitoring tool.

3.2.3.4 Wake Decay Enhancing Concept Solution

When wake vortices approach the ground they trigger intense secondary vortices at the plates that approach the wake vortices and accelerate their decay by mutual interaction of the vortices. This is crucial in situations when the combination of crosswinds below 1.5m/s and tailwinds favour wake vortex encounters in ground proximity. A plate line consists of eight plates with a length of 9m and a height of 4.5m and the plates are separated by 20m. The first plate line is installed below the glide slope at a distance of about 300m to threshold. Further plate lines can be installed at larger distances to the runway. One plate presumably will consist of aluminium lattice masts grounded with prefab concrete foundations and covered with truck tarpaulin. The masts are compatible with ICAO frangibility requirements and don't perturb the localizer signal.

3.2.4 Applicable standards and regulations

3.2.4.1 Arrivals Concepts Solutions

3.2.4.1.1 Reference Scenario WTC Schemes for the Arrivals Concepts Solutions

Today, radar and wake turbulence distance-based separation minima (hereafter referred to as DBS) are applicable by ATS to arrivals concepts solutions based on surveillance capabilities, to separate traffic in order to mitigate respectively collision risk and wake-turbulence-induced accidents.

Such WT separation schemes (including ICAO, RECAT-EU 6 category and UK 6 category) are based on Wake Turbulence Categories (WTC) and are applied independent of the wind conditions.

Additionally in SESAR 1 TBS for Arrivals (AO-0303) was developed and validated to V3 maturity and is now operationally deployed at London Heathrow based on the DB RECAT-EU 6 category scheme applied to the runway landing threshold.

ICAO DB Scheme for Arrivals

The ICAO radar separation standards for arrivals include MRS which prevents aircraft collision and WT separation which is intended to protect aircraft from adverse WTEs. Historically WT separations have been based on aircraft grouped into categories based on their MTOW and have a resolution of 1 NM. This has been needed in the past to ensure Controllers can memorise the wake separations and apply them without tool support. Additional separation has been prescribed whenever a less heavy category is following behind an aircraft from a heavier category. This implies that when the traffic at a certain airport contains aircraft from mainly one of the categories, a low penalising effect of WT separations will appear. On the other hand, whenever the aircraft categories are mixed, there will be efficiency and capacity losses due to the extra separation that has to be applied.

ICAO Doc 4444 [43] defines the following WT separation categorisation and separation minima for application on the approach and departure phase of flight. ICAO WT separation minima are based on a grouping of aircraft types into three categories according to the maximum certificated take-off mass as follows:

- **HEAVY ("H")**: all aircraft types of 136,000 kg or more;
- **MEDIUM ("M")**: aircraft types less than 136,000 kg but more than 7,000 kg;
- **LIGHT ("L")**: aircraft types of 7,000 kg or less.

Typical aircraft types in the Heavy WT category are: B747 family, B767 family, B777 family, A330/A340 family, A300/A310 family, MD11. Typical aircraft types in the Medium WT category are: B757 family, B737 family, A320 family, CRJs family (CRJ100/200/700/900/1000), E-Jets family (E135/140/145/170/175/190/195) and ATRs.

A list of more than 9000 aircraft types is categorized on that basis in ICAO Doc 8643 [44].

The Airbus A380-800 (A388), with a MTOW in the order of 560,000 kg, is the largest passenger aircraft ever entered into revenue service. The aircraft is in the Heavy WTC, which has no upper limit defined. However, for the A380-800, an ICAO State guidance released in 2008 [45] recommends an increase in relation to the WT separation minima published in the PANS-ATM.

Currently the ICAO scheme for distance-based wake turbulence longitudinal separation minima applies on approach in the majority of airports. Additional separation has then been prescribed behind Heavy category lead aircraft and for Light category follower behind Medium category leader. For arrivals the WT separations are defined in distance to be applied on approach.

Approach Distance Based Wake Turbulence Separation Minima		Follower Aircraft ICAO Wake Category or Aircraft Type			
		A388	Heavy	Medium	Light
Lead Aircraft ICAO Wake Category or Aircraft Type	A388	(*)	6 NM	7 NM	8 NM
	Heavy	(*)	4 NM	5 NM	6 NM
	Medium	(*)	(*)	(*)	5 NM
	Light	(*)	(*)	(*)	(*)

Table 9: ICAO Wake Category Based Distance Based Separations for Arrivals

(*) When a wake turbulence restriction is not required, then separation reverts to radar separation minimum set for collision risk mitigation. This is typically 3 NM although can be 2.5 NM under certain conditions prescribed in ICAO Doc 4444 [43] or as prescribed by the appropriate ATS authority. This is when local radar capabilities permit and with respect to the conditions prescribed in ICAO Doc 4444, between succeeding aircraft which are established on the same final approach track within 10 NM of the runway landing threshold.

WT separation minima are to be applied in the following scenarios:

- an aircraft is operating directly behind another aircraft at the same altitude or less than 300m (1,000ft) below, or;
- both aircraft are using the same runway, or parallel runways separated by less than 760m (2,500ft); or;
- an aircraft is crossing behind another aircraft, at the same altitude or less than 300m (1,000ft) below.

RECAT-EU DB Scheme for Arrivals

The RECAT-EU 6 category scheme aims to provide a more efficient WT scheme by re-grouping aircraft based upon MTOW and wing span and is the result of an optimization of the ICAO wake turbulence separation classes.

The criteria used for categorisation of existing and new aircraft types are respectively provided in Figure 5.

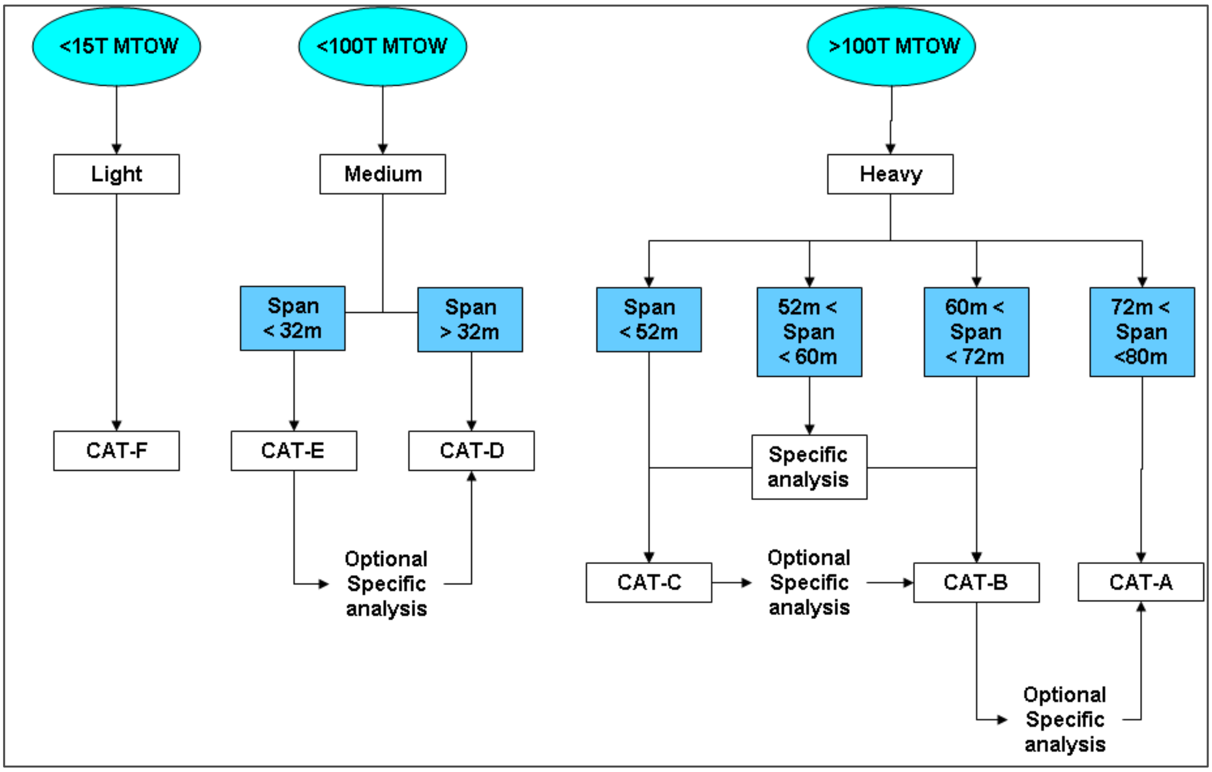

Figure 5: Categorisation process and criteria for assigning an existing aircraft type into RECAT-EU scheme

The assignment to a wake turbulence category as proposed in RECAT-EU scheme is made per aircraft type, regardless of possible variable (reduced) MTOW schemes used by the airlines for a particular aircraft type, by considering the upper range of the MTOW as defined in Manufacturers' Aircraft Characteristics Manuals for Airport Planning.

The resulting mapping of the ICAO wake category and aircraft type A380 scheme to RECAT-EU wake category scheme is as follows:

- The A380 is mapped into Super Heavy (CAT-A)
- The ICAO Heavy Wake Category is split into Upper Heavy (CAT-B) and Lower Heavy (CAT-C)
- The ICAO Medium Wake Category is split into Upper Medium (CAT-D) and Lower Medium (CAT-E) with ICAO Medium aircraft types with a MTOW greater than 100T (e.g. B752, B753) being mapped to Lower Heavy (CAT-C)
- The ICAO Light Wake Category is mapped into Light (CAT-F)

Some examples of the aircraft type assignment to the RECAT-EU wake category scheme for the most common types at European airports are provided in Table 10.

'Super Heavy'	'Upper Heavy'	'Lower Heavy'	'Upper Medium"	"Lower Medium"	"Light"
'CAT-A'	'CAT-B'	'CAT-C'	'CAT-D'	'CAT-E'	'CAT-F'
A388	A332	A306	A318	AN32	BE40
A124	A333	A30B	A319	AT43	BE45
(…)	A342	A310	A320	AT45	C152
	A343	B703	A321	AT72	C180
	A345	B752	AN12	B462	C525
	A346	B753	B736	B712	C650
	A359	B762	B737	B732	D328
	AN22	B763	B738	B733	E120
	B744	B764	B739	B734	FA10
	B748	B783	C130	B735	FA20
	B772	C135	IL18	CL30	H25B
	B773	DC10	MD81	CL60	JS32
	B77L	DC85	MD82	CRJ1	JS41
	B77W	IL76	MD83	CRJ2	LJ35
	B788	L101	MD87	CRJ7	LJ60
	IL96	MD11	MD88	CRJ9	P180
	(…)	TU22	MD90	DC93	SF34
		TU95	T204	DH8D	(…)
		(…)	TU16	E135	
			(…)	E145	
				E170	
				E175	
				E190	
				E195	
				F70	
				F100	
				GLF2	
				GLF4	
				RJ85	
				RJ1H	
				(…)	

Table 10: Example List of Aircraft Types Assigned to RECAT-EU Wake Categories

For arrivals the RECAT-EU WT separations are defined in distance to be applied on approach as per Table 11.

Approach Distance Based Wake Turbulence Separation Minima		**Follower Aircraft RECAT EU Wake Category**					
		"Super Heavy" 'CAT-A'	**"Upper Heavy" 'CAT-B'**	**"Lower Heavy" 'CAT-C'**	**"Upper Medium" 'CAT-D'**	**"Lower Medium" 'CAT-E'**	**"Light" 'CAT-F'**
Lead Aircraft RECAT EU Wake Category	**"Super Heavy" 'CAT-A'**	3 NM	4 NM	5 NM	5 NM	6 NM	8 NM
	"Upper Heavy" 'CAT-B'		3 NM	4 NM	4 NM	5 NM	7 NM
	"Lower Heavy" 'CAT-C'		(*)	3 NM	3 NM	4 NM	6 NM
	"Upper Medium" 'CAT-D'						5 NM
	"Lower Medium" 'CAT-E'						4 NM
	"Light" 'CAT-F'						3 NM

Table 11: RECAT-EU 6 Category Wake Category Based Separations for Arrivals

(*) means minimum radar separation (MRS), set at 2.5 NM, is applicable as per ICAO Doc 4444 [43] provisions.

For aircraft category pairs with no defined WT separation then the MRS is to be applied. This is typically 3 NM although can be 2.5 NM under certain conditions prescribed in ICAO Doc 4444 [43] or as prescribed by the appropriate ATS authority.

For the deployment it remains optional to locally deploy only part of the RECAT-EU scheme, or apply larger separation minima than proposed ones, or opt for a progressive application.

It should be noted that after specific analysis there are five aircraft types that require special treatment with a recommendation to treat these aircraft as CAT-B as leader and CAT-C as follower. These aircraft types are as per Table 12.

Manufacturer	Model	ICAO Type Designator
NORTHROP GRUMMAN	B-2 Spirit	B2
BOEING	B-52 Superfortress	B52
DOUGLAS	C-133 Cargomaster	C1233
TUPOLEV	TU-160	T160
MYASISHCHEV	Atlant	VMT

Table 12: Aircraft Types Requiring Special Treatment

ICAO TB Scheme for Arrivals

AO-0303 TBS for Arrivals was developed to V3 maturity in SESAR 1 in Project P06.08.01 [41]. To apply an ICAO TB Scheme for Arrivals reference time separations need to be established for each wake category pair for reference low headwind conditions over the DB ICAO wake separation to the runway landing threshold, for a reference airspeed profile over the DB ICAO wake separation. The reference time-based separations and reference airspeed profile are then applied in the prevailing wind conditions on final approach to calculate the TBS distance to be applied as the wake separation minima.

RECAT-EU TB Scheme for Arrivals

At London Heathrow TBS for Arrivals based on the DB RECAT-EU 6 category scheme is in operation. Reference time-based separations have been established for each wake category pair for reference low headwind conditions over the DB RECAT-EU wake separation to the runway landing threshold for a reference airspeed profile over the DB RECAT-EU wake separation. The reference time-based separations and reference airspeed profile are then applied in the prevailing wind conditions on final approach to calculate the TBS distance to be applied as the wake separation minima.

3.2.4.1.2 Solution Scenarios WT Separation Schemes for the Arrivals Concepts Solutions

The Solution Scenario WT Separation Schemes are RECAT-PWS-EU (PWS-A) Scheme and the Weather Dependent Separation Scheme (WDS-A).

RECAT-PWS-EU DB Scheme for Arrivals (DB-PWS-A) (AO-0306)

The S-PWS concept is intended to optimise wake separations between arrivals on final approach by moving from schemes defined by wake categories to a scheme defined between aircraft type pairs. In current operations aircraft are grouped into wake categories depending on their MTOW. Example wake category schemes include ICAO 3+1 category, RECAT-EU 6 category or UK 6 category. However, the majority of wake separations defined in a wake category scheme are overly conservative because they are designed to protect the most wake susceptible follower aircraft type in a category from the potential wake turbulence of the strongest wake generating leader aircraft type in a category. All other combinations of aircraft type pairs have larger wake separations than they require. This results in different wake risk between different aircraft type pairs. Through optimising the wake separations between aircraft type pairs the S-PWS concept results in an improved distribution of wake risk between aircraft type pairs. An example of an S-PWS wake scheme is RECAT-PWS-EU [40] that has been developed by EUROCONTROL.

The RECAT-PWS-EU wake scheme covers 96 aircraft types which are common at major European airports which have been used to specify a 96 x 96 matrix of distance based separations. The separations have been calculated using a wake severity metric method which is based on characterisation of the leader aircraft type (generated wake decay profile) and characterisation of the follower aircraft type (approach speed profile and wing geometry characteristics to determine wake resistance). This matrix may evolve over time as new aircraft types are added based on specific analysis using the wake severity metric.

These S-PWS distance based separations apply on approach, and are defined through the zoom of the 96 x 96 matrix in the following Tables extracted from [40]:

	A388	B77L	B77W	A351	A359	A358	B744	A346	A345	B773	B772	A343	A332	A333	A342	B788	MD11	B764	B762	B763	A306	A30B	A310	B752	B753
A388	2	3.5	3.5	3.5	3.5	3.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4	4.5	4.5	4.5	4.5	4.5
B77L	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	3	3	3	3	2.5	2.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
B77W	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	3	3	3	3	2.5	2.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A351	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	3	3	3	3	2.5	2.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A359	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	3	3	3	3	2.5	2.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A358	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	3	3	3	3	2.5	2.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
B744	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	3	3	3	3	2.5	2.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A346	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	3	3	3	3	2.5	2.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A345	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	3	3	3	3	2.5	2.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
B773	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2	2	2.5	3	3	3.5	3.5	3.5	3.5	3.5
B772	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2	2	2.5	3	3	3.5	3.5	3.5	3.5	3.5
A343	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2	2	2.5	3	3	3.5	3.5	3.5	3.5	3.5
A332	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2	2	2.5	3	3	3.5	3.5	3.5	3.5	3.5
A333	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2	2	2.5	3	3	3.5	3.5	3.5	3.5	3.5
A342	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2	2	2.5	3	3	3.5	3.5	3.5	3.5	3.5
B788	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2	2	2.5	3	3	3.5	3.5	3.5	3.5	3.5
MD11	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5	3	3	3
B764	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	2.5
B762	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	2.5
B763	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2	2.5	2.5	2.5
A306	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5
A30B	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5
A310	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5
B752	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
B753	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

Table 13: RECAT 96 x 96 PWS Minima on Approach – Zoom of (former) HEAVY-HEAVY Pairs

	B739	B738	B737	B736	A321	A320	A318	A319	MD83	MD82	A148	B734	B733	B735	E190	GL5T	GLEX	GLF5	B712	F100	F70	B463	RJ1H	RJ85	E170	CRJ7	CRJ9	GLF4
A388	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	5.5	4.5	5	5	5	5.5	5	5	5.5	5.5	5.5	6	6	6	5.5	6	6	5.5
B77L	4	4	4	4	4	4	4	4	4	4	4.5	4	4	4	4	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
B77W	4	4	4	4	4	4	4	4	4	4	4.5	4	4	4	4	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
A351	4	4	4	4	4	4	4	4	4	4	4.5	4	4	4	4	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
A359	4	4	4	4	4	4	4	4	4	4	4.5	4	4	4	4	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
A358	4	4	4	4	4	4	4	4	4	4	4.5	4	4	4	4	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
B744	4	4	4	4	4	4	4	4	4	4	4.5	4	4	4	4	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
A346	4	4	4	4	4	4	4	4	4	4	4.5	4	4	4	4	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
A345	4	4	4	4	4	4	4	4	4	4	4.5	4	4	4	4	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
B773	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4.5	4	4	4	4	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4
B772	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4.5	4	4	4	4	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4
A343	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4.5	4	4	4	4	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4
A332	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4.5	4	4	4	4	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4
A333	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4.5	4	4	4	4	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4
A342	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4.5	4	4	4	4	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4
B788	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4.5	4	4	4	4	4.5	4	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4
MD11	3	3	3	3	3	3	3	3	3	3	3.5	3	3	3	3	3.5	3.5	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
B764	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3.5	3.5	3
B762	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3.5	3.5	3
B763	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	2.5	3	3	3	3	3	3	3	3	3	3	3	3	3	3.5	3.5	3
A306	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3
A30B	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3
A310	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3.5	3	3	3	3	3	3	3	3	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3
B752	2	2	2	2	2	2	2	2	2	2	2.5	2	2	2	2	2.5	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B753	2	2	2	2	2	2	2	2	2	2	2.5	2	2	2	2	2.5	2	2	2	2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Table 14: RECAT 96 x 96 PWS Minima on Approach - Zoom of (former) HEAVY-LARGE MEDIUM Pairs

	F27	F50	DH8D	AT75	AT72	FA7X	AT43	AT45	CRJ2	J328	E145	E135	CL30	F2TH	F900	FA50	CL60	GALX
A388	6	6	6	6	6	5.5	6	6	6	6	6	6	6	6	6	6	6	6
B77L	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
B77W	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A351	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A359	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A358	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
B744	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A346	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
A345	4.5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
B773	4.5	5	5	5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	5
B772	4.5	5	5	5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	5
A343	4.5	5	5	5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	5
A332	4.5	5	5	5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	5
A333	4.5	5	5	5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	5
A342	4.5	5	5	5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	5
B788	4.5	5	5	5	5	4.5	5	5	5	5	5	5	5	5	5	5	5	5
MD11	3.5	4	4	4	4	3.5	4	4	4	4	4	4	4	4	4	4	4	4
B764	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	3.5	4	4	4	4	4	4
B762	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	3.5	4	4	4	4	4	4
B763	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	3.5	4	4	4	4	4	4
A306	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4	4	4	4	4	4	4	4	4	4
A30B	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4	4	4	4	4	4	4	4	4	4
A310	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4	4	4	4	4	4	4	4	4	4
B752	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	3	3	3	3	3	3	3	3.5
B753	2.5	2.5	2.5	2.5	2.5	2.5	2.5	3	3	3	3	3	3	3	3	3	3	3.5

Table 15: RECAT 96 x 96 PWS Minima on Approach - Zoom of (former) HEAVY-SMALL MEDIUM Pairs

	SF34	D328	E120	C680	C56X	H25C	C25C	LJ45	LJ40	H25B	C560	LJ60	BE40	LJ35	B350	C25B	PC12	C550	C25A	C501	C525	C510	P46T	PA34	C10T
A388	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6	6.5	6.5	6.5	6	6.5	6	7	7.5	7	7	7	7	7	7	7	6.5	6.5
B77L	5.5	6	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6	5.5	6	6.5	6	6	6.5	6	6	6.5	6.5	6.5	6.5
B77W	5.5	6	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6	5.5	6	6.5	6	6	6.5	6	6	6.5	6.5	6.5	6.5
A351	5.5	6	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6	5.5	6	6.5	6	6	6.5	6	6	6.5	6.5	6.5	6.5
A359	5.5	6	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6	5.5	6	6.5	6	6	6.5	6	6	6.5	6.5	6.5	6.5
A358	5.5	6	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6	5.5	6	6.5	6	6	6.5	6	6	6.5	6.5	6.5	6.5
B744	5.5	6	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6	5.5	6	6.5	6	6	6.5	6	6	6.5	6.5	6.5	6.5
A346	5.5	6	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6	5.5	6	6.5	6	6	6.5	6	6	6.5	6.5	6.5	6.5
A345	5.5	6	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6	5.5	6	6.5	6	6	6.5	6	6	6.5	6.5	6.5	6.5
B773	5.5	5.5	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6.5	5.5	6	6.5	6.5	6	6.5	6	6	6.5	6.5	6.5	6.5
B772	5.5	5.5	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6.5	5.5	6	6.5	6.5	6	6.5	6	6	6.5	6.5	6.5	6.5
A343	5.5	5.5	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6.5	5.5	6	6.5	6.5	6	6.5	6	6	6.5	6.5	6.5	6.5
A332	5.5	5.5	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6.5	5.5	6	6.5	6.5	6	6.5	6	6	6.5	6.5	6.5	6.5
A333	5.5	5.5	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6.5	5.5	6	6.5	6.5	6	6.5	6	6	6.5	6.5	6.5	6.5
A342	5.5	5.5	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6.5	5.5	6	6.5	6.5	6	6.5	6	6	6.5	6.5	6.5	6.5
B788	5.5	5.5	5.5	5.5	6	6	6	5.5	6	6	6	5.5	6.5	5.5	6	6.5	6.5	6	6.5	6	6	6.5	6.5	6.5	6.5
MD11	4.5	4.5	4.5	4.5	4.5	5	5	4.5	5	5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	5	5.5	5.5
B764	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	5	4.5	4.5	5	5	5	5
B762	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	5	4.5	4.5	5	5	5	5
B763	4	4	4	4	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4	4.5	4.5	4.5	4.5	4.5	4.5	5	4.5	4.5	5	5	5	5
A306	4.5	4.5	4.5	4.5	4.5	4.5	5	4.5	5	5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	5.5	5.5	5.5
A30B	4.5	4.5	4.5	4.5	4.5	4.5	5	4.5	5	5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	5.5	5.5	5.5
A310	4.5	4.5	4.5	4.5	4.5	4.5	5	4.5	5	5	5	4.5	5	4.5	5	5	5	5	5	5	5	5	5.5	5.5	5.5
B752	3	3	3	3	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4	4	4
B753	3	3	3	3	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	4	4	4	4

Table 16: RECAT 96 x 96 PWS Minima on Approach - Zoom of (former) HEAVY-LIGHT Pairs

	SF34	D328	E120	C680	C56X	H25C	C25C	LJ45	LJ40	H25B	C560	LJ60	BE40	LJ35	B350	C25B	PC12	C550	C25A	C501	C525	C510	P46T	PA34	C10T
B739	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
B738	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
B737	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
B736	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A321	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A320	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A318	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A319	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
MD83	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
MD82	3	3	3	3	3	3	3	3	3.5	3	3.5	3	3.5	3	3.5	3.5	3	3	3.5	3.5	3.5	3.5	3.5	3.5	3.5
A148															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B734															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B733															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B735															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
E190															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
GL5T															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
GLEX															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
GLF5															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B712															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
F100															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
F70															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
B463															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
RJ1H															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
RJ85															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
E170															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
CRJ7															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
CRJ9															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5
GLF4															2.5	2.5	2.5	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5

Table 17: RECAT 96 x 96 PWS Minima on Approach - Zoom of (former) MEDIUM-LIGHT Pairs

Additionally, a 14 category scheme has been defined which covers > 90% of ICAO aircraft types and has been defined in terms of MTOW, wing span and resistance factor. These categories have been defined based on similarities in aircraft design and on similarities and grouping of the PWS minima.

For all aircraft types the minima are specified by the RECAT 20 category scheme which is a combination of the RECAT-EU 6 category scheme and the RECAT 14 category scheme. For all aircraft types that have MTOW, wing span and resistance factor that fall into the one of the 14 categories then the minima are specified by the 14 category scheme. For all of the remaining aircraft types, the minima are specified by the RECAT-EU 6 category scheme.

New aircraft types can be assigned to one of the 20 categories, to one of the 14 categories and / or on a pairwise basis.

Table 18 is the 20-CAT Table extracted from [40].

	A1	A	B1	B2	B	C1	C2	C3	C4	C	D1	D	E1	E2	E3	E	F1	F2	F3	F
A	3.0	3.0	4.0	4.0	4.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0	6.0	8.0	8.0	8.0	8.0
A1	2.0	3.0	3.5	3.5	3.5	3.5	4.0	4.5	4.5	4.5	4.5	5.0	6.0	6.0	6.0	6.0	6.5	6.5	8.0	8.0
B	2.0	2.5	3.0	3.0	3.0	3.5	4.0	4.0	4.0	4.0	4.0	4.0	5.0	5.0	5.0	5.0	6.5	6.5	7.0	7.0
B1	2.0	2.5	2.5	3.0	3.0	3.0	3.5	3.5	3.5	4.0	4.0	4.0	4.5	5.0	5.0	5.0	6.0	6.0	7.0	7.0
B2	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.5	3.5	3.5	3.5	4.0	4.5	5.0	5.0	5.0	5.5	6.5	7.0	7.0
C	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.0	3.0	3.0	3.0	3.0	4.0	4.0	4.0	4.0	5.5	6.0	6.0	6.0
C1	2.0	2.0	2.0	2.0	2.0	2.0	2.5	3.0	3.0	3.0	3.0	3.0	3.5	4.0	4.0	4.0	4.5	5.0	6.0	6.0
C3	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	3.0	3.5	4.0	4.0	4.0	4.5	5.0	6.0	6.0
C2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	2.5	2.5	3.0	3.5	3.5	4.0	4.0	4.0	4.5	6.0	6.0
C4	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.5	2.5	3.0	3.5	3.5	3.0	4.0	6.0	6.0
D																	3.0	4.0	5.0	5.0
D1																	3.0	3.5	5.0	5.0
E																	3.0	3.5	4.0	4.0
E1																			4.0	4.0
E2																			4.0	4.0
E3																			4.0	4.0
F																			3.0	3.0
F1																			3.0	3.0
F2																			3.0	3.0
F3																				

Table 18: RECAT 20-CATegories Separation Minima for all 9000+ Aircraft Types

Application of the RECAT-PWS-EU wake scheme in an operational environment will require a Separation Delivery tool as Controllers will be unable to memorise the required separation. However, there is also the option of using the knowledge developed through the separation design of an S-PWS wake scheme to develop modified wake category schemes that are optimised for the local aircraft type traffic mix at an airport. Such a customised scheme may or may not need a Separation Delivery tool to support the Controllers depending on the number of categories and the complexity of the combinations of separations to be applied.

If a Separation Delivery tool is required, then the distance based separations defined in the S-PWS wake turbulence scheme will be used as input as a separation constraint to be considered.

RECAT-PWS-EU TB Scheme for Arrivals (TB-PWS-A) (AO-0306 with AO-0303)

The RECAT-PWS-EU DB wake separation scheme can be applied in combination with the TBS concept. Such a combined concept would be Time Based S-PWS or TB-PWS-A. The time separations are derived using the methods listed in SESAR 1 research [41].

Weather Dependent Scheme for Arrivals (WDS-A) (AO-0310)

The Weather Dependant Separations for arrivals (WDS-A) is the conditional reduction or suspension of wake separation minima on final approach, applicable under pre-defined wind conditions so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on final approach, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft.

Weather Dependant Separations for arrivals (DB-WDS-A) consists in defining acceptable distance or time separation reductions in favourable wind conditions (total and/or cross component). Two concepts are envisaged: a concept based on total wind effect (A-WDS-Tw) on wake vortex decay allowing for reduced separations in strong total wind conditions, and a concept based on crosswind effect (A-WDS-Xw) on vortex lateral transport allowing for reduced separations in strong crosswind conditions.

The distance separation reductions are to be applied directly to the runway landing threshold with the support of Optimised Runway Delivery on Final Approach (AO-0328)

The time separation reductions are to be applied in conjunction with TBS on final approach (AO-0303) and the support of Optimised Runway Delivery on Final Approach (AO-0328).

The time separation reduction for the crosswind concept has been defined and is detailed below. The time separation reduction for the total wind concept has not yet been defined.

The distance separation reductions for the crosswind concept and the total wind concept have not been defined as they are not considered interesting in terms of benefits because by providing wind information (which is a requisite to apply WDS-A) to the separation delivery tool it is more efficient to use time-based separations rather than distance-based separations.

Weather Dependent TB Scheme for Arrivals (TB-WDS-A) (AO-0310 with AO-0303)

Weather Dependent Crosswind-Based TB Scheme for Arrivals (A-TB-WDS-Xw)

Based on the work initiated in the framework of SESAR P6.8.1 and continued in S2020 Solution PJ02.01, the WDS-Xw time-based minima have been established. They rely on the analysis of a LiDAR database providing lateral transport of wake vortex for various aircraft types evolving in various crosswind conditions.

The first step in the WDS-Xw concept definition consists in the definition of the crosswind measurement. The crosswind measurement that are available in the database are the crosswind component of the anemometer data measured at 10m height and the in-plane wind (IPW) provided by the LiDAR as the averaged crosswind component measured in the LiDAR scanning plane of measurement just before and just after the wake measurement. As it provides a better estimate of the wind as experienced by the vortices (because measured at several altitudes), the IPW is here used in the analysis. Indeed, the wind vertical evolution might vary from one airport to another. Hence, providing results relying only on 10m measurements might be more difficult to generalize to other places.

For WDS separation design, we here consider that the upwind vortex must have travelled a distance such that it is located at one half vortex spacing from the follower' closest wing tip. In order to establish WDS-Xw time-based minima, the time required for 99% of the vortices to travel the considered distances are determined as a function of the measured IPW and for each aircraft pair category. Note that for all ICAO Medium and Lights (RECAT-EU D, E and F categories), A321 results are conservatively used as sole data available in the LiDAR dataset. Example of results for a IPW threshold of 9 knots are provided in Table 19 for wind for each RECAT-EU category pair.

9 kts	Cat-A	Cat-B	Cat-C	Cat-D	Cat-E	Cat-F
Cat-A	77	74	74	71	69	66
Cat-B	77	73	68	63	63	58
Cat-C	65	59	55	51	51	48
Cat-D	58	53	50	46	46	39
Cat-E	57	53	49	46	39	34
Cat-F	50	49	46	34	33	33

Table 19: Minimum A-TB-WDS-Xw time separation [s] for an IPW of 9 knots depending on the leader and follower RECAT-EU category

More details on the A-WDS-Xw concept are provided in Appendix B.

The A-TB-WDS-Xw minima defined above depend on the aircraft pair and crosswind conditions along the straight-in approach path to the runway landing threshold. The application hence requires an accurate forecast of the crosswind. The information on the separation allowed for a specific aircraft pair, provided to the ATCO typically 10 minutes before the leader aircraft has landed, is based on the wind information available at that time. However, when the leader aircraft reaches the separation delivery point, the wind might have dropped or changed in orientation, and the A-TB-WDS-Xw reduction might no longer be allowed. Tactical and strategic models have hence to be developed to cope with those uncertainties on the wind.

The operational definition of the activation threshold conditions should be the result of an optimisation maximising the reduction in the wake separation of the WDS-Xw application while limiting as much as possible the “failure rate” after WDS-Xw deactivation. Indeed, at the moment of WDS-Xw deactivation, some pairs were already spaced following the WDS-Xw reduced wake separation and a crosswind above the threshold might hence no longer be observed at the threshold for those pairs. A failure rate is hence defined as the number of occurrences of wind conditions below the WDS-Xw crosswind criteria in the next few minutes after deactivation.

As an example, we here provide a methodology to define the WDS-Xw activation and deactivation criteria that minimized the failure rate after WDS-Xw deactivation while maximizing the use of reduced WDS-Xw wake separation (and hence maximizing capacity benefits). WDS-Xw will be activated following three criteria, all required at the same time:

- The in-plane wind IPW is above or equal to IPWact,
- The minimum crosswind Xw is above or equal to XWact
- The 2 above criteria have been observed for the past Tact minutes

WDS-Xw will be deactivated if at least one of the following criteria is met:

- The in-plane wind IPW is below IPWdeact
- The minimum crosswind Xw is below XWdeact
- The forecast IPW in the next Tforecast minutes is below IPWthr
- The forecast XW in the next Tforecast minutes is below IPWthr

Where:

- IPWthr is the crosswind threshold value as defined in the A-TB-WDS-Xw matrix
- IPWact≥ IPWthr
- XWact≥ IPWthr
- IPWact≥IPWdeact≥ IPWthr

The IPW and Xw forecasts are based on a linear extrapolation of the two last measurements to the considered time forecast horizon. The use of such forecasts should allow for prediction of fast wind drops.

The deactivation criteria depend on the safety conditions required for A-TB-WDS-Xw operation. They hence correspond to the values obtained in the A-TB-WDS-Xw definition and safety assessment. The wind criteria used for A-TB-WDS-Xw activation should be above or equal to the deactivation criteria. For the activation of A-TB-WDS-Xw, a margin compared to the deactivation threshold should indeed be considered in order for the system to remain on for a certain range of time. All those criteria have to be designed locally and using a maximum “acceptable” failure rate to be determined also on a local basis.

3.2.4.2 Departures Concepts Solutions

3.2.4.2.1 Reference Scenario WTC Schemes for the Departures Concepts Solutions

For departures the WT separations are defined in both distance and time to be applied at take-off. Most aerodromes in Europe apply the time-based separation minima.

The departure WT separations apply as soon as the follower aircraft becomes airborne (back wheels lift off the ground).

Such WT separation schemes (including ICAO, RECAT-EU 6 category and UK 5 category) are based on Wake Turbulence Categories (WTC) and are applied independent of the wind conditions.

ICAO DB and TB Schemes for Departures

The ICAO radar separation standards for arrivals include MRS which prevents aircraft collision and WT separation which is intended to protect aircraft from adverse WTEs. Historically WT separations have been based on aircraft grouped into categories based on their MTOW and have a resolution of 1 minute (60s) for time separation application and 1 NM for distance separation application. This has been needed in the past to ensure Controllers can memorise the wake separations and apply them without tool support. Additional separation has been prescribed whenever a less heavy category is following behind an aircraft from a heavier category. This implies that when the traffic at a certain airport contains aircraft from mainly one of the categories, a low penalising effect of WT separations will appear. On the other hand, whenever the aircraft categories are mixed, there will be efficiency and capacity losses due to the extra separation that has to be applied.

ICAO Doc 4444 [43] defines the following WT separation categorisation and separation minima for application on the approach and departure phase of flight. ICAO WT separation minima are based on a grouping of aircraft types into three categories according to the maximum certificated take-off mass as follows:

- **HEAVY (“H”)**: all aircraft types of 136,000 kg or more;

- **MEDIUM (“M”)**: aircraft types less than 136,000 kg but more than 7,000 kg;
- **LIGHT (“L”)**: aircraft types of 7,000 kg or less.

Typical aircraft types in the Heavy WT category are: B747 family, B767 family, B777 family, A330/A340 family, A300/A310 family, MD11.

Typical aircraft types in the Medium WT category are: B757 family, B737 family, A320 family, CRJs family (CRJ100/200/700/900/1000), E-Jets family (E135/140/145/170/175/190/195) and ATRs.

A list of more than 9000 aircraft types is categorized on that basis in ICAO Doc 8643.

The Airbus A380-800 (A388), with a MTOW in the order of 560,000 kg, is the largest passenger aircraft ever entered into revenue service. The aircraft is in the Heavy WTC, which has no upper limit defined. However, for the A380-800, an ICAO State guidance released in 2008 recommends an increase in relation to the WT separation minima published in the PANS-ATM.

Currently the ICAO scheme for time-based wake turbulence longitudinal separation minima applies for departure at the majority of European airports. Some apply the ICAO scheme for distance-based longitudinal separation minima. Additional separation has then been prescribed behind Heavy category lead aircraft and for Light category follower behind Medium category leader.

The ICAO time separation and distance separation rules applied on departure are presented in Table 20 below.

Departures Distance Based and Time Based Wake Turbulence Separation Minima		**Follower Aircraft ICAO Wake Category or Aircraft Type**			
		A388	**Heavy**	**Medium**	**Light**
Lead Aircraft ICAO Wake Category or Aircraft Type	**A388**	(*)	6 NM 120 s (1)	7 NM 180 s (2)	8 NM 180 s (2)
	Heavy	(*)	4 NM (*)	5 NM 120 s (1)	6NM 120 s (1)
	Medium	(*)	(*)	(*)	5 NM 120 s (1)
	Light	(*)	(*)	(*)	(*)

Table 20: ICAO Wake Category Based Separations for Departures

(*) When a wake turbulence restriction is not required, then separation reverts to radar separation minimum set for collision risk mitigation. Either reduced separation in the vicinity of the aerodrome (RSVA) is applied or the 3 NM MRS is applied as prescribed by the appropriate ATS authority.

(1): 3 minutes if taking off from an intermediate position

(2): 4 minutes if taking off from an intermediate position

WT separation minima are to be applied in the following scenarios on approach:

- an aircraft is operating directly behind another aircraft at the same altitude or less than 300m (1,000ft) below, or;
- both aircraft are using the same runway, or parallel runways separated by less than 760m (2,500ft); or;
- an aircraft is crossing behind another aircraft, at the same altitude or less than 300m (1,000ft) below.

RECAT-EU DB and TB Schemes for Departures

The RECAT-EU 6 category scheme aims to provide a more efficient WT scheme by re-grouping aircraft based upon MTOW and wing span and is the result of an optimization of the ICAO wake turbulence separation classes. See the Arrivals Section 3.2.4.1.1 for more details.

For departures the RECAT-EU WT separations are defined in both time and distance to be applied on departure from when the follower aircraft becomes airborne as per Table 21.

Departures Distance Based and Time Based Wake Turbulence Separation Minima		Follower Aircraft RECAT EU Wake Category					
		"Super Heavy" "A"	"Upper Heavy" "B"	"Lower Heavy" "C"	"Upper Medium" "D"	"Lower Medium" "E"	"Light" "F"
Lead Aircraft RECAT EU Wake Category	"Super Heavy" "A"	3 NM (**)	4 NM 100 s (1)	5 NM 120 s (1)	5 NM 140 s (1)	6 NM 160 s (1)	8 NM 180 s (1)
	"Upper Heavy" "B"		3 NM (**)	4 NM (**)	4 NM 100 s (1)	5 NM 120 s (1)	7 NM 140 s (1)
	"Lower Heavy" "C"		(*) (**)	3 NM (**)	3 NM 80 s (1)	4 NM 100 s (1)	6 NM 120 s (1)
	"Upper Medium" "D"						5 NM 120 s (1)
	"Lower Medium" "E"						4 NM 100 s (1)
	"Light" "F"						3 NM 80 s (1)

Table 21: RECAT-EU 6 Category Wake Category Based Separations for Departures

(*): Minimum radar separation (MRS), set at 3 NM, is applicable as per the current ICAO Doc 4444 [43] provisions.

(**): Lower bound of 60s used in WT risk assessment

(1): Add 1 minute if taking off from an intermediate position

For aircraft category pairs with no defined WT separation then either reduced separation in the vicinity of the aerodrome (RSVA) is applied or the 3 NM MRS is applied.

For the deployment it remains optional to locally deploy only part of the RECAT-EU scheme, or apply larger separation minima than proposed ones, or opt for a progressive application.

When applying time-based separation minima, the time separation criteria are applied by measuring successive airborne times (the time the back wheels lift from the ground after rotation). To deliver the airborne time separation criteria, local procedural approaches are employed. These local procedural approaches include determining the take-off clearance time for the follower aircraft from the recorded “start of take-off roll time” of the lead aircraft, or determining the take-off clearance time of the follower aircraft from the recorded “airborne time” of the lead aircraft.

To achieve the time-based separation minima in practice, when applying the recorded “start of take-off roll time” of the lead aircraft, take-off clearance may be issued to the follower aircraft once the required time separation has elapsed after the lead aircraft recorded “start of take-off roll time”. The recorded “start of take-off roll-time” is the time the aircraft is recorded as commenced rolling beyond the line-up and wait position.

To achieve the time-based separation minima in practice, when applying airborne times, take-off clearance may be issued to the follower aircraft, with an allowance for the anticipated follower aircraft take-off roll time on the runway, once the required time separation minus the anticipated follower aircraft take-off roll time has elapsed, after the lead aircraft recorded “airborne time”.

When applying distance-based separation minima, once airborne, departure aircraft are subject to the wake turbulence radar separations, therefore the Tower Runway Controller may apply a distance based clearance such that the required distance-based wake turbulence radar separation is set up when the follower aircraft becomes airborne. A distance based clearance can be issued as long as the Tower is equipped with radar surveillance.

On handover of separation responsibilities to the TMA Departure Radar Controller there is a need to have achieved the associated radar separation minima employed in the TMA, where the minimum radar separation is 3 NM horizontal or 1,000ft vertical, and where distance-based wake separation minima apply.

3.2.4.2.2 Solution Scenario WT Separation Schemes for the Departures Concepts Solutions

The Solution Scenario WT Separation Schemes are RECAT-PWS-EU (PWS-D) Scheme and the Weather Dependent Separation Scheme (WDS-D).

RECAT-PWS-EU DB Scheme for Departures (DB-PWS-D) (AO-0323)

The PWS-D concept is a wake turbulence scheme which is based upon individual aircraft types rather than grouping aircraft into wake categories. In a wake category scheme the separations need to be designed to protect the lightest follower aircraft type in a wake category from the heaviest leader aircraft type in a wake category. This leads to inefficient separations between other aircraft type pairs which do not need the same amount of protection. The PWS-D WT scheme provides more efficient separations as they can be optimised for each aircraft type pair based upon the static characteristics of each aircraft type.

RECAT-PWS-EU has developed a 96 x 96 aircraft type pairwise table and a 20 x 20 wake category table for distance-based separation to be applied for departures (both arrivals and departures). The details of these distance-based separations are provided in the Section 3.2.4.1.2.

It is anticipated that the distance-based 96 x 96 aircraft type pairwise table and the 20 x 20 wake category table will be able to be applied to the departures together with a time-based variant of these tables based on adjusting the RECAT-EU wake separation times for departures.

RECAT-PWS-EU TB Scheme for Departures (TB-PWS-D) (AO-0323)

The S-PWS concept is a wake turbulence scheme which is based upon individual aircraft types rather than grouping aircraft into wake categories. In a wake category scheme the separations need to be designed to protect the lightest follower aircraft type in a wake category from the heaviest leader aircraft type in a wake category. This leads to inefficient separations between other aircraft type pairs which do not need the same amount of protection. The S-PWS WT scheme provides more efficient separations as they can be optimised for each aircraft type pair based upon the static characteristics of each aircraft type.

For the departures, due to not having the profiles to characterise the “time-to-fly” on departure and necessary information on take-off speeds and departure speed profiles, the RECAT / Pair-Wise minima determination for departures consists of the RECAT-EU time-based separation minima for departures in which some of the separation minima for CAT-F1, CAT-F2 and CAT-F3 aircraft times are decreased. The obtained separation table is provided in keeping the 20-category structure but effectively consisting of 7-categories (or 9 different groupings when considering F & F1 & F2 and F3 are separately grouped as the lead aircraft wake category and F1 & F2 and F & F3 are separately grouped as the follower aircraft wake category).

			A380-800	ICAO HEAVY		ICAO MEDIUM			ICAO LIGHT
			RECAT-EU A	RECAT-EU B	RECAT-EU C	RECAT-EU D	RECAT-EU E	RECAT-EU F	
			A1 | A	B1 | B2 | B	C1 | C2 | C3 | C | C4	D1 | D	E1 | E2 | E3 | E	F1 | F2	F | F3
A380-800	RECAT-EU A	A, A1	(*)	100	120	140	160	180	180
ICAO HEAVY	RECAT-EU B	B, B1, B2	(*)	(*)	(*)	100	120	140	140
ICAO HEAVY	RECAT-EU C	C, C1, C2, C3, C4	(*)	(*)	(*)	80	100	120	120
ICAO MEDIUM	RECAT-EU D	D, D1						100	120
ICAO MEDIUM	RECAT-EU E	E, E1, E2, E3							100
ICAO MEDIUM	RECAT-EU F	F, F1, F2							80
ICAO LIGHT	RECAT-EU F	F3							

Table 22: RECAT 7-CAT WT Time-Based Separation Minima on Departure

The RECAT-PWS-EU Safety Case [40] specifies the corresponding RECAT 96 x 96 Time-Based PWS Minima on Departure Based on RECAT-EU which simply applies the 7-CAT Table to the 96 x 96 aircraft type matrix.

Pending on the availability of more comprehensive operational and wake data for departure, future work may revisit the departure separation minima to develop a more optimised / pair-wise solution. An activity has been planned in SESAR 2020 to collect data and undertake more detailed work.

It is anticipated that the distance-based 96 x 96 aircraft type pairwise table and the 20 x 20 wake category table will be able to be applied to the departures together with a time-based variant of these tables based on adjusting the RECAT-EU wake separation times for departures (although the development of the time-based variants of these tables has now been deferred to SESAR 2020 Wave 2).

The full TB-PWS-D concept aims to improve overall runway throughput through using the more efficient WT separations. However it could also be used to improve runway throughput resilience to delay (assuming no change in declared capacity).

With the advent of 20 x 20 and 96 x 96 pairwise matrices, it is believed that a Separation Delivery tool will be required as it is unlikely that controllers will be able to retain the information regarding the required separation. This is the Optimised Separation Delivery tool.

In order to enable assessment of the Human Performance validation objectives of employing the full TB-PWS-D concept a method has been proposed by NATS and agreed by EUROCONTROL for deriving draft 20 x20 and 96 x 96 pairwise matrices for use in the PJ02.01 validation exercises. This method is based on adjusting the time-based RECAT-EU for departures Table 21 when there is a difference of 0.5 NM or more between the distance-based RECAT-EU wake separation and the distance based RECAT-PWS-EU for that aircraft type pair, with adjusting the time-based RECAT-EU for departures wake separation by 10s for each 0.5 NM difference to formulate the time-based RECAT-PWS-EU wake separations for the 96 x 96 aircraft type pairwise matrix and the 20 x 20 wake category matrix. The resulting time-based matrices follow below.

	A388	B77L	B77W	A351	A359	A358	B744	A346	A345	B773	B772	A343	A332	A333	A342	B788
A388		90	90	90	90	90	80	90	90	90	90	90	90	90	90	90
B77L																
B77W																
A351																
A359																
A358																
B744																
A346																
A345																
B773																
B772																
A343																
A332																
A333																
A342																
B788																
MD11																
B764																
B762																
B763																
A306																
A30B																
A310																
B752																
B753																

Table 23: Proposed 96 x 96 TB-PWS-D for CAT-A & B & C – CAT-A & B Aircraft Type Pairs

	MD11	B764	B762	B763	A306	A30B	A310	B752	B753
A388	90	100	100	100	110	110	110	110	110
B77L									
B77W									
A351									
A359									
A358									
B744									
A346									
A345									
B773									
B772									
A343									
A332									
A333									
A342									
B788									
MD11									
B764									
B762									
B763									
A306									
A30B									
A310									
B752									
B753									

Table 24: Proposed 96 x 96 TB-PWS-D for CAT-A & B & C – CAT-C Aircraft Type Pairs

	B739	B738	B737	B736	A321	A320	A318	A319	MD83	MD82
A388	130	130	130	130	130	130	130	130	130	130
B77L	100	100	100	100	100	100	100	100	100	100
B77W	100	100	100	100	100	100	100	100	100	100
A351	100	100	100	100	100	100	100	100	100	100
A359	100	100	100	100	100	100	100	100	100	100
A358	100	100	100	100	100	100	100	100	100	100
B744	100	100	100	100	100	100	100	100	100	100
A346	100	100	100	100	100	100	100	100	100	100
A345	100	100	100	100	100	100	100	100	100	100
B773	90	90	90	90	90	90	90	90	90	90
B772	90	90	90	90	90	90	90	90	90	90
A343	90	90	90	90	90	90	90	90	90	90
A332	90	90	90	90	90	90	90	90	90	90
A333	90	90	90	90	90	90	90	90	90	90
A342	90	90	90	90	90	90	90	90	90	90
B788	90	90	90	90	90	90	90	90	90	90
MD11	80	80	80	80	80	80	80	80	80	80
B764	70	70	70	70	70	70	70	70	70	70
B762	70	70	70	70	70	70	70	70	70	70
B763	70	70	70	70	70	70	70	70	70	70
A306	70	70	70	70	70	70	70	70	70	70
A30B	70	70	70	70	70	70	70	70	70	70
A310	70	70	70	70	70	70	70	70	70	70
B752	60	60	60	60	60	60	60	60	60	60
B753	60	60	60	60	60	60	60	60	60	60

Table 25: Proposed 96 x 96 TB-PWS-D for CAT-A & B & C – CAT-D Aircraft Type Pairs

	A148	B734	B733	B735	E190	GL5T	GLEX	GLF5	B712
A388	150	130	140	140	140	150	140	140	150
B77L	110	100	100	100	100	110	110	100	110
B77W	110	100	100	100	100	110	110	100	110
A351	110	100	100	100	100	110	110	100	110
A359	110	100	100	100	100	110	110	100	110
A358	110	100	100	100	100	110	110	100	110
B744	110	100	100	100	100	110	110	100	110
A346	110	100	100	100	100	110	110	100	110
A345	110	100	100	100	100	110	110	100	110
B773	110	100	100	100	100	110	100	100	100
B772	110	100	100	100	100	110	100	100	100
A343	110	100	100	100	100	110	100	100	100
A332	110	100	100	100	100	110	100	100	100
A333	110	100	100	100	100	110	100	100	100
A342	110	100	100	100	100	110	100	100	100
B788	110	100	100	100	100	110	100	100	100
MD11	90	80	80	80	80	90	90	80	90
B764	80	70	80	80	80	80	80	80	80
B762	80	70	80	80	80	80	80	80	80
B763	80	70	80	80	80	80	80	80	80
A306	90	80	80	80	80	80	80	80	80
A30B	90	80	80	80	80	80	80	80	80
A310	90	80	80	80	80	80	80	80	80
B752	70	60	60	60	60	70	60	60	60
B753	70	60	60	60	60	70	60	60	60

Table 26: Proposed 96 x 96 TB-PWS-D for CAT-A & B & C – CAT-E (Part I) Aircraft Type Pairs

	F100	F70	B463	RJ1H	RJ85	E170	CRJ7	CRJ9	GLF4
A388	150	150	160	160	160	150	160	160	150
B77L	110	110	110	110	110	110	110	110	110
B77W	110	110	110	110	110	110	110	110	110
A351	110	110	110	110	110	110	110	110	110
A359	110	110	110	110	110	110	110	110	110
A358	110	110	110	110	110	110	110	110	110
B744	110	110	110	110	110	110	110	110	110
A346	110	110	110	110	110	110	110	110	110
A345	110	110	110	110	110	110	110	110	110
B773	100	100	110	110	110	110	110	110	100
B772	100	100	110	110	110	110	110	110	100
A343	100	100	110	110	110	110	110	110	100
A332	100	100	110	110	110	110	110	110	100
A333	100	100	110	110	110	110	110	110	100
A342	100	100	110	110	110	110	110	110	100
B788	100	100	110	110	110	110	110	110	100
MD11	90	90	90	90	90	90	90	90	90
B764	80	80	80	80	80	80	90	90	80
B762	80	80	80	80	80	80	90	90	80
B763	80	80	80	80	80	80	90	90	80
A306	80	80	90	90	90	90	90	90	80
A30B	80	80	90	90	90	90	90	90	80
A310	80	80	90	90	90	90	90	90	80
B752	60	60	70	70	70	70	70	70	70
B753	60	60	70	70	70	70	70	70	70

Table 27: Proposed 96 x 96 TB-PWS-D for CAT-A & B & C – CAT-E (Part II) Aircraft Type Pairs

	F27	F50	DH8D	AT75	AT72	FA7X	AT43	AT45	CRJ2
A388	160	160	160	160	160	150	160	160	160
B77L	110	120	120	120	120	120	120	120	120
B77W	110	120	120	120	120	120	120	120	120
A351	110	120	120	120	120	120	120	120	120
A359	110	120	120	120	120	120	120	120	120
A358	110	120	120	120	120	120	120	120	120
B744	110	120	120	120	120	120	120	120	120
A346	110	120	120	120	120	120	120	120	120
A345	110	120	120	120	120	120	120	120	120
B773	110	120	120	120	120	110	120	120	120
B772	110	120	120	120	120	110	120	120	120
A343	110	120	120	120	120	110	120	120	120
A332	110	120	120	120	120	110	120	120	120
A333	110	120	120	120	120	110	120	120	120
A342	110	120	120	120	120	110	120	120	120
B788	110	120	120	120	120	110	120	120	120
MD11	90	100	100	100	100	90	100	100	100
B764	80	90	90	90	90	90	90	90	90
B762	80	90	90	90	90	90	90	90	90
B763	80	90	90	90	90	90	90	90	90
A306	90	90	90	90	90	90	100	100	100
A30B	90	90	90	90	90	90	100	100	100
A310	90	90	90	90	90	90	100	100	100
B752	70	70	70	70	70	70	70	80	80
B753	70	70	70	70	70	70	70	80	80

Table 28: Proposed 96 x 96 TB-PWS-D for CAT-A & B & C – CAT-E (Part III) Aircraft Type Pairs

	J328	E145	E135	CL30	F2TH	F900	FA50	CL60	GALX
A388	160	160	160	160	160	160	160	160	160
B77L	120	120	120	120	120	120	120	120	120
B77W	120	120	120	120	120	120	120	120	120
A351	120	120	120	120	120	120	120	120	120
A359	120	120	120	120	120	120	120	120	120
A358	120	120	120	120	120	120	120	120	120
B744	120	120	120	120	120	120	120	120	120
A346	120	120	120	120	120	120	120	120	120
A345	120	120	120	120	120	120	120	120	120
B773	120	120	120	120	120	120	120	120	120
B772	120	120	120	120	120	120	120	120	120
A343	120	120	120	120	120	120	120	120	120
A332	120	120	120	120	120	120	120	120	120
A333	120	120	120	120	120	120	120	120	120
A342	120	120	120	120	120	120	120	120	120
B788	120	120	120	120	120	120	120	120	120
MD11	100	100	100	100	100	100	100	100	100
B764	100	90	90	100	100	100	100	100	100
B762	100	90	90	100	100	100	100	100	100
B763	100	90	90	100	100	100	100	100	100
A306	100	100	100	100	100	100	100	100	100
A30B	100	100	100	100	100	100	100	100	100
A310	100	100	100	100	100	100	100	100	100
B752	80	80	80	80	80	80	80	80	90
B753	80	80	80	80	80	80	80	80	90

Table 29: Proposed 96 x 96 TB-PWS-D for CAT-A & B & C – CAT-E (Part IV) Aircraft Type Pairs

There are also further Tables for CAT-A & B & C – CAT-F, CAT-D – CAT-F, CAT-E – CAT-F and CAT-F – CAT-F Aircraft Type Pairs when CAT-F pairs are applicable in a PJ02.01 validation exercise (which is not the case for London Heathrow in PJ02.01 RTS5).

	A1	A	B1	B2	B	C1	C2	C3	C4	C	D1	D	E1	E2	E3	E	F1	F2	F3	F
A			100	100	100	120	120	120	120	120	140	140	160	160	160	160	180	180	180	180
A1			90	90	90	90	100	110	110	110	130	140	160	160	160	160	150	150	180	180
B											100	100	120	120	120	120	130	130	140	140
B1											100	100	110	120	120	120	120	120	140	140
B2											90	100	110	120	120	120	110	130	140	140
C											80	80	100	100	100	100	110	120	120	120
C1											80	80	90	100	100	100	90	100	120	120
C3											70	80	90	100	100	100	90	100	120	120
C2											70	80	90	90	100	100	80	90	120	120
C4											60	70	70	80	90	90	60	80	120	120
D																	80	100	120	120
D1																	80	90	120	120
E																	80	90	100	100
E1																			100	100
E2																			100	100
E3																			100	100
F																			80	80
F1																			80	80
F2																			80	80
F3																				

Table 30: Proposed 20 x 20 TB-PWS-D for 20-CAT Wake Category Pairs

Weather Dependent TB Schemes for Departures (TB-WDS-D) (AO-0304)

WDS-D is the conditional reduction or suspension of wake separation minima for departure operations, applicable under pre-defined wind conditions, so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on the initial departure path, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft. Two pre-defined wind conditions are under consideration, a 10 knots wind speed in any direction (Total Wind concept) and a 6 knots to 10 knots crosswind to the initial departure track (Crosswind concept). Note that for the Crosswind concept, from the CREDOS Project results, a 6 knots to 10 knots crosswind facilitates a conditional reduction to 90s due to the time required for transport of the wake vortices out of the path of the follower aircraft.

With respect to the Crosswind concept the reduced wake separation may be dependent on the strength of the crosswind with pre-define criteria, for example with pre-defined crosswind criteria for a reduction to 90s, for a reduction to 80s, for a reduction to 70s, and for a reduction to 60s.

A third WDS-D concept is also under consideration, this is the wake avoidance of the wake generated by the lead aircraft through the follower aircraft employing an earlier differentiated rotation position and a steeper climb profile than the lead aircraft. This naturally occurs between A380 and Heavy wake category lead aircraft and Medium and Light wake category follower aircraft. This may be limited by headwind criteria due to the wind transport risks. This may need to be combined with the Crosswind concept to ensure the wake is transported out of the path of the follower aircraft at low level in case the follower aircraft has a late rotation position or shallower climb profile as a result of being under-powered due to engine problems. However initial analysis of recorded operational data has indicated that the current operations differentiated rotation positions and climb profiles are not sufficiently consistent to ensure wake avoidance.

The WDS-D concepts rely on wind forecasting and monitoring at the runway surface and along the initial departure path. The reliability, accuracy and stability of the wind forecasting solutions available to a local implementation determine if a wind threshold, and / or an additional wind buffer, and / or an additional time separation safety buffer is / are required.

There is requirement to take into account terrain features and obstacles that may impact the wind field when developing and validating the WDS-D concepts. The local topography such as hanger buildings, terminal buildings and high ground in the vicinity of the aerodrome may impact both surface winds and winds aloft.

Aircraft ATM capabilities such as the initial airborne position on the runway, climb profile performance during climb-out, lateral navigational performance during climb-out, and airspeed performance during climb-out, all need to be taken into consideration in the development and validation of the WDS-S concepts solutions.

The wake separation minima on the initial departure path are to be defined as both distance-based minima and time-based minima, so as to be able to be applied as either distance-based minima or time-based minima.

On handover of separation responsibilities to the TMA Departure Radar Controller there is a need to have achieved the associated radar separation minima employed in the TMA, where the minimum radar separation is 3 NM horizontal and 1,000ft vertical, and where distance-based wake separation minima apply.

3.2.4.3 Wake Risk Monitoring Concept Solution

ICAO note AN 13/4-07/67 on “Collection of information on wake vortex encounters” of 26 Oct. 2007 [54] recommends that information related to wake turbulence encounters is collected systematically to provide a basis of data for any amendments to current wake turbulence separation rules.

Concerning ADS-B Out information the applicable standard is DO-260B “Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)” of 02 Dec. 2009 [55]. This standard is currently mandated to be introduced in all mainline aircraft in Europe and the US until 2020.

3.2.4.4 Wake Decay Enhancing Concept Solution

The plates have to comply with the frangibility requirements of ICAO Annex 14 and the Aerodrome Design Manual, Part 6: Frangibility. Comprehensive documentation of the beneficial effects of the plate lines shall be elaborated to form the basis for the preparation of regulations to be endorsed by competent authorities.

3.3 Detailed Operating Method

3.3.1 Previous Operating Method

3.3.1.1 Arrivals Concepts Solutions

The operating method covers from the arrival aircraft crossing the Initial Approach Fix (IAF) until the aircraft vacates the runway.

The Air Traffic Control (ATC) procedures for an aircraft approaching an aerodrome will be specific to each airport. This section summarises the standard procedures used to transition an arriving aircraft through the TMA and approach to landing and vacating the runway.

3.3.1.1.1 Transition from TMA to Approach

Aircraft approaching one or more aerodrome(s) from surrounding sectors typically follow a number of Standard Arrival Routes (STARs) – each aircraft follows one STAR - providing the transition from the En-route structure, and are progressively merged into a single flow for each active landing runway.

The separation of arrivals and departures is facilitated by strategic segregation of flows through airspace structures. The separation of arrivals from other arrivals is often closely related to the building and maintenance of the sequence. These tasks are performed through the use of open loop vectoring, issuing a large number of headings, speeds and level instructions.

Holding patterns may be used for arrivals, subject to local practices, either when the TMA capacity is exceeded at peak times, or more systematically to maintain the pressure at the runway.

RNAV Procedures have been defined to replace open-loop vectors. In such procedures ideally the principle is to keep aircraft on their routes; the procedures are designed so that the trajectory can be stretched or shortened through pre-defined/fixed route modifications if this is needed for the merging of arrival flows; these procedures are generally fully applied only under low to medium traffic loads.

An “efficient landing sequence” refers both to an optimised sequence order (e.g. according to wake turbulence constraints), and to the achievement of appropriate spacing between flights, both aspects contributing to maintain the throughput as close as possible to the available runway capacity. This involves:

- Planning the sequence (i.e. allocate landing runway if needed, and define sequence order);
- Building the sequence (including order and appropriate spacing);
- Maintaining the sequence (including optimisation of inter-aircraft spacing).

The Controller is the authority for assuring safe operations in the TMA / Approach and issues information and instructions to aircraft under control in order to assist pilots to navigate safely and timely in the TMA / Approach.

Voice communication is the primary Air / Ground communication in the TMA / Approach.

The Ground / Ground connection is ensured through an overall network approach using common protocols such as Aeronautical Fixed Telecommunication Network (AFTN). It covers exchanges of surveillance, trajectory data and other flight planning information.

Navigation services using conventional terrestrial navigation aids (such as VOR/DME/NDB and ILS for the final approach phase) are the primary form of ground based navigation aid, however there is an increased usage of developing technologies such as GPS and GNSS. A large range of airborne navigation capability exists, usually based on multi-sensor navigation systems.

Surveillance Coverage is provided by the use of SSR (Secondary Surveillance Radar) in combination with PSR (Primary Surveillance Radar).

3.3.1.1.2 Separation Standards

Radar separation standards for arrivals include MRS which prevents aircraft collision and WT separation which is intended to protect aircraft from adverse WTEs. In current day operations WT separations are defined between categories of aircraft which are grouped based on their MTOW. Examples of WT category schemes include ICAO, RECAT-EU 6 category and UK 6 category. When no WT separation is applicable then MRS is applied. This is typically 3 NM although can be 2.5 NM under certain conditions. Radar separations in current operations are defined in distance for arrival aircraft.

If Tower ATC can apply visual separation procedures from the VCR, the separation mode changes, and reduced separation in the vicinity of the aerodrome (RSVA) may be applied for pairs where no WT separation is applicable.

If the Flight Crew perform a visual approach, the separation mode changes, and the responsibility lies with the Flight Crew to determine the spacing.

Radar separation is applied by observing the headings, distances, and speeds, between consecutive aircraft. The Final Approach Controller knows the locally applied wake turbulence radar separation table (i.e. ICAO). From the respective aircraft wake turbulence categories from the flight strips, or from the target labels, the Controller establishes the wake turbulence radar separation required between the respective aircraft.

The separation distance limits are determined by the Controller by the use of scales on the radar map and through the observation of catch-up from the separation distance progression observed between the follower aircraft and the lead aircraft. In case of possible infringement, the Controller will first use speed instructions, and then use vectoring, or order a go-around. Inside of 4 NM from the runway threshold no speed instructions are advised.

3.3.1.1.3 Runway Layout Configuration

Runway direction is chosen, based on many criteria, but the main one is the wind direction. Headwind conditions at the runway surface are the preferred wind for arrivals and departures, compared to crosswind conditions or tailwind conditions.

3.3.1.1.4 Runway Modes of Operation

In a large airport, you can distinguish between two main runway operations. One is the segregated mode, where one duty runway-in-use is used for arrivals, and another duty runway-in-use is used for the departures. The other configuration is mixed mode, where the arrival and departure streams are interlaced on to a duty runway-in-use.

If operating in mixed mode, the penalty of having to apply distance based separation is less, since Controllers are typically able to reduce the 'Gap' size required to depart one aircraft between two arrivals, as the headwind increases, without becoming constrained by the wake turbulence separation minimum.

The two modes can also be combined, so that a few arrivals will land on the departure runway, or vice versa.

3.3.1.1.5 Arrival Management

In current operations, an Arrival Manager (AMAN) is often used for the TMA approach sector. The AMAN organises the arriving traffic, so that it can be merged and sequenced to one or more runways, as efficiently as possible. The AMAN can integrate wake turbulence categories (and distance needed) for each aircraft pair, and allocate them accordingly into the sequence. Aircraft speeds are taken into account, as well as wind speeds.

The arrival Controllers will, as far as is feasible, accommodate the AMAN proposed sequence order. Normally, the sequence order in AMAN is not updated after aircraft have passed the IAF. This means that the sequence order intent can be changed by the Approach Controllers without any update input into the associated system support. Through procedural coordination the Approach Controllers know the changed sequence order, which can also be deduced by looking at the relative display positions of the aircraft lined up on intermediate and final approach. As a consequence, there is currently no need for the Approach Controllers to update the associated system support.

For the Tower Runway Controller, the same logic applies, since there will in most cases be a slave radar display in the Tower. For other actors, it is not as clear what the real sequence actually is, or will be.

Different airports have developed different solutions, in order to provide the airport with correct landing estimates, and the correct landing runway for each aircraft.

When aircraft approach final approach, the Final Approach Controller will separate, sequence and merge all arrivals to a specific runway. This task is very precise, and requires skills in determining the correct headings and speeds to be applied, in order to be both efficient and remain safely separated.

3.3.1.1.6 Planning

In current operations at an airport, one important aspect of the short term planning, and reiterative planning done during the execution phase, is to select the most appropriate runway combination and configuration. This takes into account many criteria, such as weather forecast, infrastructure status, traffic demand and traffic mix.

For arrivals, the planning horizon is at least 20-30 minutes, in order to smoothly change the runway for landing, when in high traffic demand. Even so, a runway change will often lead to disruptions and delays.

3.3.1.1.7 Runway Arrival Control

In current operations, the Tower Runway Controller is responsible for providing landing clearance to arriving aircraft. In order to do this, the arrival traffic is transferred to the Tower Runway Controller a few nautical miles from the threshold, and the Tower Runway Controller monitors that the runway occupancy of preceding aircraft is progressing as expected. The Tower Runway Controller monitors the speed and position of the next approaching arrival, in order to determine when to give a landing clearance, or to order a go-around, if the previous aircraft runway occupancy exceeds the applied separation. Both visual out of the window, and surveillance equipment, is used.

If in mixed mode, the Tower Runway Controller also has to deliver line-up and take-off clearances to departing aircraft, and time this so that the gap between the two associated arrivals can be used.

The accuracy of planning and execution of runway and surface movements is constrained by the degree of uncertainty of aircraft behaviour in the landing, roll-out and taxi phases. Tower Runway Controllers apply additional margins to take account of aircraft behaviour during these phases, in terms of predictability of performance. Margins to absorb the uncertainty over the AROT are factored into the final approach spacing applied.

Observations at congested airports indicate that depending on runway and taxiway layout and airline operating procedures, an excess of time can be spent on the runway by individual aircraft as the current aircraft auto-brake systems apply predetermined braking to the aircraft. If braking is left to the auto-brake system, the aircraft will stop on the runway. However, in practise, the Flight Crew disconnect the auto-brake on the roll out and use pedal braking to arrive at the runway exit at the correct speed.

Existing auto-brake systems reduce pilot workload by providing deceleration at a set rate. The auto-brake setting will guarantee that the aircraft stops at or before the pre-selected distance (adjacent to the selected exit).

With a limited number of auto-brake settings available the deceleration is not necessarily customised to the specific runway exit. In theory this can lead to the AROT being extended.

As there are many factors that influence AROT it is not possible to predict an accurate AROT or guarantee the runway exit.

The situation is worsened in low visibility conditions when CAT II/III operations are in force and after landing, the auto-brake decelerates the aircraft according to the predetermined setting until the Flight Crew disconnect the auto-brake system. Flight Crew have to cope with reduced visibility and must locate the runway exit in constrained visibility conditions and this may take considerably longer than would be the case in better visibility conditions (CAT I or better). As a result, this is one reason why reductions in runway capacity are declared during CAT II/III operations which can lead to significant delays.

3.3.1.2 Departures Concepts Solutions

The operating method covers from aircraft awaiting departure at the runway holding point until they have climbed up to the Terminal Manoeuvring Area (TMA).

The ATC procedures for an aircraft departing an aerodrome will be specific to each airport. This section summarises the standard procedures used for departing aircraft.

3.3.1.2.1 Applying Separation Standards

Two methods are widely used by the Tower Runway Controller when applying wake turbulence separation criteria to departing aircraft, one method based on time separation and one method based on distance separation.

Wake turbulence separation minima are the spacing between aircraft, determined by either time or distance, to be applied so that aircraft do not fly through the wake of a preceding aircraft within the area of maximum vortices.

Wake turbulence separation is applied between preceding and following aircraft which are departing from:

- the same runway;
- closely spaced parallel runways (<760 m);
- parallel runways (>760 m) where the project path of the following aircraft crosses within 1000ft of the preceding aircraft;
- crossing runways if the project path of the following aircraft crosses within 1000ft of the preceding aircraft.

The most common method is a procedural time based separation using metric minutes and with a granularity of 1 minute. The time separation criteria are applied by measuring airborne times ("airborne time" to "airborne time") between successive aircraft. The goal of the Tower Runway Controller, when applying wake turbulence separation to departing aircraft, is to achieve a minimum airborne interval time at the point at which the follower aircraft becomes airborne

To deliver the airborne time separation local procedural approaches are employed. These local procedural approaches include determining the take-off clearance time for the follower aircraft from the recorded "start of take-off roll time" of the lead aircraft, or determining the take-off clearance time of the follower aircraft from the recorded "airborne time" of the lead aircraft.

To achieve the time-based separation minima in practice when applying the recorded "start of take-off roll time" of the lead aircraft, take-off clearance may be issued to the follower aircraft once the required time separation has elapsed after the lead aircraft recorded "start of take-off roll time". For example to achieve a 2 minute separation, 2 minutes from the recorded "start of take-off roll time" of the lead aircraft, the transmission of the take-off clearance can be issued to the follower aircraft. The recorded "start of take-off roll-time" is the time the aircraft is recorded as commenced rolling beyond the line-up and wait position with a ground speed of 10 knots or more so as to provide for time contingency for the follower aircraft having a shorter roll-time than the lead aircraft.

To achieve the time-based separation minima in practice when applying airborne times ("airborne times"), take-off clearance may be issued to the follower aircraft; with an allowance for the anticipated follower aircraft take-off roll time on the runway; once the required time separation minus the anticipated follower aircraft take-off roll time has elapsed after the lead aircraft recorded "airborne time". For example to achieve a 2 minute separation, 1 minute 30 seconds from the recorded "airborne time" of the lead aircraft, the transmission of take-off clearance can be issued to the follower aircraft. In this case the controller estimates that there will be a delay of approximately 30 seconds comprised of 1) the reaction time of the Flight Crew prior to commencing the take-off roll and 2) the time taken for the following aircraft to reach rotation speed (V_R) and to become airborne.

Note that where Flight Crews are aware of the weight category of the preceding aircraft they may also measure the required 2 minutes. Whilst not mandatory this is a common practice.

An alternative to the application of time based separation procedures for departing aircraft is the use of distance based procedures. Once airborne, aircraft are subject to wake turbulence radar separations therefore the Tower Runway Controller may apply (disregarding the minute rules) a distance based clearance to ensure the required wake separation criteria. A distance based clearance can be issued as long as the Tower is equipped with radar surveillance. The nature of speed profiles for departing aircraft means that the leading aircraft tends to accelerate away from the following aircraft which has the effect of increasing the separation distance between lead/follower pairs. Erosion of separation can occur longitudinally, although this is rare. A more likely scenario involves erosion of vertical separation between departing aircraft; where there is a risk that aircraft will fly within 1000ft vertically, action is taken by the TMA Departure Radar Controller.

Other factors can influence the required minimum spacing for departing aircraft. In high density, high complexity terminal airspace, constraints may arise from within the TMA which can affect the applied minimum spacing for departing aircraft at a given airport. For example, the requested minimum spacing for consecutive aircraft may be 5 NM even if the required/minimum radar separation is a lower value, such as 3 NM. In this case it is the duty of the Tower Runway Controller to adhere to the requirements of the TMA.

Current ICAO wake turbulence separations can be described as static and are applied in all weather conditions, however certain conditions are known to have an effect on both the transport and decay of the wake vortices. These effects are not currently taken into account in the determination of required wake turbulence separation criteria, which can make existing criteria appear overly conservative. This is especially true in strong wind conditions which can result in the wind component transporting the wake of the preceding aircraft out of the path of the following aircraft.

The rate of decay of the wake vortices can also be influenced by weather conditions which result, in some cases (unstable air mass) in a faster dissipation of the vortex, and in other cases (very stable air mass) in a more prolonged, longer lasting vortex.

3.3.1.2.2 Planning

At capacity constrained airports, queue management processes attempt to produce a departure sequence to optimise the departure queue. The departure sequence is iteratively updated at certain planning milestones and made available to a number of affected actors, including the Tower Runway Controller(s). Some airports have a Departure Manager (DMAN) tool to perform this function, whilst at other airports the departure sequence is the result of a manual process to determine the most efficient departure queue. The DMAN uses a number of criteria are such as aircraft type, weight category, expected push-back time, expected taxi time, Calculated Take-Off Time (CTOT), runway entry point (intersection departures) and SID. The use of static, fixed wake turbulence separations provides a degree of simplicity in the calculation of an optimised departure sequence.

3.3.1.2.3 Runway Layout Configuration

Runway direction is chosen, based on many criteria, but the main one is the wind direction. Headwind conditions at the runway surface are the preferred wind for departures, compared to crosswind conditions or tailwind conditions.

3.3.1.2.4 Runway Modes of Operation

In a large airport, you can distinguish between two main runway operations. One is the segregated mode, where one duty runway-in-use is used for departures, and another duty runway-in-use is used for the arrivals. The other configuration is mixed mode, where the arrival and departure streams are interlaced on to a duty runway-in-use.

If operating in mixed mode, the penalty of having to apply distance based separation for arrivals is less, since Controllers are typically able to reduce the 'Gap' size required to depart one aircraft between two arrivals, as the headwind increases, without becoming constrained by the wake turbulence separation minimum.

The two modes can also be combined, so that a few arrivals will land on the departure runway, or vice versa.

When planning a runway change the look ahead needed is a bit shorter for departures than for arrivals. The most important constraint when changing the departure runway is the time the Flight Crew need in preparation for another runway and departure SID.

In current operations the Tower Runway Controller is also responsible for providing landing clearance to arriving aircraft. In order to do this the arrival traffic is transferred to the Tower Runway Controller a few nautical miles from the threshold. They monitor the speed and position of the next approaching arrival and check the runway occupancy of preceding aircraft is progressing as expected.

3.3.1.2.5 Runway Departure Control

The Tower Runway Controller is responsible for the airborne phase of flight immediately after departure, they also have to deliver line-up and take-off clearances to departing aircraft and time.

Both visual out of the window and surveillance equipment is used.

When applying time based separation the separation minima are applied by measuring airborne times ("airborne time' to "airborne time") between successive aircraft. At least two methods are employed for achieving the time separations for successive departing aircraft:

- Use of the system clock - The time when the lead aircraft commences their take-off roll ("start of take-off roll time") or becomes airborne ("airborne time") is populated onto the flight progress strip. This may be through either ATCO action with or without automation support, or automatically through surveillance monitoring dependent on local procedures and the associated local automation support.
  - The ATCO then adds the required time separation for the follower aircraft to the "start of take-off roll time" of the lead aircraft to determine the earliest time to issue clearance to take-off to the follower aircraft using the system clock. This may be with or without the support of a count-down timer, dependent on local procedures and the associated count-down timer support.
  - The ATCO adds the required time separation for the follower aircraft to the recorded "airborne time" of the lead aircraft, and subtracts the expected time between issuing the take-off clearance and the follower aircraft to become airborne, to determine the earliest time to issue the clearance to take-off to the follower aircraft using the system clock.
- Use of the radar display - This method is based on the ATCO using one or more reference points on the radar display to ensure a sufficient lateral separation has been achieved between the 'lead' and 'follower' aircraft.

ATCOs may vary the method used depending on the conditions. For instance, in low headwind conditions some ATCOs prefer the method of using the system clock whereas in higher headwind conditions the use of the radar display may be preferred.

3.3.1.3 Wake Risk Monitoring Concept Solution

The current operating method for **wake turbulence detection and monitoring** is relying on the voluntary reporting by pilots or air traffic controllers using the reporting forms proposed by ICAO, reproduced in the figure below. These are available in paper form and as digital forms online. As can be seen, the accuracy and completeness of the information they provide relies on the memory of the flight crew that experienced the event. Most of the time, the reporting forms that are received are incomplete, and there is little possibility to verify the information contained in them. Consequently, statistical information about the occurrence of wake turbulence encounters and their correlation with rule changes or changes in traffic mix are currently not very reliable.

Furthermore, the format of these forms, whether they are filled in paper form or online, does not allow an easy automatic or semi-automatic analysis, e.g. to fill databases.

Attachment A to State letter AN 13/4-07/67

A-2

WAKE VORTEX ENCOUNTER REPORTING FORM FOR PILOTS

Date and Time	Date of incident	
	Time (UTC)	
Aircraft Type	Make	
	Model	
	Series	
Altitude	Height	□ m or □ ft
	Altitude	□ m or □ ft
	Flight level	
Geographic Position	Location	
	State	
	Airport	
	Runway	□ L □ C □ R
Details	Phase of flight	□ take-off □ initial climb □ climb □ cruise □ descent □ holding □ approach □ final □ touch-down □ taxiing □ other
	Were you turning?	□ yes □ no □ L □ R
	Which holding pattern were you in, if any?	
	Were you:	□ high □ low □ on the glide path
	Were you	□ left of □ right of □ on the centre-line
	Weight	kg
	IAS	kts
	Heading	degrees
Other	What led you to suspect wake vortex as the cause of the disturbance?	
Did you experience vertical acceleration?	□ yes □ no	Please describe:
What was the change in attitude? Please estimate angle.	Pitch: Roll: Yaw:	

Was there any change in altitude?	□ yes Please describe: □ no □ n/a
Was there buffeting?	□ yes □ no □ n/a
Was there stall warning?	□ yes □ no □ n/a
Was the autopilot engaged?	□ yes □ no □ n/a
What control action was taken?	□ none □ go-around □ runway change □ other Please describe briefly:
Could you see the aircraft suspected of generating the wake vortex?	□ yes □ no □ n/a
If yes, what was it?	Make - Model - Series -
Where was it relative to your position?	Separation distance: clock reference:
Were you aware of the preceding aircraft type before the encounter?	□ yes □ no □ n/a

— — — — — — — —

Figure 6: Wake Vortex Encounter reporting form for pilots proposed by ICAO

3.3.1.4 Wake Decay Enhancing Concept Solution

Operating methods are not influenced by the wake decay concept solution.

3.3.2 New SESAR Operating Method

3.3.2.1 Arrivals Concepts Solutions

This section presents the S-PWS, WDS, ORD concepts which are applicable on the final approach for arrivals.

The S-PWS and WDS concepts define various forms of wake turbulence separation rules. Although there are some exceptions, the application of these separation rules requires a Separation Delivery tool to visualise the required minimum separation on the CWP.

The ORD concept provides additional support to assist Controllers in delivering the required minimum separation to the separation delivery point (e.g. runway threshold) by considering the effect of compression. This is achieved through an additional visualisation in the Separation Delivery tool to show Controllers the required spacing to deliver at the DF (typically 4-6 NM from the runway landing threshold) in order to deliver the required minimum separation at the delivery point.

3.3.2.1.1 Optimised Runway Delivery on Final Approach (AO-0328)

This section describes the ORD concept and in particular the Separation Delivery tool that supports and is used by the Controllers in delivering the required separation or spacing on approach to the runway landing threshold. The Separation Delivery tool calculates and displays Target Distance Indicators (TDIs) on the Approach and Tower CWPs. The TDIs include an FTD indicator which displays the required separation / spacing to be delivered to the required delivery point and an Initial Target Distance (ITD) indicator which displays the required spacing to deliver at the DF to support the Controller in delivering the required separation / spacing.

The key steps regarding the calculation and display of these TDIs are as follows:

- Determine the Approach Arrival Sequence;
- Identify all applicable separations / spacing's per arrival pair (includes in-trail and not-in-trail pairs);
- Compute the equivalent distance for any time separations or spacing's;
- Select the maximum applicable separation or spacing which is known as the FTD;
- Compute the ITD by taking into account the effect of compression;
- Determine if the TDI should be displayed;
- Display the TDI on all applicable CWPs.

The sections below describe these key elements in further detail showing the different options that have been developed in SESAR 1 Project P06.08.01 and further refined in the current SESAR 2020 Solution PJ02.01. This is followed by information on turn on support which is needed to help the Controllers judge when to turn towards the localiser, information about normal / degraded modes as well as additional monitoring and alerting features that have been developed.

3.3.2.1.1.1 Approach Arrivals Sequence Input

The first step is to identify leader and follower pairs based on a sequence which is supplied by an Approach Arrival Sequencing Service. This could be sourced from one of the following proposed methods:

- Electronic Flight Progress Strip (EFPS);
- Sequencing tool allowing Controllers to modify the sequence;
- Automatic sequence detection tool.

In addition, the runway intent of each arrival aircraft is required to enable the Separation Delivery tool to identify in-trail and not-in-trail aircraft pairs.

The key requirement from an operational perspective is that the tool must use a very reliable sequence and the tool shall use the sequence as planned / implemented by the Intermediate and Final Approach Controllers.

High reliability is needed as the TDIs need to remain stable otherwise the Controller's workload and situational awareness could be impacted if they regularly jump around (due to sequence modifications). Also the Approach Controllers do not want the sequence dictated to them. They wish to remain in control of the sequence meaning the Separation Delivery tool needs to remain updated with any tactical sequence or runway intent changes.

One method to obtain the sequence order is to use an existing EFPS system where the Controllers are maintaining the sequence by ordering their strips. This order is stored in the system hence the Separation Delivery tool can interface with it to obtain the information. This meets the requirement of using the Controller planned / implemented sequence. If a tactical change is made, then the Controller expects to see a change to the TDIs as they are the one who initiated the change.

However, many European airports use a paper environment where sequence information is recorded on Paper Flight Strips (PFS) through writing sequence numbers down and / or ordering the strips in the sequence order. This means other viable methods should be considered so that the concept does not have to rely on EFPS as an enabler.

Many European airports are equipped with an AMAN. However, these can have issues when their sequence information is used by a Separation Delivery Tool. Controllers do not always follow the AMAN sequence if they can see a better way to handle the traffic. Also if a Controller makes a tactical change to the sequence, the Separation Delivery tool shall rely on the Controller (or another actor) to manually update the AMAN with that change.

An automatic sequence detection tool is ideal as it does not rely on any human input into the system along with the associated workload. However, such solutions may be limited in their sequence prediction horizon which in turn determines how soon TDIs can be displayed.

Finally, a custom built sequencing tool can be developed which enables the Controllers to edit the sequence via their CWP HMI. It could receive an initial sequence via an AMAN but then allow Controllers to input tactical sequence changes to ensure the Separation Delivery tool has the latest information. However, the added Controller workload to interact with the tool needs to be taken into consideration.

The Approach Arrival Sequence should be displayed on the Final Approach and Intermediate Approach CWPs showing the order of aircraft, wake category and separation / spacing constraints. However, if it can be demonstrated that the Approach Arrival Sequence has sufficient integrity then this may not be required.

3.3.2.1.1.2 Separation and Spacing

This section describes the separation and spacing constraints that need to be considered between each arrival pair in the Approach Arrival Sequence. This is where the different WT concepts are described which all make use of the Separation Delivery tool.

Wake Turbulence Separation

The separation delivery tool can use different Wake Turbulence scheme to maintain the separations between aircraft pair. The schemes can be the standard reference used nowadays at European airport like ICAO or RECAT-EU (see 3.2.4.1.1) or more advanced schemes. Two of these new advanced schemes are part of the PJ02.01 work: Static Pairwise Separation and Weather Dependent Separations for Arrivals (see section 3.2.4.1.2)

Managing Compression on Final Approach

On final approach there are two main sections in terms of aircraft speed. Firstly, the procedural section when the Final Approach Controller is giving speed instructions and secondly the landing stabilisation section which occurs in the last 4 NM to 6 NM before the runway landing threshold when aircraft are decelerating for landing. In the landing stabilisation section, speed profiles vary considerably depending on aircraft type, landing weight, stabilisation altitude, stabilisation mode, and the associated airline operator cockpit procedures. The range of stabilisation airspeeds varies from under 100 KIAS for some Light wake category aircraft types to over 160 KIAS for some Heavy wake category aircraft types.

The variation in speed profile can result in compression (in terms of distance and time) between leader and follower aircraft pairs. In current operations Controllers have to handle the compression themselves based on their experience of aircraft performance by adding additional spacing.

The ORD concept is intended to assist Controllers in coping with the effect of compression by providing additional tool support to show them what spacing needs to be delivered at the DF in order to achieve the required separation / spacing. This spacing is shown on the CWP as the ITD indicator. Further details regarding the calculation of the ITD are provided in Section 3.3.2.1.1.6.

Minimum Radar Separation

A Separation Delivery tool needs to respect the MRS. In current operations this is typically 3 NM although can be 2.5 NM under certain conditions prescribed in ICAO Doc 4444 [43] or as prescribed by the appropriate ATS authority.

However, the MRS used in current operations provides a limit on the benefits that can be gained from the above wake concepts (S-PWS and WDS). An option is to reduce the MRS constraint to 2 NM to increase the possible benefit from the wake concepts. This is being developed and validated in SESAR Solution PJ02-03.

The Separation Delivery tool needs to be aware of the MRS constraint for in-trail aircraft pairs using the same runway and if applicable for not-in-trail aircraft pairs for dependent parallel runway operations.

Runway Occupancy Time Support

Reducing wake separations using the above concepts means the Runway Occupancy Time (ROT) is a more important consideration. The reduced wake separations mean more aircraft pairs become ROT constrained and also reducing MRS to 2 NM means certain MRS pairs become ROT constrained.

The Separation Delivery tool can factor in the spacing that is required to enable the lead aircraft to vacate the runway by the time the follower aircraft requires a landing clearance. It can be defined per aircraft type / airline operator combination to ensure airline specific behaviour in terms of commonly used runway exits is taken into account. Other variables can be considered to refine the ROT model depending on the local environment.

The time when an aircraft needs to be given clearance to land depends on the local operation but this should be considered when defining the ROT spacing constraint which the Separation Delivery tool uses.

Additional Separation / Spacing Constraints

As well as the separation and spacing constraints described above, there are several additional constraints that may be needed by the Separation Delivery tool. Both the current and planned changes of these constraints are required. Regarding in-trail aircraft pairs these include (but are not limited to) the following:

- Spacing minimum – this may be different from the MRS;
- Specific spacing behind a certain wake category – for example there may be a specific spacing behind A380s;
- Scenario specific spacing – this is defined behind a certain lead aircraft (i.e. to provide a spacing for a runway inspection);
- Interlaced departure spacing – this may be defined as a standard gap spacing for one departure or two departures between an arrival pair;
- Specific airborne spacing constraint – for example to handle a specific arrival procedure.

Regarding not-in-trail aircraft pairs these include the following:

- Spacing minimum – this may be different from the not-in-trail MRS;
- Specific airborne spacing constraint – for example to handle a specific arrival procedure.

3.3.2.1.1.3 Wind Input

There are two main wind inputs needed by the Separation Delivery tool. The Glideslope Wind Conditions Service (GWCS) and a Runway Surface Wind Service.

The GWCS is required to measure or forecast the wind on the final approach path along the section applicable for calculating the FTD and ITD. This can be supplied by a wind profiler, downlinked Mode S data (allowing wind to be calculated from the IAS and groundspeed), a wind forecast algorithm or a combination of solutions. This information is required for the FTD and ITD calculation in order to convert time separation or spacing into an equivalent distance.

The Runway Surface Wind Service may be used to complement the FTD and ITD calculation if the GWCS is unable to provide wind measurements near the runway threshold. Also if applying a conditional version of a concept (e.g. WDS) then both forecast and actual runway surface wind is required. The forecast runway surface wind is required by the Approach and Tower Supervisor to plan when the applicable concept (e.g. WDS) can be applied. The actual runway surface wind is needed so the Supervisors can monitor the wind in case there is a need to revert back to DBS mode if the wind drops below the required threshold.

3.3.2.1.1.4 Additional Tool Inputs

The following additional inputs are needed as a minimum by the Separation Delivery tool:

- Callsign, aircraft type and wake category[23] of all arrival aircraft including any updates to this information;
- Aircraft position and altitude updates of all arrival aircraft.

3.3.2.1.1.5 Final Target Distance

The FTD is the separation or spacing that the Controller needs to deliver on final approach. This is the largest separation or spacing constraint. In order to compare all constraints, the time separation or spacing constraints need to be converted into an equivalent distance. There are two methods that can be used for this conversion as follows:

- Offline data mining aircraft type ground speed profiles across a range of wind conditions to compute the time-to-fly per segment of the final approach per wind band. This information can then be used alongside the reference time separation / spacing and wind conditions that are forecast at the time the follower is expected to fly the separation to compute the equivalent distance. In addition, the offline data mining can allow the uncertainty in the time-to-fly profile to be quantified which can be used to compute additional buffer on the FTD if this safety mitigation is required [49];
- Alternatively, an assumed airspeed profile can be applied over the separation / spacing distance in the wind conditions that are forecast at the time the follower is expected to fly the separation to compute an assumed groundspeed profile. This assumed groundspeed profile can then be applied over the reference time separation or spacing to compute the equivalent distance. The assumed airspeed profiles can either be defined as a single reference speed profile or speed profiles per aircraft type [48] [49].

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[2] If implementing S-PWS this wake category refers to the S-PWS 20 category scheme which is needed if the aircraft does not exist in the 96 x 96 pairwise scheme.

[3] The wake category can either be derived in the Separation Delivery tool from aircraft type or provided to the Separation Delivery as an input. This decision is dependent on whether the applicable wake category is used elsewhere in the system architecture.

After all time separation / spacing constraints (both in-trail and if applicable not-in-trail) have been converted into equivalent distances then all constraints can be compared and the largest constraint is selected as the FTD.

3.3.2.1.1.6 Initial Target Distance

The ITD is the spacing to be applied at the DF to assist the Controller in delivering the required separation or spacing (the FTD) at the delivery point. This is the FTD plus the predicted compression distance plus any additional buffer (if needed, as safety mitigation to uncertainty in the aircraft speed or wind forecast). The compression distance is the difference between the distance the leader travels from the DF to the point of delivery and the distance the follower travels in the same period of time. This can be calculated using one of the following methods:

- The same offline data source as described in Section 3.3.2.1.1.5 which provides the time-to-fly per aircraft type per segment of the final approach per wind band. Then the uncertainty in the time-to-fly profile can be used to compute additional buffer on the ITD if this safety mitigation is required;
- Alternatively, the same calculation can be carried out using assumed airspeed profiles for the leader and follower and using the input headwind profile. Additional adjustments can be made to these profiles for example to take into account the runway surface wind impact on landing stabilisation speed.

In challenging wind conditions (e.g. wind profile inversion at low altitude), if possible, the ITD computation should take into account the different wind conditions between the deceleration and the stabilization phase on the straight-in approach path, as the ITD only calculates and incorporates into the ITD Indicator the distance compression/catch-up that will occur from the lead aircraft crossing the DF and the lead aircraft crossing the runway landing threshold.

Challenging wind conditions were tested in RTS3b, when working with the ORD, controllers had to take into consideration any compression prior to the lead aircraft crossing the deceleration fix. For doing so they were instructed to add extra buffer behind the ITD as the follower aircraft was merged on to the straight-in approach path to account for the anticipated compression until the lead aircraft crossed the deceleration fix. How this issue should be addressed will depend on local implementation considerations.

It is worth to consider providing additional support to the separation delivery tool for managing the compression effects between the deceleration and stabilisation phase on the straight in approach path in SESAR 2020 Wave 2. For example, this could be done either by:

- Updating the position of the ITD moving it up further in the glide path before the aircraft intercepts the ITD.
- Add additional buffer in the ITD computation.

3.3.2.1.1.7 Indicator Support and Turn-On Support

The FTD and ITD are displayed on the extended runway centreline of the Intermediate Approach, Final Approach and Tower Runway Controller CWPs. The display criteria for initial display of TDIs depends on the operational needs of a local implementation. A key point that needs to be considered for the Approach Controllers is regarding support to turn aircraft onto base leg and intercept. This can be achieved through the early display of TDIs as that shows the Controller the required spacing on final approach however this relies on a sufficiently reliable Approach Arrival Sequence before aircraft have started the turn. If the extent of the sequence horizon is not sufficient for this, then alternative system support isrequired. Options include displaying the expected spacing in a table that the Controllers can refer to or displaying the expected spacing in the aircraft label. Such options still require sequence information but this may not need such a high level of integrity.

TDIs are to be displayed on the extended runway centreline for all leader aircraft that are established on the localiser. If the leader is not established and the perpendicular projected position on the localiser is behind its own ITD (or FTD if ORD is not implemented) then the TDI is to be displayed behind the perpendicular projected position on the localiser. If the leader is not established and the perpendicular projected position on the localiser is ahead its own ITD (or FTD if ORD is not implemented) then the TDI is to be displayed behind the ITD (or FTD if ORD is not implemented) ahead.

The Controller shall have the ability to display TDIs on demand. Also automatic TDI display criteria should be configured to avoid a Controller inadvertently crossing a hidden FTD.

Rules to suppress the display of a TDI until its associated aircraft is within a defined distance of the TDI can be used but this is a local implementation decision.

Information about the distance value of the FTD or ITD (which TDI depends on what is most useful for the Controller) and the distance ahead or behind the TDI can be displayed on the HMI.

TDI distance step resolution shall be at least 0.1 NM and TDIs shall update at the same rate as the radar update.

The FTD and ITD must not change after the point that Controllers require a stable indicator. Before this point it may be possible to update TDIs as the wind profile changes however this is a local implementation decision.

During dependent parallel runway operations there may be the need to display not-in-trail TDIs if a not-in-trail constraint is the largest applicable constraint for that aircraft.

The HMI design of the TDIs shall harmoniously integrate into the applicable CWPs. There may be a need to configure the HMI of the TDIs depending on the type of constraint it represents if there is an operational need to distinguish between them.

Figure 7 below shows an example of implementation design for the TDIs: in this example, shapes are constraints specific and colours are CWP specific.

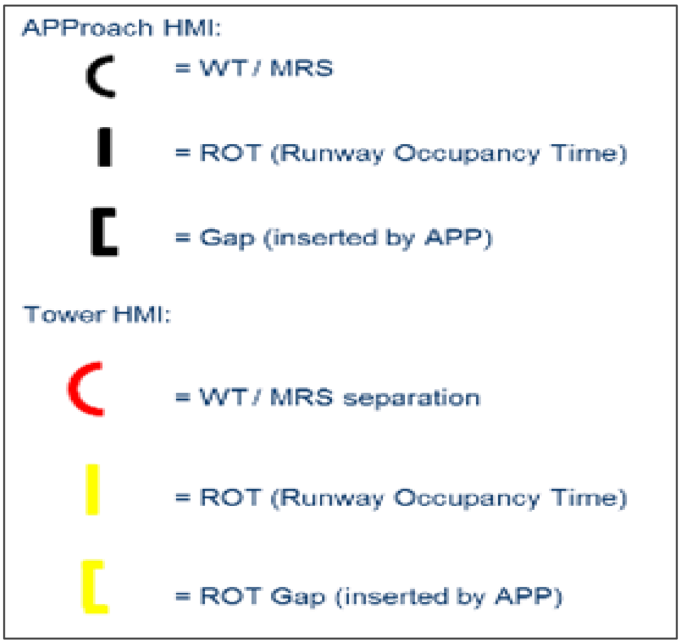


Figure 7: Example of HMI Design for TDIs

There shall be a method to allow Controllers to see the link between an aircraft and its associated TDI.

The TDI display on the extended runway centreline shall be robust to the variety of ways that aircraft merge onto final approach, typical path stretching manoeuvres and acceptable deviation from the final approach path while accommodating late runway change scenarios.

TDI removal normally occurs when the lead aircraft lands or enters a radar blanking area although there may be local requirements to display TDIs for longer such as for large spacing gaps.

For any change in aircraft sequence, separation / spacing constraints or runway intent, the TDIs for all affected arrivals pairs shall be re-calculated. This includes missed approaches which can be considered as the temporary removal of an aircraft from the sequence.

There may be a need to allow the selective removal of TDIs (for example when follower aircraft is applying visual separation from leader aircraft). This need has to be assessed on a local basis.

If a TDI cannot be calculated (for example due to insufficient information) then it shall not be displayed and the Controller shall be alerted. In this scenario the Controller is to apply a DBS wake (category based) separation.

Recommendation from Real Time Simulations

The ORD FTD for MRS and WT constraints should be distinguishable (i.e. displayed differently) as the tower runway controllers could work different depending on whether a separation is due to MRS or WT and depending on other local procedures they might use to maintain separations. For example if a separation is due to MRS, then, if the arriving aircraft is in sight and the lead aircraft has departed the runway, the runway tower controller would allow the arriving aircraft to infringe slightly the FTD.

However, they would not allow the FTD to be infringed at all if the separation minimum was due to WT (see VALR[68]).

A buffer is included in the ORD to account for variability in aircraft performance and potential errors in the accuracy of wind measures. In order not to be too high, it is recommended that an additional analysis is conducted prior to implementation to determine what buffer should be applied to further optimise separation/spacing delivery at the runway threshold in the airport environment whilst maintaining safety. Buffer parameters should be first refined based on analysis of a large operational dataset from the airport approach and airport environment and eventually fine-tuned in live trials to provide more realistic and accurate values (see VALR[68]).

3.3.2.1.1.8 Modes of Operation

The normal modes of operation for S-PWS and WDS are listed below. The ORD concept may or may not be implemented with these concepts. The list below assumes ORD is implemented. Note there could be other combinations of modes:

- DBS Category mode (with ORD);
- Distance Based S-PWS mode (with ORD);
- Time Based S-PWS mode (with ORD)
- Time Based WDS (total wind) mode (with ORD);
- Time Based WDS (cross wind) mode (with ORD);

Note that several separation computation modes could be implemented at the same time. Then ORD can be put in the most favourable mode in terms of runway throughput, e.g. TBS, WDS or DBS, depending on the MET conditions.

Table 31 provides the Modes of Operation the associated Separation Computation considered in the PJ02.01 RTS prototyping activities.

Modes of Operation	Associated Separation Computation
Arrival Nominal mode.	TBS with standard separation scheme (standard separation could be for instance ICAO, RECAT EU etc.). TBS with Static pair wise concept (S-PWS).
Arrival with WDS conditional mode on	For Arrival with WDS conditional mode, TBS with WDS cross wind (WDS-XW) as a separation computation mode is considered in the remaining part of the document.
Mixed mode	TBS with standard separation scheme (standard separation could be for instance ICAO, RECAT EU etc.). TBS with Static pair wise concept (PWS).
Degraded mode	

Table 31: Modes of Operation and Associated Separation Computation

The reasons for switching to degraded modes are listed below. The main scenarios leading to a degraded mode include loss of GWCS, loss of the Runway Surface Wind service (if implemented) and complete loss of the Separation Delivery tool:

- Loss of the GWCS – reversion to DBS Category mode (plus ORD if using a conservative assumption for the wind profile);
- Loss of the Runway Surface Wind Service (if this complements the FTD and ITD calculations) – remains in current mode but with added conservatism due to loss of a wind data source; another possible option is the reversion to DBS Category mode;
- No system support if there is a complete loss of the Separation Delivery tool, loss of the Approach Arrival Sequence Service, loss of the flight data input or loss of the radar data input. If all TDIs are lost suddenly then Controllers are to apply DBS wake category separations for those aircraft not yet established while maintaining current separations for those already established if considered safe to do so;

The current operating mode (normal or degraded) shall be displayed on the CWPs of the Supervisors and Controllers.

3.3.2.1.1.9 Monitoring and Alerting

The following monitoring and alerting options may be considered as possible safety mitigations but the exact needs depend upon the local implementation:

- Catch-up alert – this alert informs the Controller if the aircraft is predicted to cross the ITD within a set period of time if the speed remains unchanged;
- Speed conformance alert – this alert informs the Controller if the actual aircraft speed deviates beyond a configured range from the expected speed profile;
- Sequencing alert – this alert cross check the actual aircraft order against the order in the Approach Arrival Sequence Service and alert the Controller if there are any differences;
- Wind monitor / alert – this alert informs the Controller if there is a large difference between the wind used to calculate the FTD and the actual wind experienced by the Controller;
- Aircraft turned onto wrong TDI alert – this alert informs the Controllers if an aircraft is intercepting towards the incorrect TDI;
- Aircraft turned onto wrong localiser – this alert informs the Controllers if an aircraft establishes on a different localiser than that defined by the runway intent of the aircraft;
- Separation Delivery tool / support tool failure – this alert informs the Controllers and Supervisors if the Separation Delivery tool or any supporting tool fails;
- Time spacing monitor – It is proposed as a function to check actual time spacing delivered against the intended time spacing.
- Automatic FTD popup - If there is no catch-up alert, the ORD tool shows only one FTD and one ITD as described in sections 3.3.2.1.1.5 and 3.3.2.1.1.6. If ITD related to a given constraint is infringed, the Approach controller sees the FTD associated to the same infringed constraint. If the ITD associated to the second largest constraint is infringed, the FTD associated to this second largest constraint is also displayed to the approach controller; and so on. Note that even if there are not displayed, all constraints –i.e. MRS; wake separation; ROT and GAP- associated ITD and FTD are computed.

Figure 8 shows an example prototype implementation of the Catch-up alert, where the catch-up alert is triggered when the ground speed difference between follower and ITD is greater than 12 knots, and if in the next 60 seconds the ITD will be infringed. The alert is the yellow “CATCHUP” in the follower line zero of the target label together with the yellow highlight of the lead and follower IAS field in the target label.

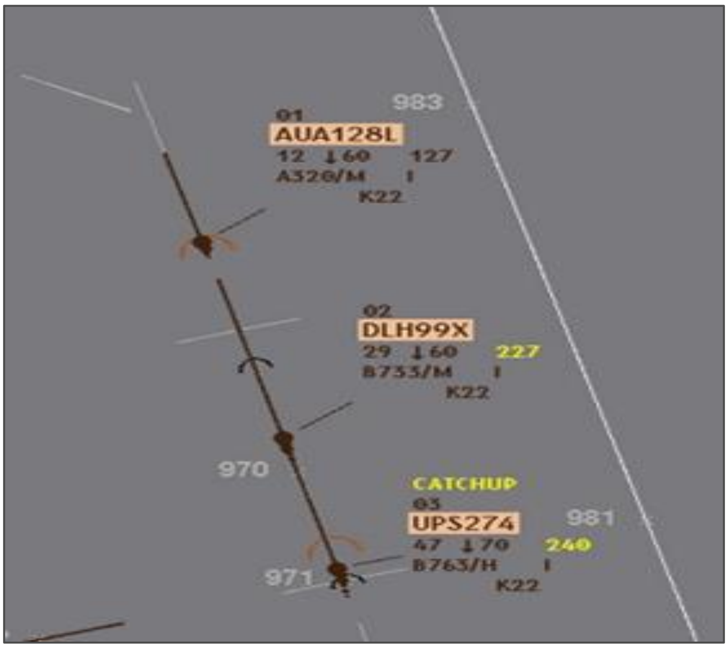


Figure 8: Example Prototype Implementation of the Catch-up Alert

Figure 9 shows an example prototype implementation of the Speed conformance alert, where the speed conformance alert is triggered when there is 20 KIAS difference between the aircraft speed and the 160 KIAS reference speed used by the LORD tool within the last 10 NM from the threshold.

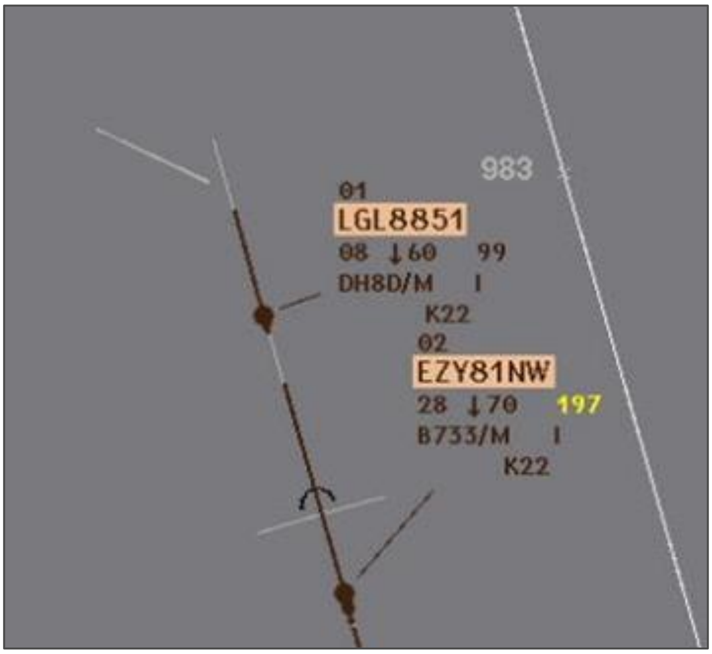


Figure 9: Example Prototype Implementation of the Speed Conformance Alert

Figure 10 shows an example prototype implementation of the Sequencing alert, where the alert appears when the actual aircraft sequence (calculated by system based on distance from a specific point on glide) is different from the a/c sequence displayed in the sequence list and a/c label.

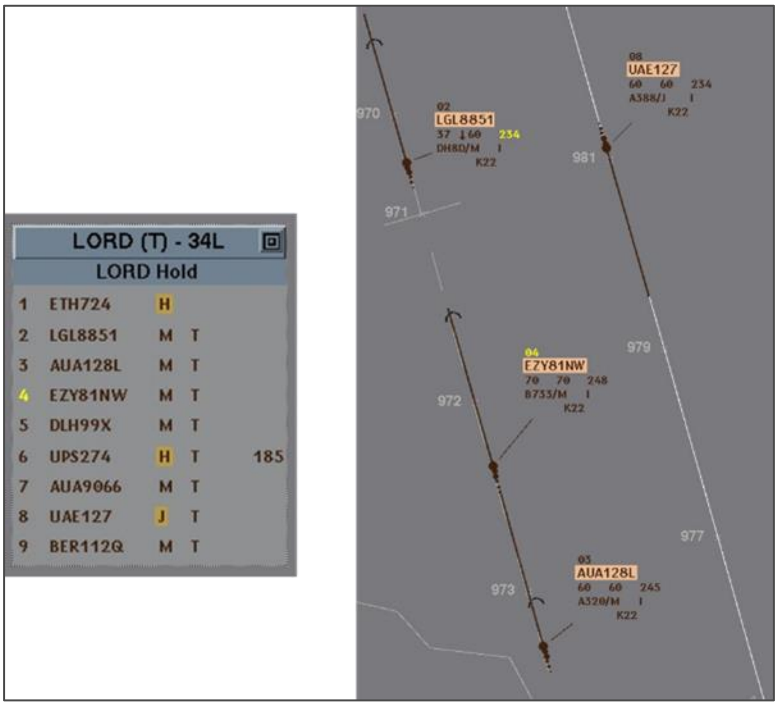


Figure 10: Example Prototype Implementation of the Sequencing Alert

Figure 11 shows an example of an Automatic FTD popup, where when the ITD is infringed, the FTD associated with the same constraint is automatically displayed.

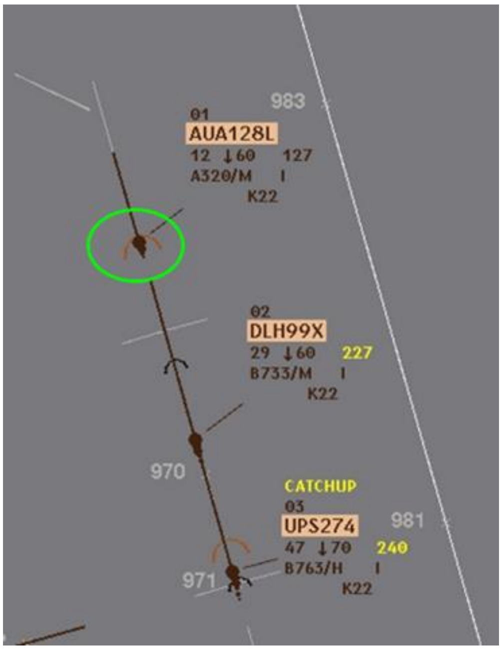


Figure 11: Example Prototype Implementation of the Automatic FTD Pop-Up

As recommended in RTS03 (see VALR[68]), for safety reasons, the minimum separation (WT or MRS) should be displayed if an aircraft infringes the Gap ITD / FTD to give the controllers an awareness of the safety minima (the same also applied to the ROT target distance indicators).

In addition to the FTD, when the ITD infringed is associated to MRS or WT separation constraint, the tower controller gets information about the distance between FTD and aircraft position, this information is displayed next to the FTD as shown by Figure 12.

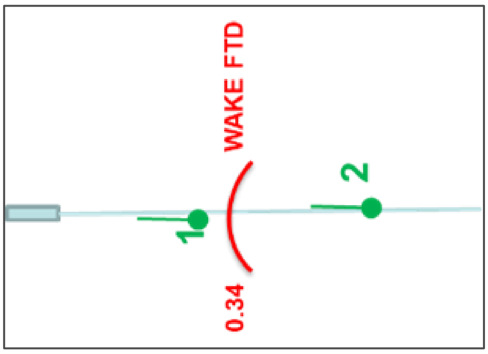


Figure 12: Example Prototype Implementation of the infringement Alert Display for the Tower Runway Controller

3.3.2.1.1.10 Controller Procedures for Optimised Runway Delivery (ORD)

Controllers shall remain responsible for monitoring for separation infringements and for timely intervention actions to resolve them. If using the FTD indicator only (if ORD is not implemented), then the Final Approach Controller shall allow for additional spacing due to the effect of compression. If using the ITD the procedure for merging onto final approach and catching up the ITD shall depend on the local implementation of the ITD algorithm. For example, sufficient conservatism in the ITD calculation may mean the Controllers can catch up the ITD without providing additional margin. The procedure regarding what to do if you cross the ITD will also depend on the local implementation of the ITD algorithm.

The Final Approach Controller shall take into account any non-standard procedures or abnormal approach speeds as reported by the Flight Crew when setting up the spacing on final approach.

The Tower Supervisor in coordination with the Approach Supervisor shall ensure the separation and spacing constraints remain up to date including planned changes.

Procedures regarding the transition of wake separations before merging onto final approach to reduced wake separations (or potentially removed wake separations if using the WDS cross wind concept) on final approach need to be considered to get most benefit from these concepts. If applying a conditional version of a concept (e.g. WDS Cross Wind concept) then the Approach and Tower Supervisors shall coordinate using available wind measurement / forecast information regarding when the transition in and out of using the applicable concept.

Separation transition procedures also need to be considered regarding go-arounds as the aircraft leaves the final approach path. Also the reduced separations on final approach mean there will be more aircraft on final approach which means a scenario causing multiple go-arounds can lead to more go-arounds than experienced in current operations.

A local implementation needs to assess if the Intermediate Approach Controllers are able to feed sufficient aircraft to the final approach to meet the optimised separations. If this is an issue, then perhaps solutions should be considered to allow the wider approach environment to meet these needs.

Procedures regarding how Controllers are able to use the available spacing information on the HMI to report the distance to touchdown for aircraft applying a Continuous Descent Approach should be considered.

Training aspects are part of implementation of the ORD tool that needs to be considered by ANSPs, depending on the specific environment, procedures, and the desired local implementation of the tool. The HP Assessment Report (Part IV of the OSED) contains considerations on the training aspect.

3.3.2.1.1.11 Airspace User Procedures for Optimised Runway Delivery (ORD)

Flight Crews shall be briefed on the applicable concept (e.g. S-PWS or WDS) to ensure sufficient understanding. Also they shall be aware of the current mode of operation at the airport which can be achieved through the Digital Automatic Terminal Information Service (D-ATIS).

Flight Crew shall notify the Approach Controller of an inability to fly the standard procedure or of any non-conformant final approach speeds.

The aircraft type is an important input into the Separation Delivery tool due to the possible implications of an error. The Flight Crew could be required to confirm aircraft type on first call to allow the Controllers to cross check it. If this is not feasible then an alternative method to reduce the chance of aircraft type errors needs to be found (i.e. via Datalink).

The cautionary wake vortex advisory phraseology may require to be modified for the applicable concept.

Additional spacing can be requested by Flight Crew but it is expected to be rare as Flight Crew will be briefed on the applicable concept.

3.3.2.1.1.12 Coordination between Tower ATC and Approach ATC for Transition between Mode of Operations

Coordination between the Tower ATC Supervisor and the Approach Supervisor is needed to switch between the modes of operation listed below:

- Arrival nominal mode: in this OSED it is assumed that one of the following mode of separation computation is used in nominal mode:
  - DBS Category mode (with ORD);
  - Or Distance Based S-PWS mode (with ORD);
  - Or Time Based S-PWS mode (with ORD)
- Arrival with conditional WDS mode (with ORD)
- Mixed mode (with ORD)
- Degraded mode

As illustrated by Figure 13, transition could be applied from whatever mode to any mode listed above.

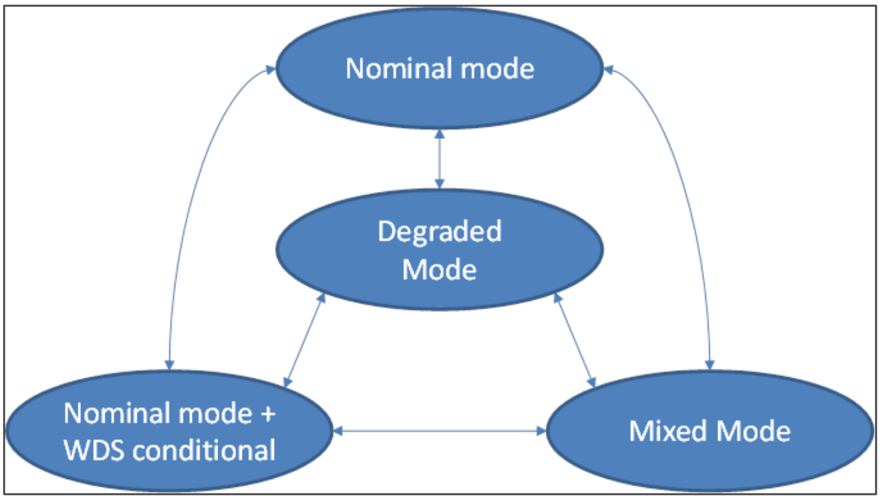


Figure 13: Transition between Modes of Operation

General principle for a transition from one mode to another (except to the degraded mode)

Depending on the weather (wind nowcast and forecast) and operational conditions (traffic demand, runway conditions, ORD tool status etc.), ORD tool should be put in the most favourable mode in terms of runway throughput. Consequently, upon a change of weather conditions (nowcast or forecast), a loss of function, a strategic planning decision (e.g. application of mixed mode) or more generally upon operational change (traffic, runway status etc.), a mode transition is initiated by either the tower or approach supervisor. Both supervisors could also initiate a transition following approach/tower controller’s feedback.

Coordination between approach and tower supervisors is needed to share the next mode to be applied as well as when to apply it. In practice, this means deciding the first leader aircraft in the arrival sequence list from which the new mode will be applied. For the approach controller to manage the potentially increased separation, the aircraft as from which the transition is applied should be on base leg at the latest.

Then, once the new mode is activated, the ORD tool computes and display alerts and Target Distance Indicators accordingly.

The only exception is when a transition to the degraded mode is decided. Then, after degraded mode activation, there is instantly no Target Distance Indicator nor alerts computed and display for any aircraft in the TSI area.

Note that the separation computation mode (TBS standard, TBD pair wise, WDS mode) is displayed to the ATCOs at all times as ATCOs need awareness of current mode of operation in case of failure.

See sections 3.3.2.1.1.14 and 3.3.2.1.3 for details on mixed mode operation and conditional WDS mode respectively.

3.3.2.1.1.13 Activation and de-activation of WDS-A

The activation/ de-activation of WDS-A can be fully automated or manually selectable by ATCOs and/or supervisor(s) depending on the local implementation.

WDS activation:

The "GO" option should be available only on the Supervisor’s side. This is a recommendation from RTS1, the ATCOs suggest to avoid having an activation button for WDS-A available on the ATCOs’ HMI in order to avoid confusions. Even if automated or initiated by the Supervisor, given the applicable wind conditions, the Supervisor shall confirm the activation by verbally communicating the transition to the ATCOs (with the mention of the first a/c from which the new mode of operations applies).

WDS de-activation

a) EITHER automatically changed by the tool- with a clear indication on the screen of both the Supervisor and the ATCO of the new mode of operation and additionally with an indication of the a/c from which the reversal to the conventional mode of operation applies (e.g. highlighting the a/c).

OR

An alert on both ATCO`s and Supervisor`s HMI, indicating the immediate required transition (to be manually changed by the Supervisor and/or ATCO).

The above mentioned options are mostly applicable for spontaneous changes that were not foreseen (e.g. degraded mode or loss of wind conditions).

b) Spontaneous change made by the ATCO- given consecutive WTE reported by pilots that confirm inadequate wind conditions OR the refusal of reduced separations by one pilot (in which case the reversal to conventional separations can be made for one a/c pair only and the ATCO must record this pair as such). For a change for one aircraft pair only, the ATCO is responsible to record the chance either of flight strips or with a "bear and range" indication on the screen so that they recall the reason for enhanced separations for an aircraft pair only, given the fact that the mode of operation would be still displaying reduced separations overall. The ATCO may use the (optional) function of the tool to remove TDIs for a single aircraft.

c) Planned by the Supervisor whom, based on the MET info and traffic situation, is able to anticipate wind changes and verbally communicate to the ATCO the first aircraft from which the reversal to the conventional mode of operation applies.

Transition to degraded mode

In degraded modes, the default procedures should be to switch back to RECAT or ICAO (i.e. existing WV separation scheme) procedures – with or without TDIs depending on the type of failure. (Note TDI (ITD and FTD) failure was tested in THALIN 2 P-RTS – from this the default procedures recommended when such a failure occurs were existing default procedures applied i.e. ICAO or RECAT-EU or ICAO).

If all the Target Distance Indicators disappeared due to a system failure, the supervisors in the tower and approach would co-ordinate, open a stack then revert to RECAT-EU or ICAO separations. Every degraded mode should be assessed by the safety assessment depending on what causes it and which training should be given to all controllers on such degraded modes to ensure they felt capable when dealing with such situations.

3.3.2.1.1.14 ORD in Mixed Mode Operation

In mixed mode operations with significant arrival and/or departure traffic demand, controllers need spacing target monitoring function and decision making support to be able to insert one or several aircraft(s) for take-off in between two consecutive arrival flights,

A gap is defined as a time lapse that covers the time needed for one or several aircraft(s) to align and take off in between two consecutive arrival flights. The gap is inserted as a spacing constraint the ORD tool considers along with the other constraints, i.e. wake, MRS and ROT (see section 3.3.2.1.1.5 & 3.3.2.1.1.6).

The ORD tool provides both decision making and spacing monitoring functions via the TDIs associated to gap constraint.

Insertion of Gap

Following recommendation of RTS 03a described in VALR[68], the gap required to insert departures within two consecutive arrivals could be defined in two ways: first according to the departure demand by Tower controller on case by case basis; or according to a predefined sequence of arrivals and departures for a predefined period of time (e.g. 2 arrivals followed by 1 departure) as part of the airport strategic plan. Tower and approach supervisor coordination is put in place for applying mixed mode operation. This is decided at the coordination step as described in the Use Cases section.

The approach controller inputs a gap of a given time at a given place in the arrival sequence, such that is possible for the final controller to intercept the GAP ITD on the final leg. Figure 14 and Figure 15 provide examples of how the gap spacing can be inserted within the ORD tool:

- Figure 14 illustrates the process of the approach controller selecting a flight in the arrival sequence, and selecting the Gap to be inserted behind it. The time spacing for the gap has standard values in the menu (e.g. 120s, 180s, 250s), or the approach controller can enter via the keypad the specific tailored time spacing required.

- Figure 15 illustrates the ORD tool computing the new spacing constraint for the arrival pair and displaying the gap spacing when it is the largest constraint compared to the MRS, the wake separation and the ROT spacing. A GAP specific TDI symbol is displayed to tower and approach controllers to aid the controllers' situation awareness. Monitoring and alerting associated to gap follows the behaviour described in Monitoring and Alerting section.

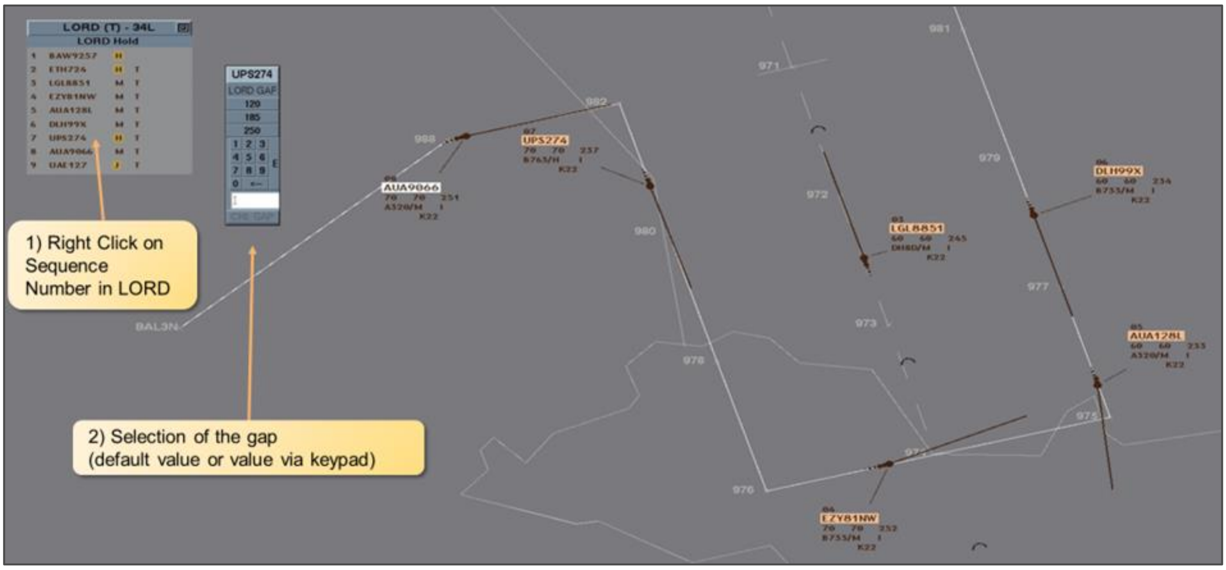


Figure 14: Example Prototype Implementation of Gap Insertion with the ORD Tool

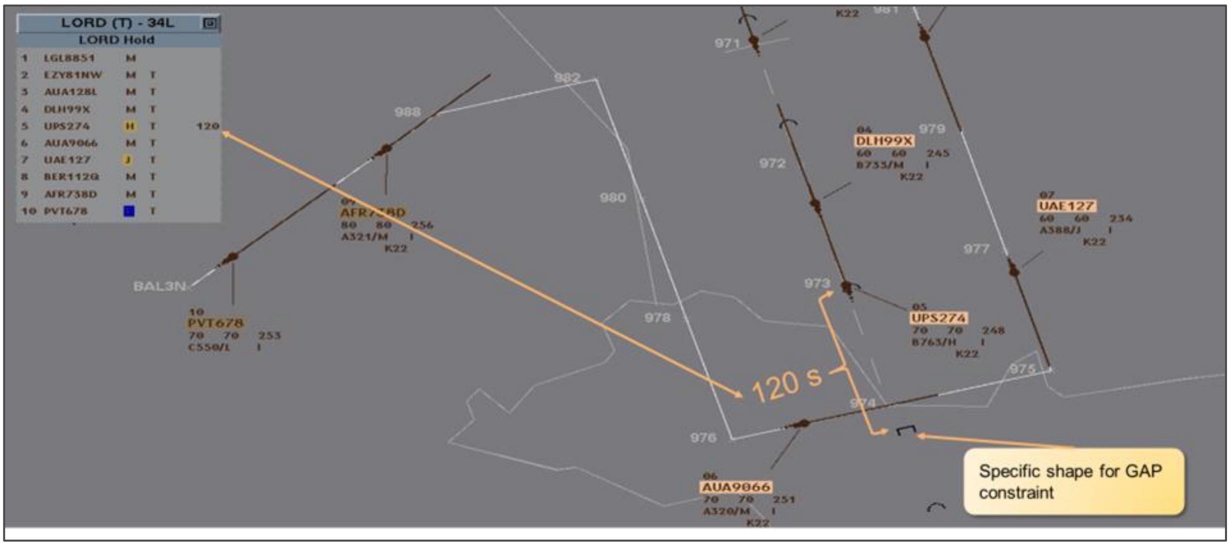


Figure 15: Example Prototype Implementation of an Inserted Gap in the ORD Tool

The flight on which gap is inserted shall be on the base leg, before aircraft intercepts the localizer at the latest, so that approach controller can adapt the heading and speed to target the gap TDI updated with increased spacing.

Following recommendation of RTS 03a described in VALR[68], if gap cannot be inserted due to the fact that the requested gap was not adequate e.g. due to the aircraft type of the lead aircraft or if there is a problem with the gap management tool then controllers need to be notified. The reason why the gap cannot be inserted should also be indicated to the controllers in the notification.

Once the gap is inserted, the tower controller has to verify whether the allocated gap size is compatible with the planned departures in the sequence. An evolution of the situation on the ground (e.g. departing aircraft not ready for line-up) or on the air (e.g. wrong/late interception of the glide) might lead to the modification of the Gap ITD for optimising the spacing on the final leg. For example when a gap is created for two departures but the second departure will not be capable of lining-up on the runway in time it could be worth to reduce the Gap ITD size to accommodate 1 departure only and let the incoming arrival aircraft fly higher speed and land earlier. For optimising the tactical spacing described above the ATCO might use some support information described in Appendix C.

On the tower the ATCO monitors the landing and vacate of the runway of the arrival aircraft to which the GAP FTD was associated. He asses the gaps size by looking at the position of the next arrival aircraft when the first aircraft touches down. If the spacing is sufficient he gives clearance to line up and take-off to the departure. If the Tower ATCO cannot guarantee the respect of the separation between the two aircraft (departure and arrival), he holds the departing aircraft, gives clearance to land to the arrival and assess the position of the next gap where he can fit it in the planned departure for line-up and take-off.

3.3.2.1.1.15 ORD in CSPR

CSPR – closely spaced parallel runway operations are applied when two parallel runways centre line are separated by less than 2500ft. The separation delivery tool in CSPR must take into account all variables and calculates the required separation minima between two aircraft to display ITD and FTD correctly. The separations to be applied between two planes are governed by the same three constraints as for an approach on a single track:

- Wake Turbulence Separation, where 3 different cases shall be considered:
    - leader and follower aircraft on the same glide;
    - leader on glide 1 and follower on glide 2;
    - leader on glide 2 and follower on glide 1.
- MRS, where at least two values shall be considered:
    - if Leader and follower aircraft are on the same glide (e.g. 2.5 NM)
    - if leader and follower are on different glides (e.g. 2.0 NM)
- ROT:
    - The runway occupancy time (ROT) constraint shall only be checked for the next flight that lands on the leader's glide.

If two successive flights follow different glides, the reference distance is the diagonal distance between the two flights whereas if the two flights follow the same glide, the distance is measured along the axis of the same glide. See the figure below as example for two separations where leader and follower aircraft are on different glide.

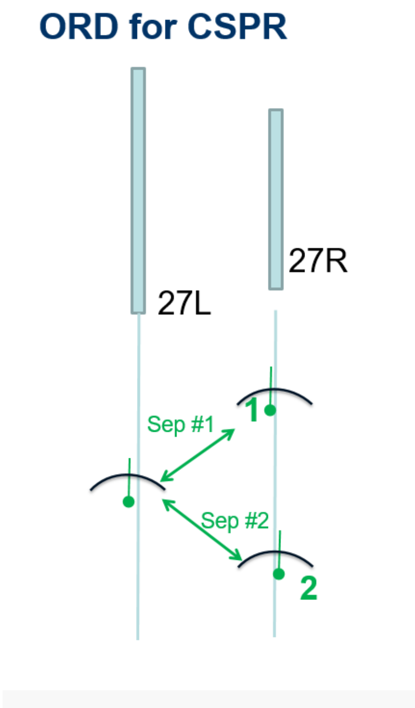


Figure 16: Example of TDI separations in CSPR

In CSPR mode, flights from both approaches are combined in one sequence, thus there is a need to differentiate on the ATCO HMI screen which aircraft are assigned to one runway and which to the others. These can be achieved by using different colours in the sequence list and on the radar label. The figures below show how CSPR has been used for the RTS4b with CDG airport environment.

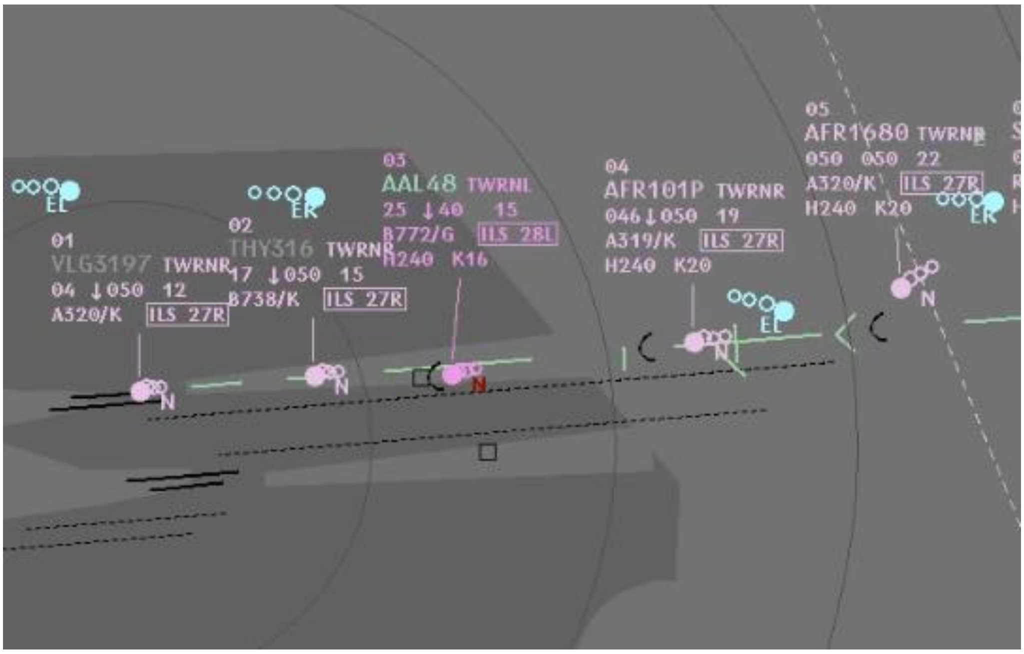


Figure 17: Example of CSPR ITD for aircraft number 3 assigned to RWY27L

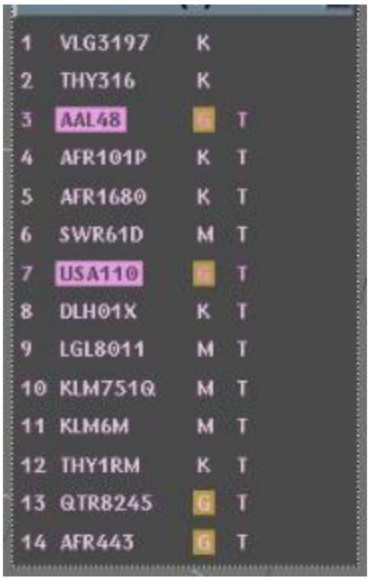


Figure 18: Example of Sequence list (based on situation above)

In Figure 17 and Figure 18 we see that aircraft assigned to the inner runway are highlighted.

3.3.2.1.2 Wake Turbulence Separations (for Arrivals) Based on Static Aircraft Characteristics (AO-0306)

The RECAT-PWS-EU DB Scheme for Arrivals (DB-PWS-A) is specified in Section 3.2.4.1.2. To apply this WT Separation Scheme the Controllers require the support of Optimised Runway Delivery on Final Approach (AO-0328) as described in Section 3.3.2.1.1.

The RECAT-PWS-EU TB Scheme for Arrivals (TB-PWS-A) is specified in Section 3.2.4.1.2 and is the based on the RECAT-PWS-EU DB Scheme for Arrivals (DB-PWS-A) in conjunction with AO-0303 TBS for Arrivals. To apply this WT Separation Scheme the Controllers require support of the Optimised Runway Delivery on Final Approach (AO-0328) as described in Section 3.3.2.1.1.

3.3.2.1.3 Weather Dependent Reductions of Wake Turbulence Separations for Final Approach (AO-0310)

The Weather Dependant Separations for arrivals (WDS-A) is the conditional reduction or suspension of wake separation minima on final approach, applicable under pre-defined wind conditions so as to enable runway throughput increase compared to the applicable standard weather independent wake separation minima. This is on the basis that under the pre-defined wind conditions the wake turbulence generated by the lead aircraft is either wind transported out of the path of the follower aircraft on final approach, or has decayed sufficiently to be acceptable to be encountered by the follower aircraft.

Weather Dependant Separations for arrivals (WDS-A) consists in defining acceptable distance or time separation reductions in favourable wind conditions (total and/or cross component). Two concepts are envisaged: a concept based on total wind effect (A-WDS-Tw) on wake vortex decay allowing for reduced separations in strong total wind conditions, and a concept based on crosswind effect (A-WDS-Xw) on vortex lateral transport allowing for reduced separations in strong crosswind conditions.

The time separation reductions are to be applied in conjunction with TBS on final approach (AO-0303) and the support of Optimised Runway Delivery on Final Approach (AO-0328).

The time separation reduction for the crosswind concept (A-TB-WDS-Xw) has been defined and is detailed in Section 3.2.4.1.2 and Appendix B. The time separation reduction for the total wind concept has not yet been defined.

ORD Support for A-WDS-Xw Concepts

As described in Section 3.2.4.1.2 and Appendix B the WDS-Xw conditional mode is activated upon certain wind conditions, that ensure with an adequate level of certainty that the wake vortex are moved away from the centreline so that the minimum wake separation could be reduced.

Wake vortex displacement is characterised around the centreline, per aircraft pair and in certain wind conditions. Therefore, WDS wake separation scheme can be applied, only when all applicable conditions are met, i.e. when both aircrafts are on the centreline and in the applicable wind conditions.

Outside of the centreline, wind direction, wake vortices transportation uncertainty and great variability of an aircraft pair relative positions (in terms of relative heading and altitude) leads to not being able to apply the reduced separation and so the TMA separation minima apply instead.

To mitigate the risk for an aircraft to encounter wake vortices on the base leg due to the uncertainty of leader wake vortices relative position, a solution is for the controller to first target the minima of the standard separation scheme (ICAO, RECAT EU, S-PWS, etc.) for the aircraft pair and then only apply the WDS-Xw separation scheme once both leader and follower are aligned on the centreline.

With respect to the ORD tool support this implies the following:

- The TDIs first reflect the minima of the standard separation scheme in the TMA until both leader and follower are aligned on the centreline.
- Once both leader and follower are aligned, the TDI reflects the WDS-Xw separation scheme, resulting in a jump of the TDI that is to be recovered with airspeed management.
- Depending on the aircraft pair, on the interception position and the difference in ground speed of leader and follower aircraft, not all the margin could be recovered with airspeed management. The overall gain in throughput with this method is assessed in the FTS exercise and reported in the VALR[68].

Figure 19 and Figure 20 illustrate the jump of the ITD. In Figure 19 the TDIs for the pair B772-A319 are computed according to the ICAO wake separation scheme. Once the follower A319 aircraft is aligned on the centreline in Figure 20, the ITD jumps and the TDIs follow the WDS wake separation scheme. The controller has to provide adequate airspeed clearances to recover the distance from the leader aircraft and optimise the separation as allowed by A-WDS-Xw separation scheme.

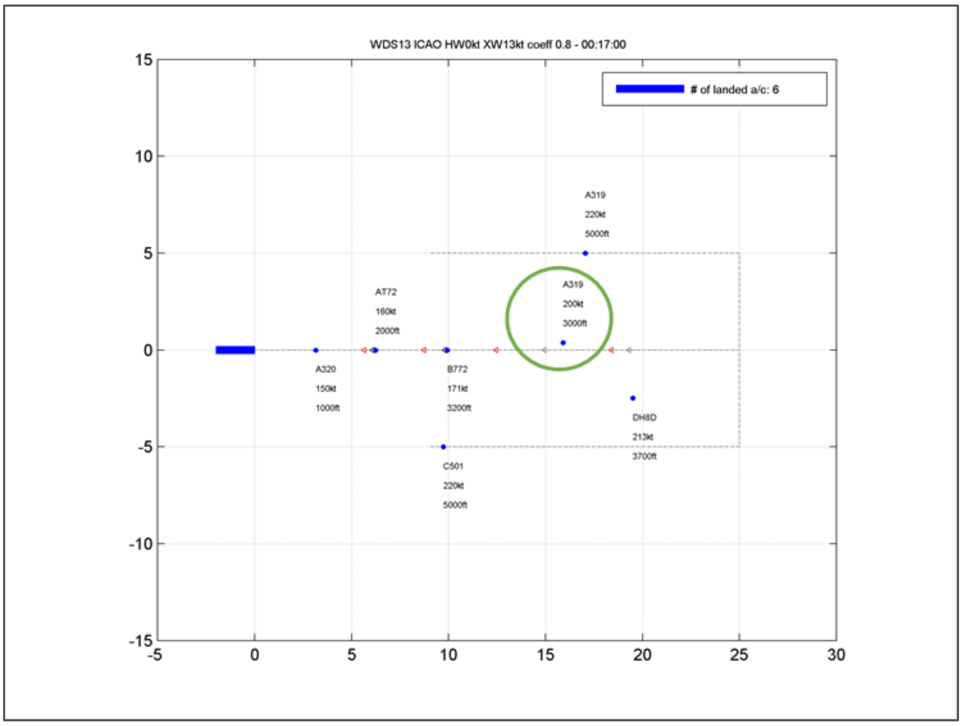


Figure 19: Illustration of TDIs following ICAO Wake scheme out of centreline

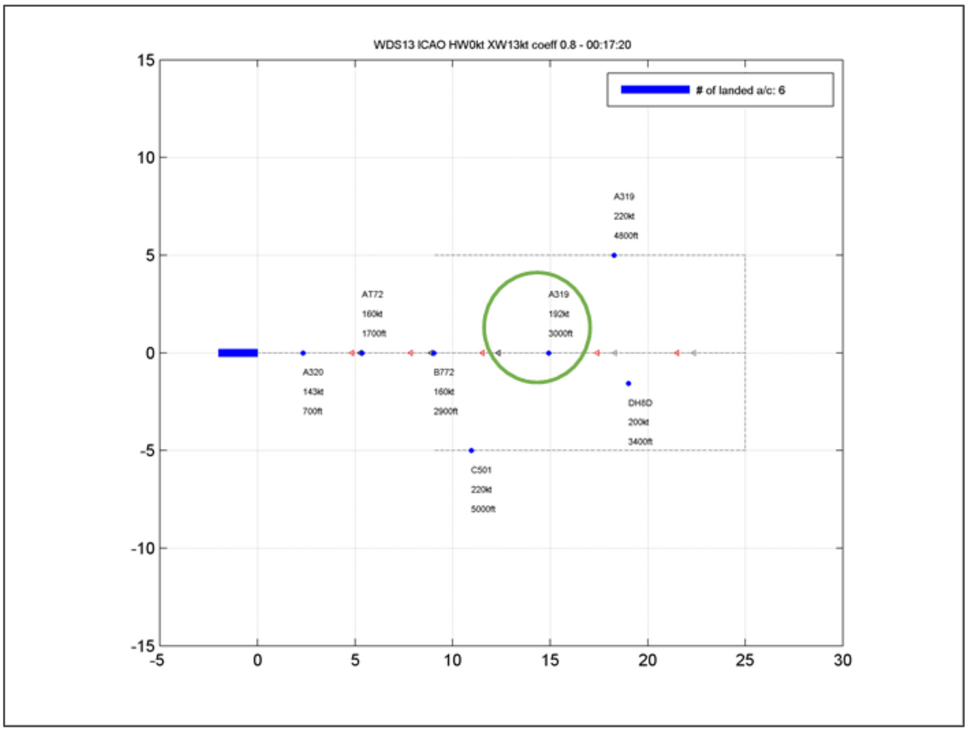


Figure 20: Illustration of TDIs following WDS wake scheme once both leader and follower are on the centreline

Strategic decision to apply or remove the WDS as a conditional mode

The present section follows validation recommendation from the VALR[68].

Strategic decisions on activation of WDS conditional mode is mainly based on weather nowcast and forecast expertise. Weather local model based on historical wind data, data mining and analysis considering the global uncertainty on wind evolution (and hence on the average buffer to be added on the separations in such wind conditions) supports the strategic decision to apply or not the WDS conditional mode.

Due to the workload levels of the ATCOs in the TMA, the point in the arrival sequence at which the transition is to be applied, should be planned and triggered by the supervisor. The Supervisor needs access to the weather expertise described above, aircraft sequence list, information on the traffic forecast and the approach radar situation in order to make this decision.

The Final Approach and Intermediate/Initial Approach controllers should be able to suggest and agree with the supervisor an alternative timing and aircraft from which the mode transition should take place if they think the aircraft selected for the transition is not feasible for some reason.

Transition from nominal mode to WDS conditional mode

The aircraft from which the mode change occurs must be able to reach the RWY threshold / separation delivery point without the wind reducing below the threshold value for WDS operations.

Transition from WDS conditional mode to nominal mode

This is the worst-case scenario, as it leads to increase the separation between aircraft pair, as from one aircraft in the sequence list. Therefore, Approach and tower controller need to be notified in advance about the change in wind conditions and the imminent need to transition from one separation scheme.

ATCOs in the approach sectors directly impacted by the mode change need to know the last aircraft in sequence that will be under the previous separation. The first aircraft in sequence under the new separation scheme should be on the base leg, before aircraft intercepts the localizer at the latest, so that the controller can adapt the heading and speed to target the TDI updated with increased separation.

It is advised to instigate a mode transition (WDS to RECAT-EU /ICAO) between two Medium aircraft where MRS is applied or where the change in separations pair with the new scheme is zero or very limited, to minimize the impact on the ATCOs work.

ATCOs in the TMA should be able to adapt the throughput capacity when there is a mode transition so when the transition goes from WDS to RECAT-EU or ICAO separation scheme, they can regulate the flow of traffic using holdings or via co-ordination with the adjacent upstream sectors.

An advanced warning of the mode transition is required in order to temporarily limit or regulate the flow of inbound traffic (e.g. through metering) during the switch of separation scheme in order to manage the change and controllers' workload

Also, it is advised to apply WDS cross wind operations when there is enough wind strength and stability for remaining during the entire duration of the traffic peak period; so that mode transition to nominal is avoided in peak traffic period.

Transition to Degraded mode while WDS is applied

As assessed in RTS1, (see VALR[68]), controllers would have to receive training on contingency procedures in case of degraded modes for them to handle a sudden loss of the ORD separation. For example a degraded mode could be transitioning from WDS with the ORD tool to RECAT EU without indicators. As controllers are not systematically checking the aircraft type and WV categories of all aircraft with the ORD tool, controllers may not have the adequate level of situation awareness in degraded mode to adapt and recover quickly and safely if not properly trained.

3.3.2.2 Departures Concepts Solutions

This section presents the new operating method for the PWS-D, WDS-D and OSD concepts that are applicable on the initial departure path for departures.

The philosophy adopted is to evolve the current operating method focusing on:

- Enabling the Tower Runway Controller to apply the more efficient PWS-D wake separation rules consistently, efficiently and safely between departure pairs.
- Enabling the safe employment of the WDS-D conditional reduction or suspension of the wake separation rules, applicable under pre-defined wind conditions.
- Supporting the coordination required such that the appropriate pressure of departure traffic is provided to the Tower Runway Controller at the runway holding positions.
- Supporting the coordination required with TMA operations.

3.3.2.2.1 Enabling the Tower Runway Controller to Apply the PWS-D Wake Separation Rules (AO-0323)

3.3.2.2.1.1 Optimised Separation Delivery for Departure (AO-0329)

With the PWS-D wake separation rules employing the 96 x 96 aircraft type matrix, with the 20 x 20 wake category matrix for the other aircraft type pairs, it is no longer possible for the Tower Runway Controller to mentally derive the required wake separation between a departure pair.

It is proposed that the OSD system support is provided for a follower departure aircraft from when the follower departure aircraft is given the clearance to line-up instruction. It is not until this occurs that the runway departure sequence order for the follower aircraft is established in relation to the lead aircraft ahead, and thus the PWS-D wake separation rules and SID route separation and other separation and spacing constraints can be applied by the OSD system support.

For time-based separation, it is proposed that the OSD system support calculates the earliest take-off clearance time or the earliest airborne time for the follower aircraft. This is the “Not Before Take-Off Time” or the “Not Before Airborne Time” for separation and spacing constraints supported by the OSD system support for displaying to the Tower Runway Controller. It is a “Not Before Take-Off Time” or “Not Before Airborne Time” as there may be other more constraining separation or spacing constraints unknown by the OSD system support that still need to be manually applied by the Tower Runway Controller.

It is proposed that the “Not Before Take-Off Time” or “Not Before Airborne Time” is displayed in a time field of the follower departure aircraft information in the electronic environment (e.g. a time field of the electronic flight progress strip of the departure aircraft in the Heathrow EFPS environment). This may or may not be supported by a count-down timer depending on local procedural preferences and the associated automated system support.

Procedural Option of Applying the Recorded “Start of Take-Off Roll Time”

In the local procedural option of applying the recorded “start of take-off roll time” of the lead aircraft, the earliest the take-off clearance may be issued to the follower aircraft is the time once the required time separation has elapsed after the lead aircraft recorded “start of take-off roll time”.

- For this local procedural option, the “Not Before Take-Off Time” for the separation constraints between the lead and follower aircraft, is the recorded “start of take-off roll time” for the lead aircraft, plus the required time separation for the largest separation constraint to the follower aircraft.
- This is in the case of when no larger constraint, such as a SID route separation to a proceeding aircraft in front of the lead aircraft is required to be applied, and is being supported by the OSD system support; in which the case the associated “Not Before Take-Off Time” for this larger separation constraint, is the recorded “start of take-off roll time” of the associated proceeding aircraft, plus the required time separation of the larger separation constraint.
- For this local procedural option, the Tower Runway Controller uses the “Not Before Take-Off Time” directly as the earliest time the take-off clearance may be issued.

Procedural Option of Applying the Recorded “Airborne Time”

In the local procedural option of applying the recorded “airborne time” of the lead aircraft, the earliest the take-off the clearance may be issued to the follower aircraft; with an allowance of the anticipated follower aircraft take-off roll time on the runway; is the time once the required time separation, minus the anticipated follower aircraft roll time on the runway has elapsed, after the lead aircraft recorded “airborne time”.

- For the local procedural option, the “Not Before Airborne Time” being the earliest time for the “airborne time” for the follower aircraft, the “Not Before Airborne Time” for the separation constraints between the lead and follower aircraft, is the recorded “airborne time” of the lead aircraft, plus the required time separation for the largest separation or spacing constraint to the follower aircraft.
- This is in the case of when no larger constraint, such as a SID route separation to a proceeding aircraft in front of the lead aircraft, is required to be applied and is being supported by the OSD system support; in which the case the associated “Not Before Airborne Time” for this larger separation constraint, is the recorded “airborne time” of the associated proceeding aircraft, plus the required time separation of the larger separation constraint.
- For this local procedural option, the Tower Runway Controller uses the “Not Before Airborne Time” as the earliest time for the “airborne time” of the follower aircraft, and mentally subtracts the anticipated roll time for the follower aircraft, to mentally establish the earliest time the take-off clearance may be issued.

- Note that in cases where the lead aircraft recorded airborne time is known to be late, due to a late manual indication action on the EFPS, the Tower Runway Controller may take this into account when mentally establishing the earliest clearance to take-off time.
- The Tower Runway Controller may prefer that the displayed “Not Before Airborne Time” is rounded up to the nearest 5 seconds, in order to simplify the mental calculation of subtracting the anticipated roll time.

- In the case when there is no wake separation constraint, and no other time separation constraints are either supported by the OSD support tool, or apply to the follower aircraft, the Tower Runway Controller prefers that the indication that no “Not Before Airborne Time” applies to the follower aircraft is displayed well before the lead aircraft becomes airborne, soon after the lead aircraft starts rolling, in order to prepare for giving clearance to take-off to the next aircraft, potentially immediately or soon after the lead aircraft becomes airborne.

Optional OSD Support for Other Departure Separation or Spacing Criteria

The “Not Before Take-Off Time” or the “Not Before Airborne Time” may just be based on the required wake separation to the lead departure aircraft ahead, or may take into account other departure separation or spacing criteria depending on local preferences:

- It is envisaged that there may be a local preference for the “Not Before Take-Off Time” or “Not Before Airborne Time” to at least be based on the required wake separation time to the lead departure aircraft ahead, and also the required SID route separation, or an indication of a possible SID route separation; with the responsibility for providing for the CTOT slot time, and the minimum departure intervals and average departure intervals, remaining with the Tower Runway Controller, without incorporating into the OSD system support.

  - Note that it is perceived as potentially significantly misleading for the “Not Before Take-Off Time” or the “Not Before Airborne Time” to be based just on the required wake separation time, due to the potential for the Tower Runway Controller being drawn into giving a clearance to take-off without consideration of the required SID route separation.

  - However the local application of the SID route separations may be too complex to be fully supported by the OSD system support, with the OSD system support just being able to provide an indication of a possible SID route separation. When this is the case the responsibility for providing for the required SID route separation remains with the Tower Runway Controller, without the SID route separation being incorporated into the “Not Before Take-Off Time” or “Not Before Airborne Time”.

- It is envisaged that there may be a local preference for the “Not Before Take-Off Time” or “Not Before Airborne Time” to also include consideration of SID route related Minimum Departure Intervals (MDIs) and Average Departure Intervals (ADIs).

- It is not envisaged that the CTOT slot times need to be included when calculating the "Not Before Take-Off Time" or "Not Before Airborne Time", as the issues associated with conformance to a CTOT slot time are usually resolved before the departure aircraft is given the clearance to line-up. Coordination may have taken place for the departure aircraft to take-off outside of the CTOT slot time, without the CTOT slot time being updated, and so the CTOT slot time constraints may no longer apply.

Note that with SID route separations, there may be a need to take into account the "start of take-off roll time" or "airborne time" of not just the lead departure aircraft ahead, but also the previous departure aircraft ahead (for a 2 minute SID route separation), and also the previous to the previous departure aircraft ahead (for a 3 minute SID route separation). This is also a consideration for supporting MDIs and ADIs on particular SID routes; there is a need to retain a sufficient horizon of the previous departure aircraft that have taken-off, with associated "start of take-off roll time" or "airborne time" and SID route information. MDIs are specified in minutes, typically from 3 minutes up to 10 minutes.

With respect to applying the SID route separations, it is proposed that the OSD system support be able to support the local SID routes from each of the departure runways, with the associated SID route separations, including the application of the additional separation when the lead aircraft type is in a slower speed group than the follower aircraft type, with either none, one or two intervening speed groups, depending on the SID route combination. Within the enabling context of the OSD system support, there may be a possibility of the refinement of the application of the SID route separations, directly taking into account aircraft type speed characteristics rather than just speed group speed characteristics.

Departure Pairs Not Constrained by a Wake Separation

When a departure pair is not constrained by a wake separation, or a SID route separation, then either a reduced separation in the vicinity of the aerodrome (RSVA) is applied, or the 3 NM MRS is applied. There is not a requirement to apply a 60s time separation minimum. Because of this there is no time separation to be applied for the OSD system support to calculate a "Not Before Take-Off Time" or a "Not Before Airborne Time" for the follower aircraft. For these departure pairs the OSD system support will need to indicate that no "Not Before Take-Off Time" or "Not Before Airborne Time" applies to the follower aircraft, for example by displaying "NONE" or "----" in the MM:SS fields of the "Not Before Take-Off Time" or "Not Before Airborne Time".

High Integrity Data Requirements

To calculate the required wake separation, the OSD system support is required to be provided with high integrity aircraft type and wake category information. This may be provided from flight data processing, or from the Tower Runway Controller electronic environment. In order to ensure the integrity of the aircraft type information, there will need to be associated controller procedures with respect to checking and amending the aircraft type and wake category information, preferably prior to the departure aircraft reaching the departure holding points, while at the latest prior to the departure aircraft being given clearance to line-up.

To correctly calculate the required wake separation for a departure aircraft taking-off from an intermediate position, the OSD system support needs to be notified of when a departure aircraft is taking-off from an intermediate position.

To correctly apply the required SID route separations and for supporting MDIs and ADIs on particular SID routes, the OSD system support is required to be provided with the high integrity SID route information for each departure aircraft. This may be provided from flight data processing, or from the Tower Runway Controller electronic environment. In order to ensure the integrity of the SID route information, there will need to be associated controller procedures with respect to checking and amending the SID route information, preferably prior to the departure aircraft reaching the departure holding points, while at the latest prior to the departure aircraft being given clearance to line-up.

Flight Crew Requests for the Application of RECAT-EU or ICAO Wake Separations

There may be situations where a flight crew requests the application of RECAT-EU or ICAO departure wake separations. For the ORD system support to be able to provide support for this, the OSD system support will need to be notified of the request, in order for the OSD system support to correctly calculate the required RECAT-EU or ICAO wake separation.

Clear Indication of a Wake Separation

It is envisaged that there may be a local preference for a clear indication to be provided when the "Not Before Take-Off Time" or "Not Before Airborne Time" is for a wake separation, rather than a SID route separation, or MDI or ADI. To support this, the OSD system support will need to indicate when the "Not Before Take-Off Time" or "Not Before Airborne Time" is for a wake separation.

On being provided with a "Not Before Take-Off Time" or a "Not Before Airborne Time" the Tower Runway Controller may wish to review which separations have been taken into consideration to derive the "Not Before Take-Off Time" or "Not Before Airborne Time"; the wake separation, the SID route separation, the MDI or ADI, and so on. To support this, the OSD system support will need to provide all the constituent separation information associated with a "Not Before Take-Off Time" or "Not Before Airborne Time".

Provision of a Countdown Timer

If Countdown Timer support is provided the zero of the countdown should be that of the "Not Before Take-Off Time" or "Not Before Airborne Time". The countdown timer may be analogue or digital, and the display window it is displayed in may also include information to facilitate the situation awareness of the Tower Runway Controller such as the required wake separation time and associated context such as the entry taxiways and wake categories of the associated preceding and following aircraft, depending on local preferences. Figure 21 provides an illustration of a display window with a digital countdown timer.

OSD Support for Distance Separations

For distance-based separation, there is a need to develop the OSD system support. A possible approach is for the OSD system support to calculate the required minimum distance spacing from the line-up position of the follower aircraft (or the line-up end of the runway) that the lead aircraft ahead is required to achieve, before issuing the clearance to take-off to the follower aircraft.

- This is so that when the follower aircraft rotates and becomes airborne the required distance-based separation to the lead aircraft ahead is achieved.
- It is proposed that the required minimum distance is displayed as an arc or line across the planned SID route of lead aircraft ahead on the Tower Runway Controller radar display. This is the “Dynamic Departure Indicator -Distance” (DDI -D) and is illustrated in Figure 21.
- It is possible that the DDI-D may be displayed once the lead aircraft ahead is rolling. This is based on the assumption that the displayed DDI-D for the required minimum distance spacing in front of the lead aircraft ahead is no longer required once the clearance to take-off has been issued and the lead aircraft is rolling.

An algorithm for calculating the required minimum distance spacing from the line-up position of the follower aircraft (or the line-up end of the runway) has been developed and validated. There is a need for the algorithm to take into account the impact of the prevailing wind conditions on the ground speed of the lead aircraft on the initial departure path as this is impacts the amount of increase in the separation to the follower aircraft over the take-off roll time of the follower aircraft.

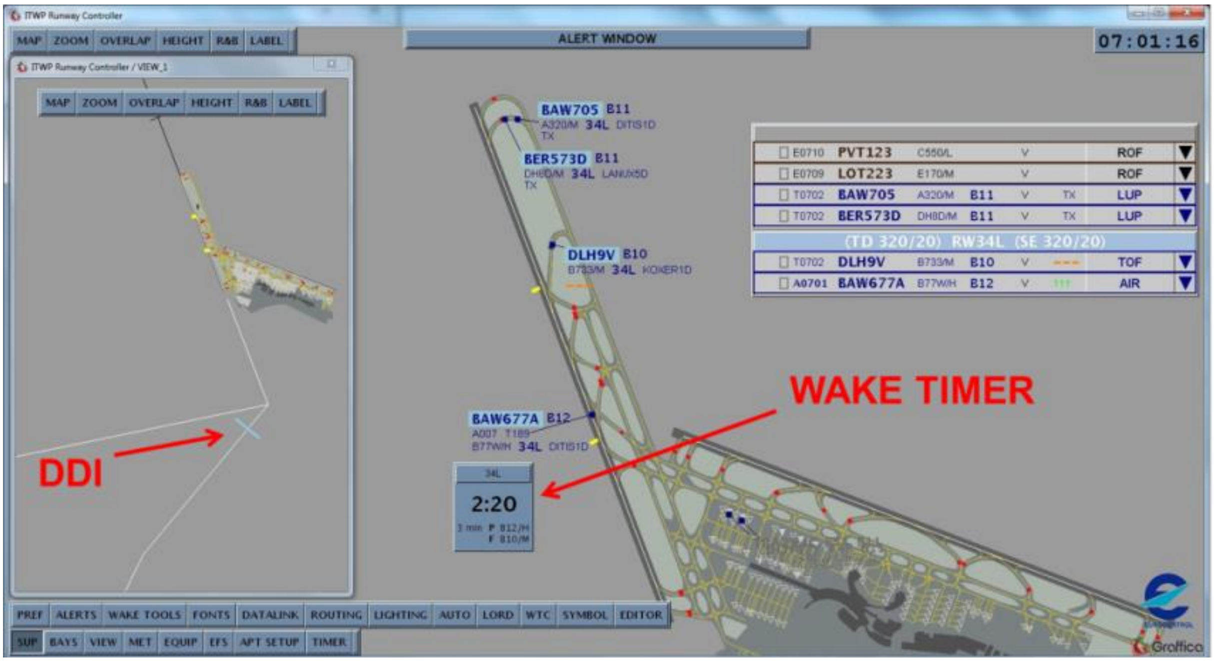


Figure 21: Illustration of a Departure Distance Indicator (DDI) and a Digital Count Down Timer (WAKE TIMER) on an Integrated Tower Workstation Position (ITWP)

Note that the Departure Distance Indicator (DDI) has been renamed the Dynamic Departure Indicator – Distance (DDI-D) and the Digital Countdown Timer (WAKE TIMER) has been renamed Dynamic Departure Indicator – Time (DDI-T).

Aircraft separation is calculated depending on the separation scheme, whether is time-based (TBS) or distance-based (DBS), and the type of separation constraint: Wake Turbulence, Minimum Radar Separation (MRS) and/or Weather Dependent.

For departure operations, the EUROCONTROL OSD tool supports the following separation rules:

- Wake Turbulence Separation: TBS or DBS, with delivery point at the follower's take off position
- Minimum Radar Separation (MRS): DBS, with delivery point at the follower's take off position
- Other DBS spacing constraint, potentially satisfied at delivery altitude

OSD Support for Mixed Mode Operations

It is anticipated that a Coupled AMAN/DMAN as developed in SESAR Solution PJ02-08 will be employed to coordinate the arrival and departure flow rates and the associated departure gap provision between the arrival aircraft.

In ECTL RTS3a where a Coupled AMAN/DMAN was not employed it was found that additional support was required to tactically coordinate the departure gap provision between arrival aircraft on intermediate and final approach.

3.3.2.2.1.2 Proposed Provision of Departure Sequence Order to the OSD System Support

The DMAN System departure sequence order is used to support the push-back and ground movement decisions to the departure holding points. It is not necessarily updated to reflect that some aircraft may not be ready to line-up when at the holding points and that the Tower Runway Controller is required to make late tactical decisions as to the actual order that aircraft are lined-up and take-off. Because of this the DMAN System departure sequence order may not be a suitable order for use by the OSD system support.

It is proposed that the departure sequence information is provided from the Tower Runway Controller electronic environment.

- When a departure aircraft is provided with the instruction for clearance to line up, or for the combined clearance to line-up and take-off, and the departure aircraft is moved to the line-up area or the take-off area of the associated runway bay it is proposed the departure sequence ordering in the runway bay is provided, across both the line-up area and take-off area.
- When a departure aircraft takes-off and is moved from the runway bay to the airborne departure bay it is proposed that the updated departure sequence ordering in the airborne departure bay is provided together with the associated "airborne time" or "start of take-off roll time" of each departure aircraft.

An alternative approach to providing for the departure sequence information, particularly in paper flight progress strip environments, is to employ ground movement surveillance monitoring of when departure aircraft enter the runway and line-up, including the line-up order when multiple departure aircraft are lined-up, and also ground movement and/or air movement surveillance monitoring of the departure aircraft ahead either rolling down the runway or airborne on the initial departure path.

Note that for applying SID route separations there may be a need to retain at last three previous departure aircraft with their associated "Start of take-off roll time" or "airborne time" and SID route information.

Note that for applying SID route MDIs and ADIs there may be a need to retain up to ten minutes of previous departure aircraft with their associated "airborne time" or "start of take-off roll time" and SID route information.

3.3.2.2.1.3 Proposed Provision of the Departure "Start of Take-Off Roll Time" to the OSD System Support

It is proposed that the "start of take-off roll time" is provided through ground movement surveillance of the line-up and initial roll of the aircraft, from each of the line-up positions on each departure runway. The "start of take-off roll time" is the time the aircraft is observed as commenced rolling beyond the line-up and wait position with a minimum ground speed such as 15 knots.

An alternative approach is for the "start of take-off roll time" to be provided from the Tower Runway Controller electronic environment when the departure aircraft is seen as commenced rolling beyond the line-up and wait position.

3.3.2.2.1.4 Proposed Provision of the Departure "Airborne Time" to the OSD System Support

It is proposed that the "airborne time" of a departure aircraft is provided from the Tower Runway Controller electronic environment when the departure aircraft is seen as initially airborne by the Tower Runway Controller and the associated flight data entry (FDE) or flight progress strip (FPS) is moved to the airborne departure bay.

An alternative approach, particularly in a paper flight progress strip environment, is to employ ground movement and air movement surveillance, including the related downlinked airborne parameter (although this can be inconsistent for some aircraft types), to determine when each aircraft rotates and initially becomes airborne. This may also be considered in conjunction with a Tower Runway Controller electronic environment, in order to improve the consistency of the airborne time information, particularly if there is the possibility of any inconsistency in the time the departure aircraft may be moved to the airborne departure bay, especially if this could be early, and also if this could be significantly late.

3.3.2.2.1.5 Proposed Provision of Departure Sequence Order Optimisation Support

Optimisation of the Departure Sequence Order starts from establishing the Target Off Blocks Time to being delivered to the departure holding positions for the departure runway-in-use. This is supported by the DMAN System in conjunction with the A-CDM System.

It is proposed for PWS-D that this is continued to be supported in the same way, with the DMAN System taking into account the more efficient PWS-D wake separation rules.

A potential issue with PWS-D and WDS-D, is the possible need to support tactical departure sequence order optimisation, when a departure aircraft at the departure holding position is unready to line-up, approaching the time for the line-up clearance for the optimised departure sequence order, and reports that they may be unready for some time, and thus an alternative departure aircraft will need to be given a line-up clearance, in order to maintain an efficient departure flow from the runway. In this situation the Tower Runway Controller may decide on a revised order sequence order, by applying similar criteria as per today, mentally deciding on the revised departure sequence order without sequence order optimisation system support, or possibly more preferentially, to be provided with a revises optimised departure sequence order by extending the DMAN system support.

3.3.2.2.2 Enabling the Employment of the WDS-D Conditional Reduction or Suspension of the Wake Separation Rules (AO-0304)

3.3.2.2.2.1 WDS-D System Support

It is proposed that WDS-D system support is provided to inform Tower ATC of when WDS-D can be applied, and for supporting the decisions and coordination required, for the transition to employing the WDS-D conditional reduction or suspension of the wake separation rules, and also the timely transition to employing standard PWS-D wake separation rules.

It is proposed that sufficient conservatism is applied with respect to wind conditions criteria for employing WDS-D, such that there is assurance of sufficient persistence of the conditions when the follower aircraft is given clearance to line up.

It is proposed that the GO/NO GO Indication of the wind conditions criteria is presented on the wind conditions display of the Tower Supervisor, together with the prevailing/forecast wind criteria basis for the GO /NO GO Indication.

With respect to a transition from NO GO to GO, the Tower Supervisor may then make a decision to authorise the application of the WDS-D reduced wake separations, which then enables the GO Indication, together with the prevailing/forecast wind criteria basis, to be displayed on the wind conditions display at all the Tower ATC working positions. The Tower Supervisor may in some circumstances wish to pre-authorise the application of the WDS-D reduced wake separations when there is queued departure traffic and it forecast that the wind criteria will be satisfied in the near future.

With respect to the controlled transition from GO to NO GO by the Tower Supervisor, in advance of the prevailing/forecast wind conditions not meeting the wind conditions criteria, the Tower Supervisor may make a decision to withdraw the authorisation for the application of the WDS-D reduced wake separations, which then changes the GO Indication to a NO GO Indication on the Tower ATC working positions.

With respect to the uncontrolled transition from GO to NO GO, when the wind conditions change such that the wind conditions criteria are no longer prevalent, the Tower Supervisor is informed of the NO GO Indication on their wind conditions display, so that they can action withdrawing the authorisation to employ the reduced wake separation. Optionally, the WDS-S system support may automatically action the withdrawing of the authorisation to employ the reduced wake separation. The withdrawing of the authorisation changes the GO Indication to a NO GO Indication on the Tower ATC working positions.

There may be situations where the Tower Runway Controller decides that it is inappropriate to apply the reduced wake separations while there is a GO Indication. In these situations the Tower Runway Controller can either apply standard wake category based wake separation manually, probably RECAT EU wake separations, or co-ordinate with the Tower Supervisor to request withdrawing the authorisation to employ the reduced wake separation, to change the GO Indication to a NO GO Indication.

3.3.2.2.2.2 Enhanced OSD System Support (AO-0329)

It is proposed that in the case of a conditional reduction of the wake separation rules, the OSD system support is enhanced to include these conditional reductions when calculating the required wake separation, and is notified of when to apply the WDS-D reduced wake separations, and when to apply the PWS-D standard wake separations.

For WDS-D based on crosswind transport of the wake vortices generated by the departure aircraft ahead out of the path of the departure aircraft, these conditional reductions are dependent on the departure aircraft SID route being upwind of the departure aircraft ahead SID route beyond the initial departure path. This will need to be supported and taken into account by the Enhanced OSD system support when applying the WDS-D reduced wake separations. There will also need to be assurance of the integrity of the SID route information, with associated controller procedures with respect to checking and amending the SID route information, prior to the departure aircraft reaching the departure holding points.

At any time the Flight Crew may request the application of standard wake separation, rather than the reduced wake separation. In this situation the Tower Runway Controller can manually apply the standard wake category based wake separation, probably RECAT EU wake separations and/or possibly ICAO wake separations. An optional alternative is to provide the Tower Runway Controller with the means to indicate to the Enhanced OSD tool support when there has been a request for the standard wake separation to be applied, so that the Enhanced OSD tool support is directed to use the standard wake separation.

There may be situations where the Tower Runway Controller decides that it is inappropriate to apply the reduced wake separations when there is a GO Indication. In these situations the Tower Runway Controller can manually apply the standard wake category based wake separation, probably RECAT EU wake separations, in advance of the co-ordination with the Tower Supervisor to request withdrawing the authorisation to employ the reduced wake separation, so as to change the GO Indication to a NO GO Indication.

3.3.2.2.2.3 Conformance Monitoring and Alerting Support

For WDS-D based on cross-wind transport there may be a need to provide for conformance monitoring of the trajectory of the departure aircraft ahead, with respect to lateral navigation performance against the centre-line of the initial departure path, and the turn on to the planned SID route, and to alert the Tower Runway Controller when the departure aircraft ahead deviates outside of the required lateral navigation performance, such that the risk of a WVE by the departure aircraft has been unacceptably increased. This is so as to alert the Tower Runway Controller to the potential need to take action, with respect to protecting the departure aircraft. Similarly there may also be the need to provide for conformance monitoring of the trajectory of the departure aircraft, with respect to lateral navigation performance against the centre-line of the initial departure path, and the turn on to the planned SID route.

For WDS-D based on differentiated rotation position and differentiated climb profile, there may be a need to provide for conformance monitoring of the rotation position and vertical climb profile of the departure aircraft ahead, with respect to the anticipated rotation position and anticipated vertical climb profile performance for the aircraft type or wake category, and to alert the Tower Runway Controller, when the departure aircraft ahead deviates outside of the required rotation position performance, or vertical climb profile performance, such that the risk of a WVE by the departure aircraft has been unacceptably increased. This is so as to alert the Tower Runway Controller to the potential need to take action, with respect to protecting the departure aircraft. Similarly there may also be the need to provide for conformance monitoring of the rotation position, and climb profile of the departure aircraft, with respect to the anticipated rotation position performance, and anticipated vertical climb profile performance, of the aircraft type or wake category.

3.3.2.2.3 Supporting the Coordination for Ensuring Appropriate Pressure of Departure Traffic

The queue management processes optimising the departure queue, will need to take into account the efficient PWS-D and WDS-D wake separation rules, in order to ensure the appropriate pressure of departure traffic is presented to the Tower Runway Controller, at the runway holding positions.

It is proposed that the DMAN and A-CDM system support is enhanced, to take into the more efficient wake separation rules, and that the coordination and supporting procedures, for the transitions to/from employing the WDS-D conditional reduction or suspension of the wake separation rules, includes ensuring that the DMAN System and A-CDM System support, are taking into account the impact on the associated required pressure of traffic.

3.3.2.2.4 Supporting the Coordination with TMA Operations

In a complex TMA servicing several airports, it may be important that TMA Operations are informed of when WDS-D is to be employed, so that the increase in the resulting departure rate can be taken into account.

It is proposed that where this is the case, that TMA Operations is informed of when WDS-D is able to be employed, together with the anticipated impact on the departure rate, so that consideration can be given as to whether departure rate restrictions will be required to be applied.

3.3.2.3 Wake Risk Monitoring Concept Solution

The new operating method for **wake turbulence detection and monitoring** will include an objective and automated tool for identification and reporting of wake turbulence encounters. This solution can replace the manual reporting of the previous operating method.

In the new operating method, wake turbulence encounters in daily operation are automatically identified based on aircraft avionics data and traffic data. The tool automatically creates a report in a digital format without any interaction by the flight crew necessary. These reports can be collected and stored in a common database. Such a process can thus satisfy the recommendation of ICAO note AN 13/4-07/67.

The detection and monitoring tool will typically run during the Post-execution phase, without any direct influence on any Execution phase activities. The results can for example be used to verify and monitor that the level of safety concerning wake turbulence encounters is maintained after a change of wake separation rules, or to support adjustment and optimisation of the wake separation rules.

3.3.2.4 Wake Decay Enhancing Concept Solution

Plate lines constitute a *passive* means that reduces the lifetime of the most critical and long-lived wake vortices close to the ground. It reduces the frequency of encounters during landing and thus contributes to increase the safety level. Once the measurements at Vienna airport are assessed and the associated safety gain is quantified, it can be evaluated whether the accelerated vortex decay can be exploited for the further optimization of arrival separations or whether it should just be considered as one contribution to make aviation safer. Probably the degree of exploitation of the concept for reducing the separation will be dependent on the quality of MET information available.

3.3.2.5 Use Cases

3.3.2.5.1 Arrivals Concepts Solutions

3.3.2.5.1.1 [NOV-2] Operational Node View for Wake Turbulence Separation Optimisation for Arrivals Concepts Solutions

The Operational Node View in Figure 22 summarises the information exchanges for PJ02-01 concepts for arrivals described in the following Use Cases:

Use case	[NOV-5][ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)
Use case	[NOV-5][ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)
Use case	[NOV-5][MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)
Use case	[NOV-5][MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

There are additional information exchanges from Aerodrome ATS to the Flight Crew informing of the runways in use and associated operating modes, the prevailing operating conditions, and other important operational information through the automatic terminal information service (D-ATIS). Additionally, on first contact, Aerodrome ATC inform the Flight Crew of the prevailing runway surface wind conditions.

There are additional information exchanges between Approach ATC and the Flight Crew, for example with respect to informing of the landing runway and the final approach procedure to be flow.

These additional information exchanges from Aerodrome ATS to the Flight Crew between Approach ATC and the Flight Crew are not modelled in the Operational Node View in Figure 22 for simplification, and also because the Arrivals Concepts Solutions of PJ02.01 do not impact these additional information exchanges.

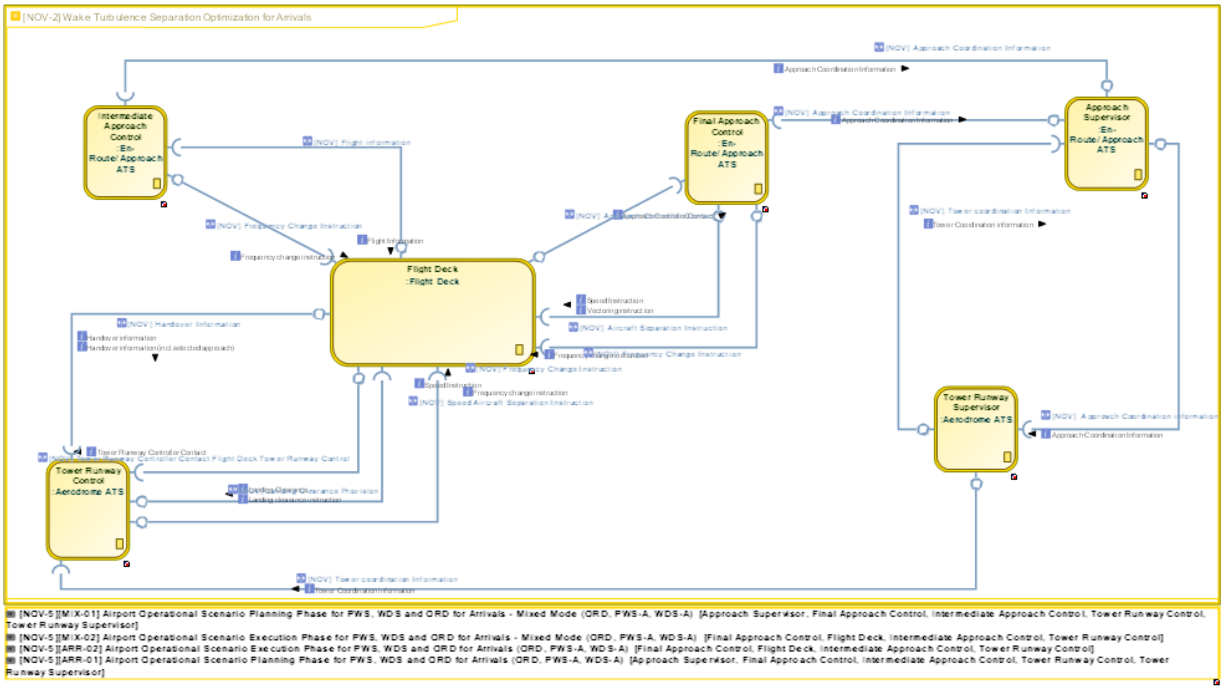


Figure 22: [NOV-2] Operational Node View for Wake Turbulence Separation Optimisation for Arrivals

The [NOV-2] Operational Node View provided in Figure 22 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the operational node view is also provided below.

NOV-2-ARR.pdf

3.3.2.5.1.2 [NOV-5][ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

This Use Case takes place in the planning or tactical execution phase. It describes the coordination workflow and exchanges between ATC Supervisors (Tower and Approach) and Controllers when a scenario change is detected.

The following scenarios changes are identified:

- Conditional usage of WDS, based on nowcast and forecast weather conditions.
- Degraded mode of operations, where the ATCO Separation Delivery Tool or supporting services like GWCS are no longer suitable for operations.

Other specific non-nominal/alternative flows in addition to the cases mentioned above (e.g. planned or unplanned change of runway in-use) are detailed in the SESAR 1 OFA 01.03.01 Enhanced Runway Throughput OSED [56].

The use case starts when the Tower or Approach Supervisor identifies the need for a change in the scenario. The nominal flow ends when the new scenario is implemented.

General Conditions (Scope and Summary)

Approach and Tower controllers make use of ORD and related SESAR 1 and SESAR2020 concepts (e.g. TBS-A, PWS-A. WDS-A) as described in [NOV-5] [ARR-02].

Approach and Tower Supervisors put in place a coordination process that can lead to the following scenarios change:

- Conditional usage of WDS, based on nowcast and forecast weather conditions.
- Degraded mode of operations, where the ATCO Separation Delivery Tool or supporting services like GWCS are no longer suitable for operations.

Pre Conditions

The Separation Delivery tool and all applicable alerting / monitoring tools are operational.

The GWCS is operational.

The Approach Arrival Sequence Service is operational.

Post Conditions

Post conditions are depending on the change scenario implemented:

- **WDS**: The Approach and Tower Supervisors have coordinated the activation/deactivation of the WDS-A concept considering the current wind conditions (and coordinated with the MET service if needed).
- **Degraded Mode**: The Approach and Tower Supervisors have coordinated the reversion to DBS with or without TDI. The Separation Delivery tool and/or all applicable alerting / monitoring tools and/or GWCS and/or Approach Arrival Sequence Service are no longer operational.

For all the scenarios changes an updated flow of arrival aircraft for the aerodrome into the TMA is established. The new flow matches the runway capacity in the prevailing operating conditions.

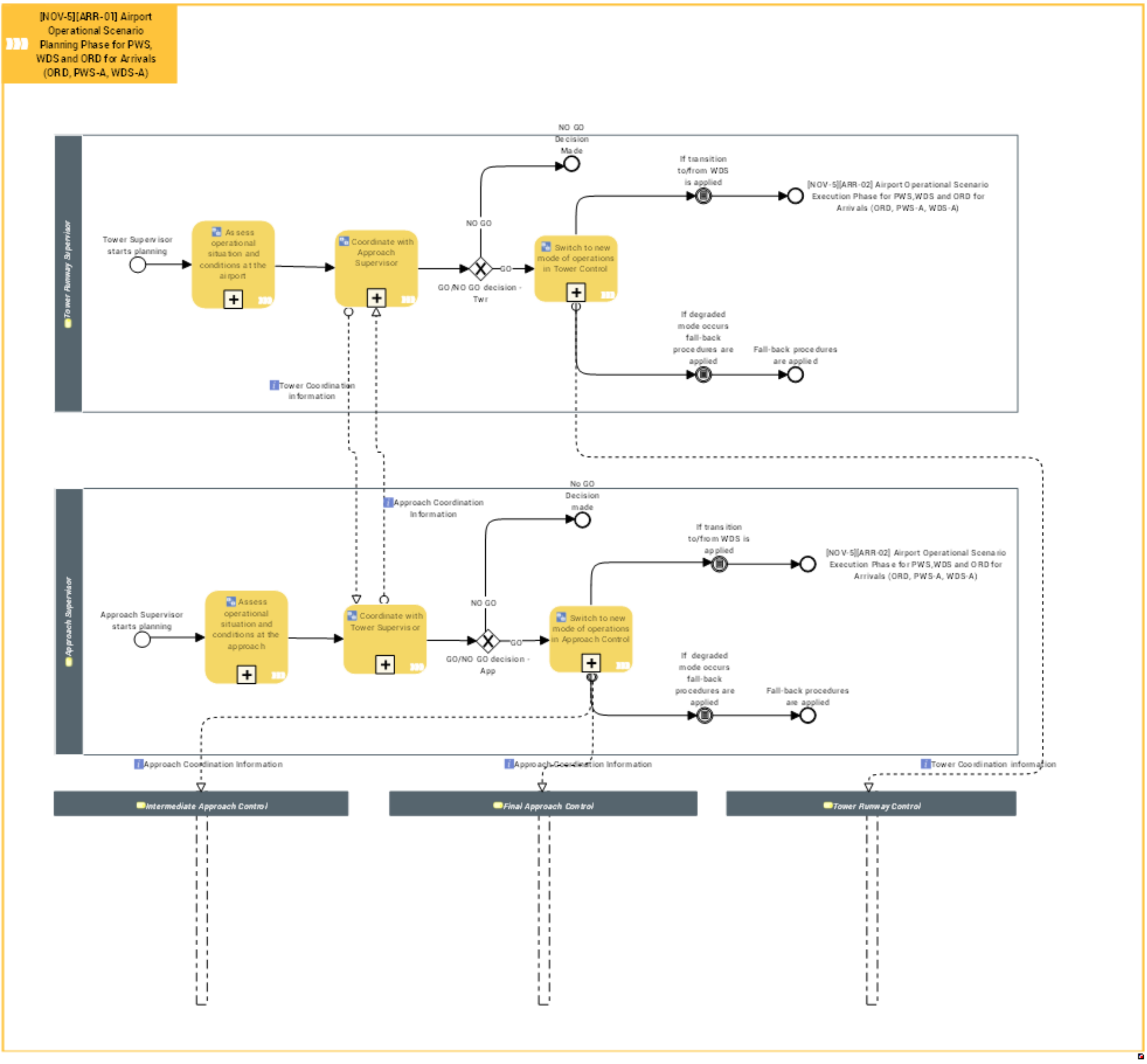


Figure 23: [NOV-5] [ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

The [NOV-5] Process Diagram provided in Figure 23 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-ARR-01.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 32 and Table 33 respectively.

Activity	Description
Assess operational situation and conditions at the airport	The Tower Supervisor is continuously monitoring and assessing the operational situation and conditions at the airport. For this purpose, the Tower Supervisor analyses the current and near-future status of the following elements: • mode of operation • traffic situation and composition • wind conditions • runway status This is in order to determine if a change in the mode of operations is needed. The Tower Supervisor also provides and receives feedback about the current status from the Tower Runway Controller.
Assess operational situation and conditions at the approach	The Approach Supervisor is continuously monitoring and assessing the operational situation and conditions at the approach control area of an airport. For this purpose, the Approach Supervisor analyses the current and near-future status of the following elements: • mode of operation • traffic situation and composition • wind conditions • runway status This is in order to determine if a change in the mode of operations is needed. The Approach Supervisor also provides and receives feedback about the current status from the Approach Controller(s).
Coordinate with Approach Supervisor	The Tower Supervisor might decide to • optimise the mode of operations due to the compliance with certain conditions (e.g. to provide specific traffic spacing scenario or to activate weather dependant separations due to the forecast information) • shift mode of operations to cope with the short-term changing environment (e.g. runway closure, unexpected wind change, failure of ATCO separation delivery tool) The Tower Supervisor contacts the Approach Supervisor to discuss the options and agree on timing and mode of operations to be applied.
Coordinate with Tower Supervisor	The Approach Supervisor might decide to • optimise the mode of operations due to the compliance with certain conditions (e.g. to provide specific traffic spacing scenario or to activate weather dependant separations due to the forecast information) • shift mode of operations to cope with the short-term changing environment (e.g. runway closure, unexpected wind change, failure of ATCO separation delivery tool) The Approach Supervisor contacts the Tower Supervisor to discuss the options and agree on timing and mode of operations to be applied.
Switch to new mode of operations in Approach Control	After coordination with the Tower Supervisor on the terms and details of the transition to a different mode of operations, the Approach Supervisor informs the Approach Controller(s) of the coordinated decision. There might be the need to apply the proposed changes to the ATCO Separation Delivery Tool.

Activity	Description
	<u>WDS</u> In the case of transition from one mode of operation to WDS (and vice-versa) the Tower or Approach Supervisor selects on the Separation Delivery Tool Sequence List the first aircraft from which the new mode will be applied. The Approach Supervisor will also ensure the applied change is properly reflected in Approach CWP (e.g. TDIs have been adapted to the WDS, sequence list indicates the new mode of operations). [NOV-5] [ARR-02] is applied. <u>DEGRADED MODE</u> In the case of degraded mode (e.g. due to failure of TDI, arrival sequence, GWCS...) the Approach Supervisor informs the Approach Controller of the switch to degraded mode operations applying DBS with or without the TDI (depending on whether the type of failure impacts the TDI calculation and display in DBS or not).
Switch to new mode of operations in Tower Control	After coordination with the Approach Supervisor on the terms and details on the transition to a different mode of operations, the Tower Supervisor informs the Tower Runway Controller of the coordinated decision. There might be the need to apply the proposed changes to the ATCO Separation Delivery Tool. <u>WDS</u> In the case of transition from one mode of operation to WDS (and vice-versa) the Tower or Approach Supervisor selects on the Separation Delivery Tool Sequence List the first aircraft from which the new mode will be applied. The Tower Supervisor will also ensure the applied change is properly reflected in Tower CWP (e.g. TDIs have been adapted to the WDS, sequence list indicates the new mode of operations). [NOV-5] [ARR-02] is applied. <u>DEGRADED MODE</u> In the case of degraded mode (e.g. due to failure of TDI, arrival sequence, GWCS...) The Tower Supervisor informs the Tower Runway Controller of the switch to degraded mode operations applying DBS with or without the TDI (depending on whether the type of failure impacts the TDI calculation and display in DBS or not).

Table 32: Activity Descriptions for [NOV-5] [ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Tower Runway Supervisor	Switch to new mode of operations in Tower Control o--> Tower Runway Control	Tower Runway Control	Tower Coordination information	CoordinationMessage
Approach Supervisor	Switch to new mode of operations in Approach Control o--> Intermediate Approach Control	Intermediate Approach Control	Approach Coordination Information	CoordinationMessage
Approach Supervisor	Switch to new mode of operations in Approach Control o--> Final Approach Control	Final Approach Control	Approach Coordination Information	CoordinationMessage
Approach Supervisor	Coordinate with Tower Supervisor o--> Coordinate with Approach Supervisor	Tower Runway Supervisor	Tower Coordination information	CoordinationMessage
Tower Runway Supervisor	Coordinate with Approach Supervisor o--> Coordinate with Tower Supervisor	Approach Supervisor	Tower Coordination information	CoordinationMessage

Table 33: Information Exchange Descriptions for [NOV-5] [ARR-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

3.3.2.5.1.3 [NOV-5][ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

This use case takes place in the execution phase. It describes the operational flow involved in sequencing and delivering arrival aircraft on the approach phase with an Optimised Runway Delivery (ORD) Separation tool, which is available for Approach and Tower Control use. This ORD tool computes two indicators on the HMI (Initial and Final Target Distance Indicators -ITD, FTD-). Indicators are computed according to the different SESAR1 and SESAR2020 concepts which are applied (e.g. ORD, TBS, PWS-A and/or WDS-A).

This use case starts when the flight enters the TDI Area (taking into account that the Flight Deck has prepared and briefed the approach at the end of cruise). The nominal flow ends when the aircraft has landed.

General Conditions (Scope and Summary)

This Use Case describes the steps involved in sequencing and delivering arrival aircraft using the applicable SESAR1 and SESAR2020 concept (e.g. TBS, PWS-A, ORD and/or WDS-A) on final approach with the aid of TDIs displayed on the extended runway centreline of the Final Approach Controller radar display and Tower Runway Controller air traffic monitor display.

This Use Case takes place from the arrival aircraft entering the TDI area until the arrival aircraft lands and vacates the runway.

The Approach Operations in this Use Case are equipped with (some are optional subject to a local safety case):

- Separation Delivery tool;
- Approach Arrival Sequence Service;
- Approach Arrival Sequence Display;
- Wrong aircraft turned on TDI alert;
- Aircraft turned onto wrong localiser alert;
- Speed conformance alert;
- ITD catch-up alert;
- Separation Delivery tool monitor;
- GWCS monitor;
- Approach Arrival Sequence monitor;
- GWCS and distance display;
- Wind monitor / alert;

The Tower Operations in this Use Case are equipped with (some are optional subject to a local safety case):

- Separation Delivery tool;
- Approach Arrival Sequence Display;
- Speed conformance alert;
- ITD catch-up alert;
- Separation Delivery tool monitor;
- GWCS monitor;
- Approach Arrival Sequence monitor.

Pre Conditions

Airport Medium / Short Term Planning and Demand and Capacity Balancing have established a flow of arrival aircraft for the aerodrome into the TMA that matches the runway capacity in the prevailing operating conditions.

The approach arrival sequence into the IAFs is optimised as far as reasonable and if applicable is reflected in the AMAN.

The Separation Delivery tool and all applicable alerting / monitoring tools are operational.

The GWCS is operational.

The Approach Arrival Sequence Service is operational.

If applicable, the Approach and Tower Supervisors have coordinated the activation of the concept (TBS-A or WDS-A) considering the current wind conditions (and coordinated with the MET service if needed).

The Flight Crew are aware that an alternative WT scheme (TBS-A, PWS-A or WDS-A) is being employed on final approach through notification via the Aeronautical Information Publication (AIP), the pre-departure briefing, the top of descent briefing, and from the D-ATIS notification as the aircraft enters the TMA.

The Flight Crew establish the landing stabilisation speed required for the landing weight, cockpit stabilisation procedures including approach flap setting, and D-ATIS reported runway surface wind conditions soon after the aircraft enters the TMA.

The Flight Crew are aware of the runway in use and the approach type.

Post Conditions

The arrival aircraft has landed and vacated the runway.

Actors

Approach Supervisor, Tower Supervisor, TMA Sector Controllers, Intermediate Approach Controller, Final Approach Controller, Tower Runway Controller, Flight Crew.

Trigger

Coordination of an arrival aircraft into the assigned IAF is initiated between the TMA Sector Controller and the Intermediate Approach Controller.

Nominal Flow Process Diagram

The nominal flow is represented in the [NOV-5] [ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A) in Figure 24.

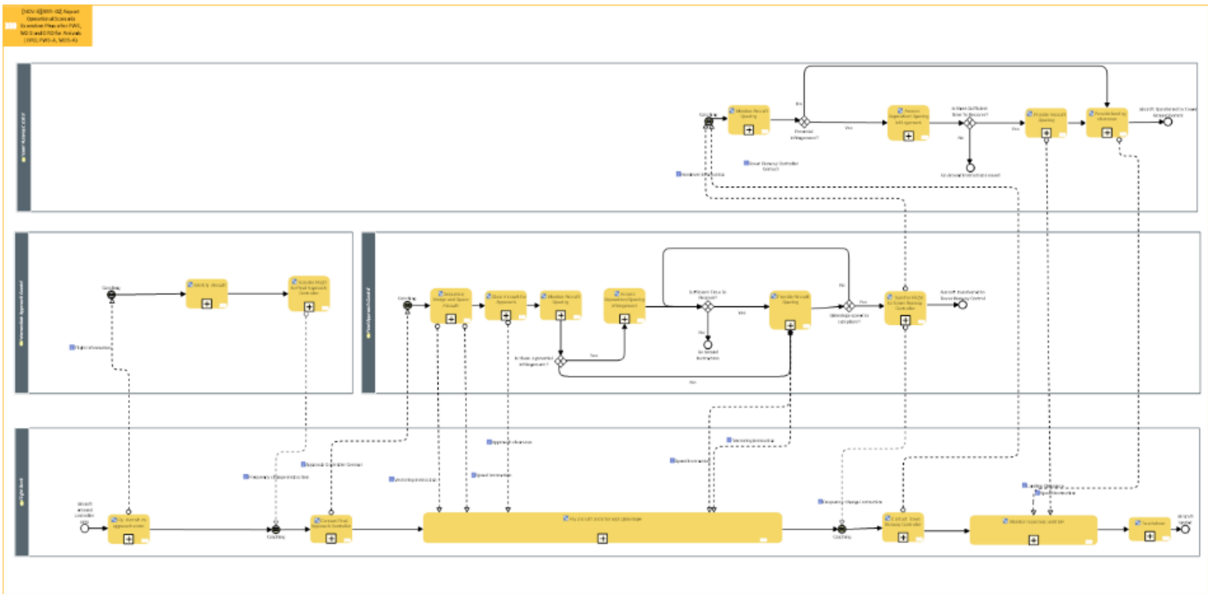


Figure 24: [NOV-5] [ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

The Process Diagram for [ARR-02] in Figure 24 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-ARR-02.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 34 and Table 35 respectively.

Activity	Description
Assess Separation/Spacing Infringement (Final Approach Control)	If an ITD infringement occurs, the Final Approach Controller assesses the feasibility and time to recover the flight. According to the result of the assessment: • Nominal: If it is positive, the Final Approach Controller will provide spacing through speed and/or vectoring instructions. • Non-Nominal: If it is negative, the Final Approach Controller will instruct the Flight Deck to go-around
Assess Separation/Spacing Infringement (Tower Runway Control)	If an FTD infringement occurs, the Tower Runway Controller assesses the feasibility and time to recover the flight. According to the result of the assessment: • Nominal: If it is positive, the Tower Runway Controller will provide spacing through speed and/or vectoring instructions. • Non-Nominal: If it is negative, the Tower Runway Controller will instruct the Flight Deck to go-around
Clear Aircraft for Approach	Nominal The Approach Controller authorises the aircraft to follow the approach procedure towards the runway. Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Contact Final Approach Controller	Nominal Flight Deck changes frequency in FMS following ATC instructions and contacts Final Approach Controller
Contact Tower Runway Controller	Nominal Flight Deck changes frequency in FMS following ATC instructions and contacts Tower Runway Controller
Fly aircraft and intercept glideslope	Nominal The Flight Deck flies the aircraft following previous ATC instructions towards intercepting the localiser and glideslope of the runway
Fly aircraft on approach route	Nominal Once the a/c enters the initial approach area (from IAF to FAF), the Flight Deck flies the aircraft following ATC speed and vectoring (vertical and horizontal) instructions
Identify Aircraft	Nominal Once the aircraft enters the TDI area, the corresponding ITD (Initial Target Distance) indicator and FTD (Final Target Distance) indicator are computed and displayed in the HMI for Intermediate Approach Controller's use. At that moment, the ATCO matches the entering aircraft with its corresponding ITD to follow the evolution of the trajectory until the transfer to the Final Approach

Activity	Description
	Controller.
Monitor Aircraft Spacing (Final Approach Control)	Nominal The Final Approach Controller monitors the position, speed and altitude of the aircraft in their assigned airspace by radar in order to identify a possible infringement of the ITD Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Monitor Aircraft Spacing (Tower Runway Control)	Nominal The Tower Runway Controller monitors the position, speed and altitude of the aircraft in their assigned airspace by radar in order to identify a possible infringement of the FTD Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Monitor trajectory until DH	Nominal Until the landing clearance is received, the Flight Deck monitors the approach, adjusting the trajectory until reaching the DA/H. If distance/altitude are provided on the chart, "Distance to Go" (to threshold) information can be used to perform distance/altitude checks. The purpose is to check whether the a/c flies the correct vertical approach path.
Provide Aircraft Spacing	Nominal The controller confirms that there is sufficient time to recover the aircraft back onto the safe spacing position, the controller will provide aircraft spacing via speed and vectoring (horizontal and vertical) instructions aiming to situate the aircraft on/behind the ITD/FTD.
Provide landing clearance	Nominal The Tower Runway Controller authorises the Flight Deck to land the aircraft.
Sequence, Merge and Space Aircraft	Nominal The Final Approach Controller sequence, merge and space the aircraft behind the ITD. On a best case scenario the Final Approach Controller aims to vector the a/c on the ITD indicator, which represents the separation to be applied at the Deceleration Fix point to assist the Final Approach Controller in delivering the required separation or spacing (represented by the FTD) at the Delivery point. Furthermore, the Final Approach Controller also monitors the spacing during the final approach, especially the spacing with the leader a/c, providing speed instructions if the traffic situation requires. Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Touchdown	Nominal

Activity	Description
	The Flight Deck safely executes landing until touchdown on the runway
Transfer Flight to Final Approach Controller	Nominal At appropriate time and operational conditions (around Final Approach Fix), the Intermediate Approach Controller • hands over and transfers the control of the flight to the Final Approach Controller • instructs the Flight Deck to contact Final Approach Control
Transfer Flight to Tower Runway Controller	Nominal At appropriate time and operational conditions (around Decision Point), the Final Approach Controller • hands over and transfers the control of the flight to the Tower Runway Controller • instructs the Flight Deck to contact Tower Runway Control

Table 34: Activity Descriptions for the [NOV-5] [ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Vectoring instruction	OpenLoopInstruction
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	SpeedConstraint
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Vectoring instruction	OpenLoopInstruction
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	SpeedConstraint
Final Approach Control	Clear Aircraft for Approach o--> Fly aircraft and intercept glideslope	Flight Deck	Approach clearance	ApproachClearance
Approach Executive Control	Transfer Flight to Tower Runway Controller o--> Catching	Flight Deck	Frequency change instruction	FrequencyChangeInstruction
Approach Executive Control	Transfer Flight to Tower Runway Controller o--> Catching	Tower Runway Control	Handover information	
Flight Deck	Contact Final Approach Controller o--> Catching	Final Approach Control	Approach Controller Contact	AIRM_OutOfScope
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	ReduceSpeedToSpeed

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	SpeedConstraint
Flight Deck	Contact Tower Runway Controller o--> Catching	Tower Runway Control	Tower Runway Controller Contact	ATCInstruction
Tower Runway Control	Provide landing clearance o--> Monitor trajectory until DH	Flight Deck	Landing Clearance	LandingClearance
Approach Executive Control	Transfer Flight to Final Approach Controller o--> Catching	Flight Deck	Frequency change instruction	FrequencyChangeInstruction
Flight Deck	Fly aircraft on approach route o--> Catching	Approach Executive Control	Flight Information	Flight

Table 35: Information Exchange Descriptions for [NOV-5] [ARR-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals (ORD, PWS-A, WDS-A)

3.3.2.5.1.4 [NOV-5][MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

This Use Case takes place in the planning or tactical execution phase. It describes the coordination workflow and exchanges between ATC Supervisors (Tower and Approach) and Controllers when a scenario change is detected.

The following scenarios changes are identified:

- Mix Mode of operations, applying tactical or planned specific scenario spacing (GAP management)
- Degraded mode of operations, where the ATCO Separation Delivery Tool or supporting services like GWCS are no longer suitable for operations.

Other specific non-nominal/alternative flows in addition to the cases mentioned above (e.g. planned or unplanned change of runway in-use) are detailed in the SESAR1 OFA01.03.01 Enhanced Runway Throughput OSED.

The use case starts when the Tower or Approach Supervisor identifies the need for a change in the scenario. The nominal flow ends when the new scenario is implemented.

General Conditions (Scope and Summary)

Approach and Tower Controllers make use of ORD and related SESAR1 and SESAR2020 concepts (e.g. TBS-A, PWS-A) as described in [NOV-5] [ARR-02].

Approach and Tower Supervisors put in place a coordination process that can lead to the following scenarios change:

- Mix Mode of operations, applying tactical or planned specific scenario spacing (GAP management)
- Degraded mode of operations, where the ATCO Separation Delivery Tool or supporting services like GWCS are no longer suitable for operations.

Pre Conditions

The Separation Delivery tool and all applicable alerting / monitoring tools are operational.

The GWCS is operational.

The Approach Arrival Sequence Service is operational.

Post Conditions

Post conditions are depending on the change scenario implemented:

- Mix Mode
  - The Approach and Tower Supervisors have coordinated the application of specific scenario spacing.
- Degraded Mode
  - The Approach and Tower Supervisors have coordinated the reversion to DBS with or without TDI.
  - The Separation Delivery tool and/or all applicable alerting / monitoring tools and/or GWCS and/or Approach Arrival Sequence Service are no longer operational.

For all the scenarios changes an updated flow of arrival aircraft for the aerodrome into the TMA is established. The new flow matches the runway capacity in the prevailing operating conditions.

Nominal Flow Process Diagram

The nominal flow is represented in the [NOV-5] Process Diagram for [MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (PWS-A, WDS-A, ORD) in Figure 25.

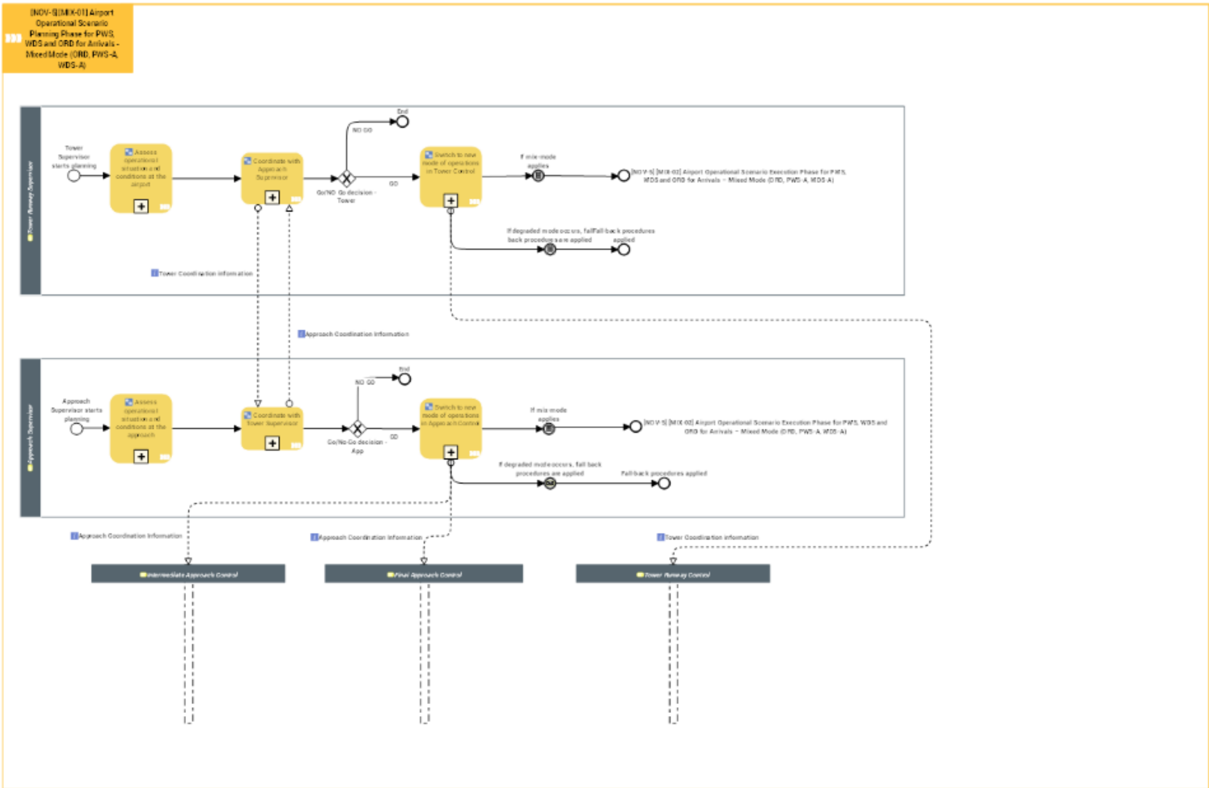


Figure 25: [NOV-5] [MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (PRD, PWS-A, WDS-A)

The Process Diagram for [MIX-01] in Figure 25 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-MIX-01.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 36 and Table 37 respectively.

Activity	Description
Assess operational situation and conditions at the airport	The Tower Supervisor is continuously monitoring and assessing the operational situation and conditions at the airport. For this purpose, the Tower Supervisor analyses the current and near-future status of the following elements: • mode of operation • traffic situation and composition • runway status • arrivals vs departures need This is in order to determine if a change in the mode of operations is needed.

Activity	Description
	The Tower Supervisor also provides and receives feedback about the current status from the Tower Runway Controller.
Assess operational situation and conditions at the approach	The Approach Supervisor is continuously monitoring and assessing the operational situation and conditions at the approach control area of an airport. For this purpose, the Approach Supervisor analyses the current and near-future status of the following elements: • mode of operation • traffic situation and composition • runway status • arrivals vs departures need This is in order to determine if a change in the mode of operations is needed. The Approach Supervisor also provides and receives feedback about the current status from the Approach Controller(s).
Coordinate with Approach Supervisor	The Tower Supervisor might decide to • optimize the mode of operations due to the compliance with certain conditions (e.g. to provide specific traffic spacing scenario or to activate mix mode operations to cope with airport capacity needs) • shift mode of operations to cope with the short-term changing environment (e.g. runway closure, unexpected wind change, failure of ATCO separation delivery tool) The Tower Supervisor contacts the Approach Supervisor to discuss the options and agree on timing and mode of operations to be applied.
Coordinate with Tower Supervisor	The Approach Supervisor might decide to: • optimise the mode of operations due to the compliance with certain conditions (e.g. to provide specific traffic spacing scenario or to activate mix mode operations to cope with airport capacity needs) • shift mode of operations to cope with the short-term changing environment (e.g. runway closure, unexpected wind change, failure of ATCO separation delivery tool) The Approach Supervisor contacts the Tower Supervisor to discuss the options and agree on timing and mode of operations to be applied.
Switch to new mode of operations in Approach Control	After coordination with the Tower Supervisor on the terms and details of the transition to a different mode of operations, the Approach Supervisor informs the Approach Controller(s) of the coordinated decision. There might be the need to apply the proposed changes to the ATCO Separation Delivery Tool. Nominal (Gap spacing scenarios) In case specific spacing scenarios are implemented, the Approach Supervisor and/or the Approach ATCO insert spacing requests in the Separation Delivery Tool. The Approach Supervisor checks that the spacing requests are reflected in the Separation Delivery Tool. Use Case [NOV-5] [MIX-02] is applied for the aircraft pair where spacing

Activity	Description
	requests are inserted. Non-Nominal (Degraded Mode) In the case of degraded mode (e.g. due to failure of TDI, arrival sequence, GWCS...) the Approach Supervisor informs the Approach Controller of the switch to degraded mode of operations, applying DBS with or without the TDI (depending on whether the type of failure impacts the TDI calculation and display in DBS or not).
Switch to new mode of operations in Tower Control	After coordination with the Approach Supervisor on the terms and details on the transition to a different mode of operations, the Tower Supervisor informs the Tower Runway Controller of the coordinated decision. There might be the need to apply the proposed changes to the ATCO Separation Delivery Tool. Nominal (Gap spacing scenarios) In case specific spacing scenarios are implemented, the Approach Supervisor and/or the Approach ATCO insert spacing requests in the Separation Delivery Tool. The Tower Supervisor checks that the spacing requests are reflected in the Separation Delivery Tool. Use Case [NOV-5] [MIX-02] is applied for the aircraft pair where spacing requests are inserted. Non-Nominal (Degraded Mode) In the case of degraded mode (e.g. due to failure of TDI, arrival sequence, GWCS...) the Tower Supervisor informs the Tower Runway Controller of the switch to degraded mode of operations, applying DBS with or without the TDI (depending on whether the type of failure impacts the TDI calculation and display in DBS or not).

Table 36: Activity Descriptions for [NOV-5] [MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Tower Runway Supervisor	Switch to new mode of operations in Tower Control o--> Tower Runway Control	Tower Runway Control	Tower Coordination information	CoordinationMessage
Tower Runway Supervisor	Coordinate with Approach Supervisor o--> Coordinate with Tower Supervisor	Approach Supervisor	Tower Coordination information	CoordinationMessage

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Approach Supervisor	Switch to new mode of operations in Approach Control o--> Intermediate Approach Control	Intermediate Approach Control	Approach Coordination Information	CoordinationMessage
Approach Supervisor	Coordinate with Tower Supervisor o--> Coordinate with Approach Supervisor	Tower Runway Supervisor	Approach Coordination Information	CoordinationMessage
Approach Supervisor	Switch to new mode of operations in Approach Control o--> Final Approach Control	Final Approach Control	Approach Coordination Information	CoordinationMessage

Table 37: Information Exchange Descriptions for [NOV-5] [MIX-01] Airport Operational Scenario Planning Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

3.3.2.5.1.5 [NOV-5][MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

This use case takes place in the execution phase. It describes the operational flow involved in sequencing and delivering arrival aircraft on the approach phase with an Optimised Runway Delivery (ORD) Separation tool and the applicable SESAR1 and SESAR2020 concepts (TBS, PWS-A, and /or WDS-A) including additional specific spacing requests previously coordinated by Approach and Tower Supervisors in the [NOV-5] [MIX-01] Use Case.

Spacing requests are called GAP in the Use Case.

The use case starts when the flight enters the TDI Area (taking into account that the Flight Deck has prepared and briefed the approach at the end of cruise). The nominal flow ends when the aircraft has landed.

General Conditions (Scope and Summary)

As per Use Case [NOV-5] [ARR-02]

Pre Conditions

As per Use Case [NOV-5] [ARR-02]

In addition the Approach and Tower Supervisors have coordinated on the provision of the scenario specific spacing (GAP) between two or more aircraft and they have agreed on the position in the sequence (see Use Case [NOV-5] [MIX-01]).

Post Conditions

The arrival aircraft after the spacing has landed and vacated the runway.

The aircraft(s) planned for departure within the arrival sequence has been cleared for take-off

Nominal Flow Process Diagram

The nominal flow is represented in the [NOV-5] Process Diagram for [MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A) in Figure 26.

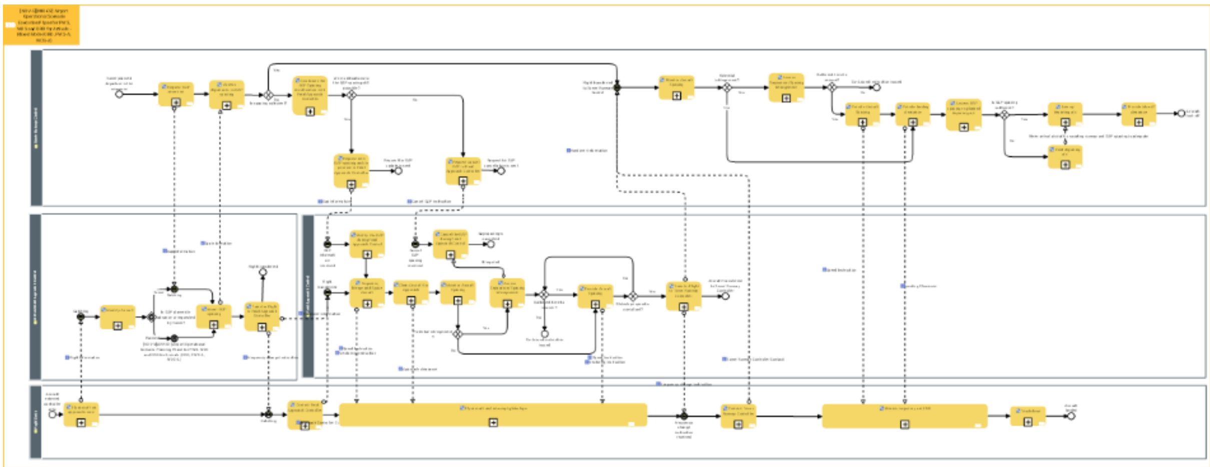


Figure 26: [NOV-5] [MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

The Process Diagram for [MIX-02] in Figure 26 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

PDF

NOV-5-MIX-02.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 38 and Table 39 respectively.

Activity	Description
Assess departures vs GAP spacing	Nominal The Tower Runway Controller compares the departures aircraft position on the ground with the requested spacing between the next two arriving aircraft. If the spacing is not adequate he will coordinate a modification with the Final Approach Controller.
Assess GAP spacing vs planned departing a/c	Nominal While the leader arriving aircraft vacates the runway, the Tower Runway Controller monitors the position of the vacating aircraft, the position and readiness of the next departing aircraft as well as the spacing with the follower arriving aircraft. If the {GAP spacing} with the follower aircraft in the arrival sequence is still sufficient, the Tower Runway Controller will line-up on the runway the next

Activity	Description
	planned departing aircraft. Alternate If the {GAP spacing} with the follower aircraft in the arrival sequence is not sufficient, the Tower Runway Controller will hold the next planned departing aircraft.
Assess Separation/Spacing Infringement (Final Approach Control)	If a GAP ITD infringement occurs, the Final Approach Controller assesses the feasibility and time to recover the spacing for the flight. According to the result of the assessment: • Nominal: If it is positive, the Final Approach Controller will provide spacing through speed and/or vectoring instructions • Non-Nominal: If it is negative, the Final Approach Controller will cancel the GAP spacing
Assess Separation/Spacing Infringement (Tower Runway Control)	If a GAP FTD infringement occurs, the Tower Runway Controller assesses the feasibility and time to recover the appropriate spacing for the flight. According to the result of the assessment: • Nominal: If it is positive, the Tower Runway Controller will provide spacing through speed and/or vectoring instructions • Non-Nominal: If it is negative, the Tower Runway Controller might issue a Go-Around if the arrival landing and/or departure take-off cannot be safely operated
Cancel the GAP during Final Approach Control	Non-Nominal The Final Approach Controller cancels the gap. This can happen upon request of the Tower Runway Controller or when the GAP ITD is infringed and is not possible to recover the spacing by the ATCO.
Clear Aircraft for Approach	Nominal The Approach Controller authorises the aircraft to follow the approach procedure towards the runway. Non-Nominal A go-around procedure may be initiated if the conditions for landing are not fulfilled.
Contact Final Approach Controller	Nominal Flight Deck changes frequency in FMS following ATC instructions and contacts Final Approach Controller
Contact Tower Runway Controller	Nominal Flight Deck changes frequency in FMS following ATC instructions and contacts Tower Runway Controller
Coordinate the GAP Spacing modification with Final Approach Controller	The spacing of GAP FTD has been deemed not large enough to accommodate the planned departures aircraft to be inserted between the two consecutive arrivals. Therefore, the Tower Runway Controller coordinates with either the Final Approach Controller or the Intermediate Approach Controller to assess whether: • Nominal: the modification of the gap spacing is still possible (e.g. for example gap spacing might be reduced from accommodating 2

Activity	Description
	departures to 1 departure) • Non-Nominal: the modification of the gap spacing is not possible. The Tower Runway Controller requests the GAP cancellation
Fly aircraft and intercept glideslope	Nominal The Flight Deck flies the aircraft following previous ATC instructions towards intercepting the towards intercepting the localiser and glideslope of the runway
Fly aircraft on approach route	Nominal Once the a/c enters the initial approach area (from IAF to FAF), the Flight Deck flies the aircraft following ATC speed and vectoring (vertical and horizontal) instructions
Hold departing a/c	Alternate The Tower Runway Controller gives a hold clearance to the next departing aircraft. Then the Tower Runway Controller has to execute again this use case to find another adequate gap spacing in the arrival sequence for the planned departure.
Identify Aircraft	Nominal Once the aircraft enters the TDI area, the corresponding ITD (Initial Target Distance) indicator and FTD (Final Target Distance) indicator are computed and displayed in the HMI for Intermediate Approach Controller's use. At that moment, the ATCO matches the entering aircraft with its corresponding ITD to follow the evolution of the trajectory until the transfer to the Final Approach Controller.
Insert GAP spacing	The request for GAP has been provided ad-hoc by the Tower Runway Controller or planned in advance by the Tower Supervisor. The Intermediate Approach Controller inserts the requested GAP spacing in the correct position in the sequence list with the associated GAP information.
Line-up departing a/c	Nominal The Tower Runway Controller gives the line-up clearance to the next departing aircraft.
Modify the GAP during Final Approach Control	Nominal The Final Approach Controller modifies the gap according to the Tower Runway Controller's request to meet the departure demand and operational situation.
Monitor Aircraft Spacing (Final Approach Control)	Nominal The Final Approach Controller monitors the position, speed and altitude of the aircraft in their assigned airspace by radar in order to identify a possible infringement of the ITD.
Monitor Aircraft Spacing (Tower Runway Control)	Nominal The Tower Runway Controller monitors the position, speed and altitude of the aircraft in their assigned airspace by radar in order to identify a possible infringement of the FTD.
Monitor trajectory until DH	Nominal

Activity	Description
	Until the landing clearance is received, the Flight Deck monitors the approach, adjusting the trajectory until reaching the DA/H. If distance/altitude are provided on the chart, "Distance to Go" (to threshold) information can be used to perform distance/altitude checks. The purpose is to check whether the a/c flies the correct vertical approach path.
Provide Aircraft Spacing (Tower Runway Control)	Nominal The Tower Runway Controller confirms that there is sufficient time to recover the aircraft back onto the safe spacing position, the controller will provide aircraft spacing via speed and vectoring (horizontal and vertical) instructions aiming to situate the aircraft on/behind the FTD.
Provide Aircraft Spacing (Final Approach Control)	Nominal The Final Approach Controller confirms that there is sufficient time to recover the aircraft back onto the safe spacing position, the controller will provide aircraft spacing via speed and vectoring (horizontal and vertical) instructions aiming to situate the aircraft on/behind the ITD.
Provide landing clearance	Nominal The Tower Runway Controller authorizes the Flight Deck to land the aircraft.
Provide take-off clearance	Nominal Following line up clearance, the Tower Runway Controller issues the take-off clearance to the Flight Crew.
Request cancel GAP to Final Approach Control	Non-Nominal Providing the modification of the GAP is not possible and not useful, the Tower Approach Controller requests the Final Approach Controller to cancel the gap.
Request GAP insertion	Nominal To accommodate the departure aircraft demand within the arrival sequence (according to case by case demand or strategic plan) the Tower Runway Controller request gap spacing (in distance or time) to be inserted in between consecutive arrival aircraft pairs.
Request new GAP spacing and/or position to Final Approach Control	Nominal Providing the modification of the GAP is still possible, the Tower Runway Controller requests a new gap spacing and/or new gap position to accommodate the requested departure(s) within the consecutive arrivals.
Sequence, Merge and Space Aircraft	Nominal The Final Approach Controller sequence, merge and space the aircraft behind the ITD. On a best case scenario the Final Approach Controller aims to vector the a/c on the ITD indicator, which represents the separation to be applied at the Deceleration Fix point to assist the Controller in delivering the required spacing (represented by the FTD) at the Delivery point. Furthermore, the Final Approach Controller also monitors the spacing during the final approach, especially the spacing with the leader a/c, providing speed instructions if the traffic situation requires. Non-Nominal A go-around procedure may be initiated if the conditions for landing are not

Activity	Description
	fulfilled.
Touchdown	Nominal The Flight Deck safely executes landing until touchdown on the runway.
Transfer Flight to Final Approach Controller	Nominal At appropriate time and operational conditions (around Final Approach Fix), the Intermediate Approach Controller: • hands over and transfers the control of the flight to the Final Approach Controller • instructs the Flight Deck to contact Final Approach Control
Transfer Flight to Tower Runway Controller	Nominal At appropriate time and operational conditions (around Decision Point), the Final Approach Controller: • hands over and transfers the control of the flight to Tower Runway Control, mentioning the followed published approach chart, and • instructs the Flight Deck to contact Tower Runway Control

Table 38: Activity Descriptions for [NOV-5] [MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Final Approach Control	Clear Aircraft for Approach o--> Fly aircraft and intercept glideslope	Flight Deck	Approach clearance	ApproachClearance
Flight Deck	Fly aircraft on approach route o--> Catching	Intermediate Approach Control	Flight Information	Flight
Flight Deck	Contact Final Approach Controller o--> Flight transferred	Final Approach Control	Approach Controller Contact	AIRM_OutOfScope
Tower Runway Control	Request cancel GAP to Final Approach Controller o--> Cancel GAP spacing received	Final Approach Control	Cancel GAP instruction	
Intermediate Approach Control	Transfer Flight to Final Approach Controller o--> Flight transferred	Final Approach Control	Handover information	
Tower Runway Control	Request new GAP spacing and/or position to Final Approach Controller o--> GAP information received	Final Approach Control	Gap information	

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Intermediate Approach Control	Transfer Flight to Final Approach Controller o--> Catching	Flight Deck	Frequency change instruction	FrequencyChangeInstruction
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Tower Runway Control	Provide Aircraft Spacing o--> Monitor trajectory until DH	Flight Deck	Speed Instruction	SpeedConstraint
Tower Runway Control	Provide landing clearance o--> Monitor trajectory until DH	Flight Deck	Landing Clearance	LandingClearance
Flight Deck	Contact Tower Runway Controller o--> Flight transferred to Tower Runway Control	Tower Runway Control	Tower Runway Controller Contact	ATCInstruction
Intermediate Approach Control	Insert GAP spacing o--> Assess departures vs GAP spacing	Tower Runway Control	Gap information	
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Vectoring instruction	OpenLoopInstruction
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Final Approach Control	Sequence, Merge, Space Aircraft o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	SpeedConstraint
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Vectoring instruction	OpenLoopInstruction
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	IncreaseSpeedToSpeed

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	ReduceSpeedToSpeed
Final Approach Control	Provide Aircraft Spacing o--> Fly aircraft and intercept glideslope	Flight Deck	Speed Instruction	SpeedConstraint
Tower Runway Control	Request GAP insertion o--> Catching	Intermediate Approach Control	Gap information	
Final Approach Control	Transfer Flight to Tower Runway Controller o--> Frequency change instruction received	Flight Deck	Frequency change instruction	FrequencyChangeInstruction
Final Approach Control	Transfer Flight to Tower Runway Controller o--> Flight transferred to Tower Runway Control	Tower Runway Control	Handover information	

Table 39: Information Exchange Descriptions for [NOV-5] [MIX-02] Airport Operational Scenario Execution Phase for PWS, WDS and ORD for Arrivals - Mixed Mode (ORD, PWS-A, WDS-A)

3.3.2.5.2 Departures Concepts Solutions

3.3.2.5.2.1 [NOV-2] Operational Node View for Wake Turbulence Separation Optimisation for Departures Concepts Solutions

The Operational Node View summarise the information exchanges for PJ02-01 concepts for departures described in the following Use Cases:

Use case	[NOV-5][DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)
Use case	[NOV-5][DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)

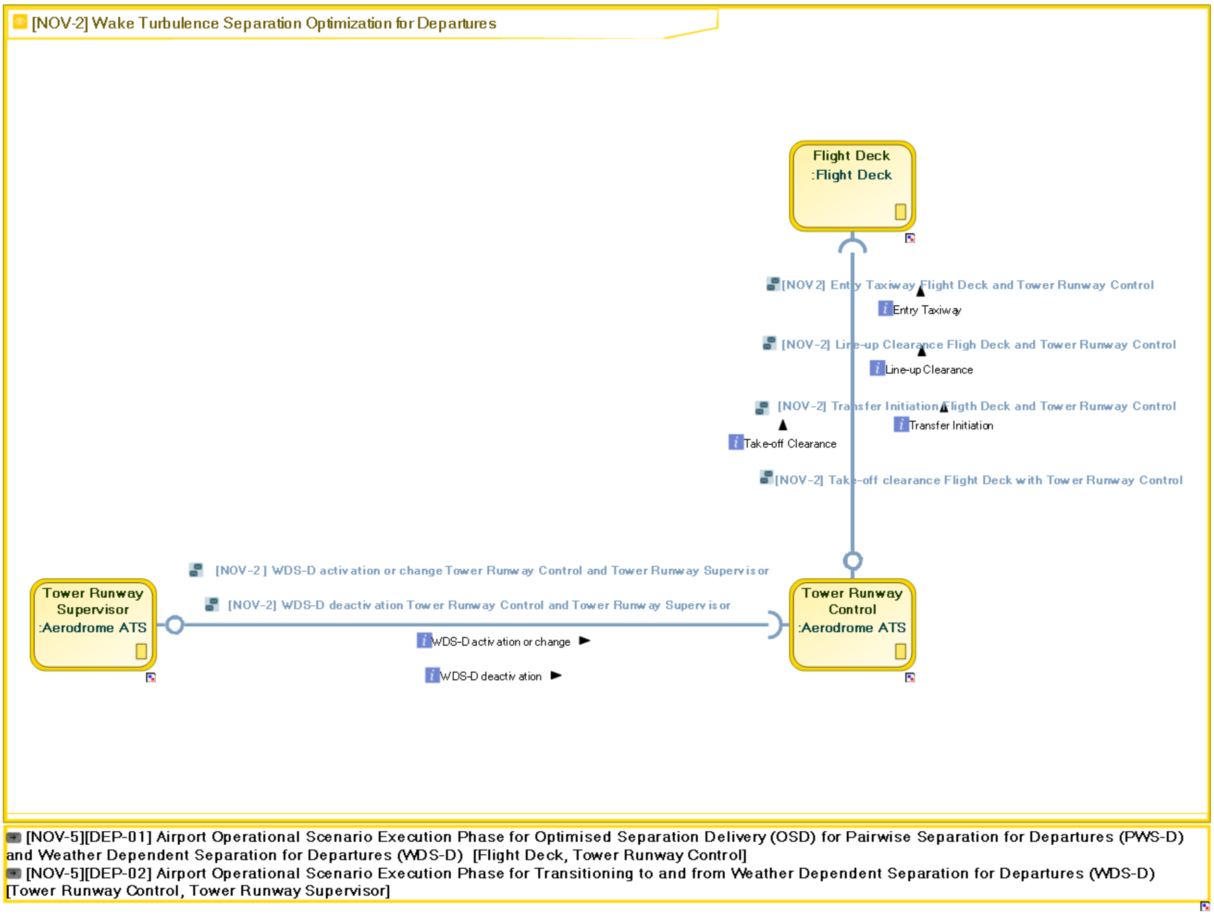


Figure 27: [NOV-2] Operational Node View for Wake Turbulence Separation Optimisation for Departures Concepts Solutions

The [NOV-2] Operational Node View provided in Figure 27 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the operational node view diagram is provided below.

NOV-2-DEP.pdf

It is to be noted that the DEP UC for Airport Operational Scenario Long Term Planning is not identified as a relevant PJ02-01 Operational Scenario in the SESAR 2020 Concept of Operations Edition 2017 [5]. This Use Case describes the steps involved with respect to the long term planning for employing PWS-D and WDS-D. This UC applies when a decision is being considered with respect to the options of employing PWS-D and of employing WDS-D at an aerodrome. The actors involved are the long term planning representatives of the aerodrome, such as the Airport Operator, the ATC Operator, the Airline Operators, and the Regulator Authority. This UC is invoked when there is capacity constrained aerodrome operations combined with the V3 maturity of the PWS-D and WDS-D concepts. The following nominal flow steps have been identified:

- For the planned evolution of the aircraft type traffic mix at the aerodrome establish the forecast departure rate benefits of employing PWS-D compared to the current departure separation regime.
- Determine how the forecast departure rate benefits of PWS-D are to be employed with respect to both providing an increase in the scheduled departure rate and also in providing for additional headroom for resilience to adverse operating conditions.
- For the four seasons wind conditions experienced at the aerodrome establish the forecast departure rate benefits of employing WDS-D with PWS-D compared to just PWS-D and the benefits with respect to the rate at which queued departure traffic can be cleared.
- Determine how the forecast departure rate benefits of WDS-D can contribute to providing additional headroom for resilience to adverse operating conditions, and thus potentially negating the need to utilise some of the additional departure rate of PWS-D to provide for the additional headroom for resilience to adverse operating conditions.
- Determine the adjustments to be made to the A-CDM system support and the D-MAN system support with respect to the departure rate impact of employing PWS-D and WDS-D.
- Establish the Benefits Case for employing PWS-D and WDS-D.
- Instigate the Feasibility & Options, Project Definition and Implementation investment for developing and deploying PWS-D and WDS-D at the aerodrome.

3.3.2.5.2.2 [NOV-5][DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)

General Conditions (Scope and Summary)

This Use Case describes in detail the steps involved for the Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)

Pre Conditions

The OSD or Enhanced OSD system support is deployed and available for supporting PWS-D and WDS-D respectively.

The OSD or Enhanced OSD system support is configured to support applying PWS-D and WDS-D respectively and optionally SID route separations and possibly MDI and ADI dependent on local requirements.

The OSD or Enhanced OSD system support is being provided with the high integrity departure sequence take-off order on the runway.

The OSD or Enhanced OSD system support is being provided with the "airborne time" or the "start of take-off roll time" for each departure aircraft dependent on local procedures.

The OSD or Enhanced OSD system support is being provided with high integrity aircraft type and wake category information for each departure aircraft.

The OSD or Enhanced OSD system support is being provided with high integrity SID route information for each departure aircraft.

The OSD or Enhanced OSD system support is being informed of departure aircraft taking off from an intermediate position.

The OSD or Enhanced OSD system support, dependent on local procedures, is being informed of departure aircraft requesting that the RECAT-EU or the ICAO wake separation be applied.

In the local case of supporting distance-based separation for departures, the required wind conditions service over each of the SID routes from the initial airborne positions to the maximum "Required Minimum Distance Spacing" is deployed and available for supporting the calculation of the position of the "Required Minimum Distance Spacing Arc" by the OSD or Enhanced OSD system support.

The A-CDM System and DMAN System have been configured to take into account the PWS-D and WDS-D wake separation rules that are being applied so that an appropriate pressure of departure aircraft with an appropriately optimised departure sequence order is delivered to the departure holding points for the departure runway-in-use.

The Flight Crew have been informed that the PWS-D and WDS-D wake separation rules are being applied and have been fully briefed and aware of the PWS-D and WDS-D wake separation rules.

Post Conditions

The departure aircraft has been delivered with optimised separation to the TMA Departure Radar Controller.

Actors

Tower Runway Controller, Flight Crew, TMA Departure Radar Controller.

Trigger

Departure aircraft at or approaching the runway holding points and have contacted the Tower Runway Controller.

Nominal Flow Process Diagram

The nominal flow is represented in the [NOV-5] [DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D) in Figure 28.

Figure 28: [NOV-5] Process Diagram for [DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)

The Process Diagram for [DEP-01] in Figure 28 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-DEP-01.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 40 and Table 41 respectively.

Activity	Description
	Tower Runway Control
Formulate optimised sequence order for departing aircraft	Nominal For departure aircraft at or approaching the runway holding points the Tower Runway Controller formulates optimised sequence order for the next few departure aircraft, optimising the amount of wake separation and SID separation/spacing required while meeting any CTOT requirements. This may be with the aid of an automatically optimised departure sequence order or may be self-determined without any automated system support. When self-determining the optimised sequence order the Tower Runway Controller may take into account the RECAT-EU (or ICAO) wake category based wake separations using an aide-memoire table rather than the 96x96 pairwise and 20-CAT matrices of the PWS-D wake separations. The Tower Runway Controller may reflect the formulated optimised sequence order in the electronic environment runway holding bay.

	In mixed mode operations the optimisation of the departure sequence order also takes into account the coordination of the departure gaps in the arrival sequence. This includes optimising packed departures to where possible to being non-wake pairs without any SID separation/spacing constraints, and where a departure pair has wake separation or SID separation/spacing requirements interleaving an arrival aircraft between the two departing aircraft. This may be with the aid of automated system support as is being developed and validated in PJ02-08. Non-Nominal The Flight Crew may inform the Tower Runway Controller that they are not ready to be given a line-up clearance due for example not having completed the authorisation steps with their airline operations centre. In such cases the Tower Runway Controller requests the reasons for not being ready for line-up, and the estimated time for when the aircraft will be ready for line-up. This may result in the need to change the optimised sequence order. Once ready the Flight Crew inform the Tower Runway Controller that they are ready to be given a line-up clearance so that the departure aircraft can be re-considered for including in the optimised sequence order.
Determine next aircraft to be given a line-up clearance	Nominal When it is time to line-up the next departure aircraft the Tower Runway Controller uses the formulated optimised departure sequence order to determine the next departure aircraft to line-up. Non-Nominal For mixed mode operations if the departure gap spacing provided between the arrival aircraft on final approach is not as requested there may be a late change as to whether to line-up a departure aircraft or whether to switch to lining-up a different departure aircraft; in the case of a smaller departure gap than requested switching to lining-up a smaller departure aircraft type with a reduced take-off roll time; in the case of a larger departure gap than requested switching to lining-up a larger departure aircraft type requiring more take-off roll time.
Instruct aircraft to line-up	Nominal The Tower Runway Controller instructs the departure aircraft to line-up which may include informing the Flight Crew of the entry taxiway with the associated line-up position. In an electronic environment the Flight Data Entry (FDE) or Flight Progress Strip (FPS) is moved from the holding bay to the runway bay and the entry taxiway with the associated line-up position entered on the FDE or FPS. In mixed mode operations the departure aircraft may start lining-up after an arrival aircraft in front has crossed beyond the entry taxiway. The departure aircraft may be given a conditional clearance to line-up once the arrival aircraft has crossed beyond the entry taxiway. Non-Nominal In segregated mode operations more than one departure aircraft at a time may be instructed to line-up, and the line-up instructions and order the aircraft are moved from the holding bay to the runway bay may be out-of-order. Departure aircraft may be instructed to line-up at an intermediate position with the associated line-up position entered on the FDE or FPS.
Determine Wake Separation Distance to	Nominal When the departure aircraft is the next aircraft in the runway departure sequence

preceding aircraft	to be given a take-off clearance, the Tower Runway Controller determines the Wake Separation Distance to apply. When PWS-D is being applied, the Tower Runway Controller is unable to mentally apply the PWS-D pairwise 96 x 96 matrix, and the wake category 20-CAT matrix, and so is supported by the OSD tool, which determines and presents the Wake Separation Distance to apply. When WDS-D is being applied in the context of PWS-D, the Tower Runway Controller is unable to mentally determine the Wake Separation Distance, and so is supported by the Enhanced OSD tool which determines and presents the Wake Separation Distance to apply, taking into account when the WDS-D reduced wake separation has been authorised to be applied, and in the case of the D-DB-WDS-Xw concept, that the follower departure aircraft planned SID path is upwind of the preceding departure aircraft planned SID path beyond the straight-out initial common departure path. When a D-DB-WDS-Xw reduced wake separation is being applied, the Enhanced OSD tool is to clearly inform the Tower Runway Controller this is the case. When RECAT-EU or ICAO wake separations are being applied, the Tower Runway Controller is able to self-determine the required Wake Separation Distance without the aid of the OSD or Enhanced OSD tool, although may optionally be supported by the OSD or Enhanced OSD tool. Non-Nominal The Flight Crew may inform the Tower Runway Controller that they want the RECAT-EU or ICAO wake separation to be applied to the preceding departure aircraft rather than the PWS-D or WDS-D wake separation. The Tower Runway Controller acknowledges the request and applies the requested wake separation distance with the optional support of the OSD or Enhanced OSD tool. Failure In the event of the OSD or Enhanced OSD tool becoming unavailable the Tower Runway Controller shall revert to manually applying ICAO or RECAT-EU DB wake separations with an optional aide memoire table of the ICAO or RECAT-EU wake separation rules.
Determine SID Separation Distance to each relevant preceding aircraft	Nominal The Tower Runway Controller determines the SID Separation Distance required to be applied to each relevant preceding aircraft. This may optionally be with the support of the OSD or Enhanced OSD tool.
Determine the most restrictive Wake Separation or SID Separation Distance	Nominal The Tower Runway Controller determines the most restrictive Wake Separation Distance or SID Separation Distance that is required to be applied.
Determine preceding aircraft earliest distance position taking into account any other separation	Nominal The Tower Runway Controller identifies the preceding aircraft and the associated earliest distance position that must be passed before issuing the take-off clearance in order to deliver the most restrictive separation distance required to be applied. This takes into account any other separation constraints, such as the MRS, and whether and to what extent reduced separation in the vicinity of the aerodrome can be applied.
Wait for the proceeding	Nominal

aircraft to pass the earliest distance position	The Tower Runway Controller monitors the progress of the identified preceding aircraft, waiting for the preceding aircraft to pass the earliest distance position for issuing the take-off clearance. <u>Non-Nominal</u> The Flight Crew of the lined-up aircraft may inform the Tower Runway Controller that they are not ready to be given a take-off clearance due for example having a technical problem. The Tower Runway Controller requests the reasons for not being ready and in the case of being able to recover the situation, the estimated time for when the aircraft will be ready for take-off. If recover action is possible with just a short delay, the Tower Runway Controller waits for the aircraft to be ready, and then proceeds to issue the take-off clearance, once the identified proceeding aircraft has passed the earliest distance position for issuing the take-off clearance. If recover action is not possible with just a short delay, the Tower Runway Controller instructs the aircraft to vacate the runway, removing the aircraft from the runway bay. While the aircraft is vacating the runway, the Tower Runway Controller determines the next aircraft to be given a line-up clearance and instructs the aircraft to line-up.
Determine Wake Separation Time to preceding aircraft and associated Time	<u>Nominal</u> When the departure aircraft is the next aircraft in the runway departure sequence to be given a take-off clearance, the Tower Runway Controller determines the Wake Separation Time to apply. When PWS-D is being applied, the Tower Runway Controller is unable to mentally apply the PWS-D pairwise 96 x 96 matrix, and the wake category 20-CAT matrix, and so is supported by the OSD tool, which determines and presents the Wake Separation Time to apply. When WDS-D is being applied in the context of PWS-D, the Tower Runway Controller is unable to mentally determine the Wake Separation Time, and so is supported by the Enhanced OSD tool, which determines and presents the Wake Separation Time to apply, taking into account when the WDS-D reduced wake separation has been authorised to be applied, and in the case of the D-TB-WDS-Xw concept, that the follower departure aircraft planned SID path is upwind of the preceding departure aircraft planned SID path beyond the straight-out initial common departure path. When a D-TB-WDS-Xw reduced wake separation is being applied the Enhanced OSD tool is to clearly inform the Tower Runway Controller this is the case. When RECAT-EU or ICAO wake separations are being applied, the Tower Runway Controller is able to self-determine the required Wake Separation Time without the aid of the OSD or Enhanced OSD tool, although may optionally be supported by the OSD or Enhanced OSD tool. In the case of applying a “Not Before Take-Off Time”, once the “start of take-off roll time” is provided for the preceding aircraft, the “Not Before Take-Off Time” for the take-off clearance is determined, with the aid of the OSD or Enhanced OSD tool in the case of applying the PWS-D and WDS-D wake separations respectively, and optionally with the aid of the OSD or Enhanced OSD tool in the case of applying the RECAT-EU or ICAO wake separations. In the case of applying a “Not Before Airborne Time”, once the “airborne time” is provided for the preceding aircraft, the “Not Before Airborne Time” is determined, with the aid of the OSD or Enhanced OSD tool in the case of applying the PWS-D and WDS-D wake separations respectively, and optionally with the aid of the OSD

	or Enhanced OSD tool in the case of applying the RECAT-EU or ICAO wake separations. Non-Nominal When follower aircraft lines-up at an intermediate position in relation to the preceding aircraft line-up position, the Tower Runway Controller and the OSD or Enhanced OSD tool are required to apply the wake separation rules for taking-off from an intermediate position. These rules require that an additional 60s is to be added to the Wake Separation Time. The Flight Crew may inform the Tower Runway Controller that they want the RECAT-EU or ICAO wake separation to be applied to the preceding departure aircraft, rather than the PWS-D or WDS-D wake separation. The Tower Runway Controller acknowledges the request, and applies the requested wake separation time, with the optional support of the OSD or Enhanced OSD tool. Failure In the event of the OSD or Enhanced OSD tool becoming unavailable the Tower Runway Controller shall revert to manually applying the ICAO or RECAT-EU TB wake separations, with an optional aide memoire table of the ICAO or RECAT-EU wake separation rules.
Determine SID Separation and earliest Time to each preceding aircraft	Nominal The Tower Runway Controller determines the SID Separation time required to be applied to each relevant preceding aircraft. This may optionally be with the support of the OSD or Enhanced OSD tool. In the case of applying a "Not Before Take-Off Time", once the "start of take-off roll time" is provided for the preceding aircraft, the "Not Before Take-Off Time" for the take-off clearance is determined, optionally with the aid of the OSD or Enhanced OSD tool, for each relevant SID separation. In the case of applying a "Not Before Airborne Time", once the "airborne time" is provided for the preceding aircraft, the "Not Before Airborne Time" is determined, optionally with the aid of the OSD or Enhanced OSD tool for each relevant SID separation.
Determine the most restrictive Time satisfying Wake Separation or SID Separation	Nominal The Tower Runway Controller determines the most restrictive Wake Separation Time or SID Separation Time that is required to be applied. This is the most restrictive "Not Before Take-Off Time" or "Not Before Airborne Time"
Determine earliest take-off clearance time taking into account any other separation	Nominal The Tower Runway Controller determines the earliest take-off clearance time. In the case of the applying a "Not Before Take-Off Time", this is the most restrictive "Not Before Take-Off Time". In the case of applying a "Not Before Airborne Time", this is the most restrictive "Not Before Airborne Time" minus the anticipated combined pilot reaction time and the take-off roll time of the follower aircraft. The Tower Runway Controller determines this by mentally subtracting the anticipated combined pilot reaction time and take-off roll time of the follower aircraft from the "Not Before Airborne Time", taking onto account the aircraft type, the anticipated airline operator take-off procedures in the prevailing operating conditions, and the anticipated pilot reaction time to the take-off clearance. When no Wake Separation or SID Separation is required to be applied, the Tower

	Runway Controller takes into account any other separation constraints, such as the MRS, and whether and to what extent reduced separation in the vicinity of the aerodrome can be applied.
Wait for the time to pass the earliest take-off time	Nominal The Tower Runway Controller monitors for when the time passes the earliest time to issue the take-off clearance. This may be with the aid of a countdown timer. In the case of applying a "Not Before Take-Off Time", the zero of the countdown timer should correspond to the "Not Before Take-Off Time", and so the take-off clearance can be issued once the countdown reaches zero. In the case of applying a "Not Before Airborne Time", the zero of the countdown timer should correspond to the "Not Before Airborne Time", and so the take-off clearance can be issued once the countdown reaches the anticipated combined pilot reaction time and take-off roll time of the follower aircraft. When no Wake Separation or SID Separation is required to be applied, the Tower Runway Controller takes into account any other separation constraints, such as the MRS, and whether and to what extent reduced separation in the vicinity of the aerodrome can be applied, often determining when to issue the take-off clearance based on the preceding aircraft passing a predetermined position on the straight-out initial departure path. Non-Nominal The Flight Crew of the lined-up aircraft may inform the Tower Runway Controller that they are not ready to be given a take-off clearance, due for example having a technical problem. The Tower Runway Controller requests the reasons for not being ready, and in the case of being able to recover the situation, the estimated time for when the aircraft will be ready for take-off. If recover action is possible with just a short delay, the Tower Runway Controller waits for the aircraft to be ready, and then proceeds to issue the take-off clearance once the take-off clearance can be issued. If recover action is not possible with just a short delay, the Tower Runway Controller instructs the aircraft to vacate the runway, removing the aircraft from the runway bay. While the aircraft is vacating the runway, the Tower Runway Controller determines the next aircraft to be given a line-up clearance and instructs the aircraft to line-up.
Issue Take-Off Clearance and Monitor & Record Roll Time	Nominal The Tower Runway Controller issues the take-off clearance provided the runway is clear; in the case of mixed mode, or tactical enhanced arrival management, that any preceding interleaved arrival aircraft is confirmed as clear of the runway; in the case of crossing traffic, that the crossing traffic is confirmed as clear of the runway. In the case of applying a "Not Before Take-Off Time", there is a need to monitor and record the "start of take-off roll time", which may be through a manual interaction in the electronic environment of the Tower Runway Controller, or in a non-electronic environment or an electronic environment may be through automatic surveillance based monitoring support. In the case of applying a "Not Before Airborne Time", the notification of the "start of take-off roll" may be used as a trigger event to calculate the required Wake Separation time to the next follower aircraft.

	Non-Nominal The take-off clearance may be issued before the follower aircraft is lined-up and waiting at the line-up position. In these cases there is a need to wait until the follower aircraft has passed the normal line-up and wait position before recording the "start of take-off roll time".
Monitor for aircraft becoming airborne and record Airborne Time	Nominal The Tower Runway Controller monitors the take-off roll of the departure aircraft, and the departure aircraft rotating and becoming airborne (back wheels airborne). In the case of applying a "Not Before Airborne Time", there is a need to monitor and record the "airborne time" which is usually through a manual interaction in the electronic environment of the Tower Runway Controller, with the FDE or FPS being moved from the runway bay to the airborne bay, and the timing of this manual interaction being automatically recorded as the "airborne time" of the departure aircraft. There may be automatic surveillance based monitoring support for determining and recording the "airborne time" of each departure aircraft; however there appear to be significant feasibility issues associated with the consistency of such an approach. This is because the Mode S airborne indicator is indicating the aircraft is airborne while the aircraft is still rolling on the runway for many aircraft types. Non-Nominal The Flight Crew may be instructed to, or may self-determine, to abort the take-off roll and do not take-off. The Tower Runway Controller instructs the aircraft to vacate the runway and removes the aircraft from the runway bay in the electronic environment.
Monitor separation on initial departure path	Nominal The Tower Runway Controller monitors the separation on the initial departure path, to ensure that the appropriate separation is being delivered to the TMA Departure Controller. When a D-WDS-Xw reduced separation is being employed, the monitoring may also include that the lead aircraft correctly turns onto the planned SID, and both the lead and follower aircraft lateral navigation performance over the straight-out initial common departure path is appropriate to ensure the crosswind transport of the wake vortices out of the path follower aircraft. Non-Nominal When D-WDS-Xw reduced separation is being employed, and non-nominal behaviour of either the lead aircraft or the follower aircraft could result in an unacceptable increase in wake vortex encounter risk, there may be a need to take intervention action, and there may be a need to provide a cautionary wake advisory to the follower aircraft warning of the potential increase in wake vortex encounter risk. When D-WDS-Xw reduced separation is being employed, and there is a need to take intervention action to provide separation to other traffic, such as an arrival go-around or an intruder, there is a need to ensure that the intervention action does not result in an unacceptable increase in wake vortex encounter risk to the follower aircraft of a departure pair with D-WDS-Wx reduced separation.
Instruct the Flight Crew to contact the TMA	Once the appropriate separation has been set up for the TMA Departure Radar Controller, the Tower Runway Controller instructs the Flight Crew to contact the

Departure Radar Controller	TMA Departure Radar Controller.
Flight Deck	
Line-up and hold	The Flight Crew lines up the aircraft, using the entry taxiway and associated holding position instructed by the Tower Runway Controller.
Wait for Clearance	Nominal Once lined-up at the holding position, the Flight Crew await for the clearance to take-off. Non-Nominal If a problem occurs when lining-up or holding that needs to be addressed before take-off, the Flight Crew will inform the Tower Runway Controller that they are not ready for the take-off clearance.
Commence take-off roll	Nominal On receiving the clearance to take-off, the Flight Crew commence the take-off roll. Non-Nominal On receiving the clearance to take-off, the Flight Crew may delay the start of the take-off roll, or may query the Tower Runway Controller on the separation to the preceding departure aircraft when unsure whether sufficient separation is being provided.
Aircraft rotates and becomes airborne	Nominal The aircraft executes a normal take-off roll, and rotates and becomes airborne at the anticipated position for the prevailing operating conditions. Non-Nominal The Flight Crew abort the take-off roll, either due to a problem, or as a result of being instructed by the Tower Runway Controller.
Contact TMA Departure Radar Controller	As instructed by the Tower Runway Controller, the Flight Crew contact the TMA Departure Radar Controller.

Table 40: Activity Descriptions for [NOV-5] [DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Tower Runway Control	Instruct aircraft to line-up o--> Catching	Flight Deck	Line-up Clearance	RUNWAY_ENTRY_EXIT_NODE
Tower Runway Control	Instruct aircraft to line-up o--> Catching	Flight Deck	Entry Taxiway	RunwayCrossingClearance
Tower Runway Control	Issue take-off clearance and Monitor & Record Roll Time o--> Catching	Flight Deck	Take-off clearance	TakeOffClearance
Tower Runway Control	Instruct the flight crew to contact the TMA Departure Controller o--> Catching	Flight Deck	Transfer Initiation	CoordinationAndTransfer

Table 41: Information Exchange Descriptions for the Process Diagram for [DEP-01] Airport Operational Scenario Execution Phase for Optimised Separation Delivery (OSD) for Pairwise Separation for Departures (PWS-D) and Weather Dependent Separation for Departures (WDS-D)

3.3.2.5.2.3 [NOV-5][DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)

General Conditions (Scope and Summary)

This Use Case describes in detail the steps involved for transitioning to and from Weather Dependent Separation for Departures (WDS-D).

Pre Conditions

The WDS-D system support is deployed and available for supporting WDS-D.

The required wind conditions service over the straight-out initial departure path from becoming airborne to the first SID turns is deployed and available for supporting WDS-D for each departure runway.

The Tower Supervisor and Approach Supervisor have coordinated tactically about departure rates when WDS-D reduced wake separations can be applied.

The Tower Supervisor and Tower Runway Controller have coordinated when WDS-D reduced wake separations are to be applied taking into account the wind information.

The Flight Crew are aware of the operation of the WDS-D reduction of wake turbulence separations, and have been fully briefed and aware of the WDS-D wake separation rules.

Post Conditions

The WDS-D system support has correctly indicated whether the WDS-D reduced wake separations can be applied.

Actors

Tower Supervisor, Tower Runway Controller, Flight Crew, TMA Departure Radar Controller, Approach Supervisor.

Trigger

The wind condition information over the straight-out initial departure path for the departures runway is available for determining whether or not the WDS-D reduced wake separations can be applied.

Nominal Flow Process Diagram

The nominal flow is represented in the [NOV-5] Process Diagram for [DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D) in Figure 29.

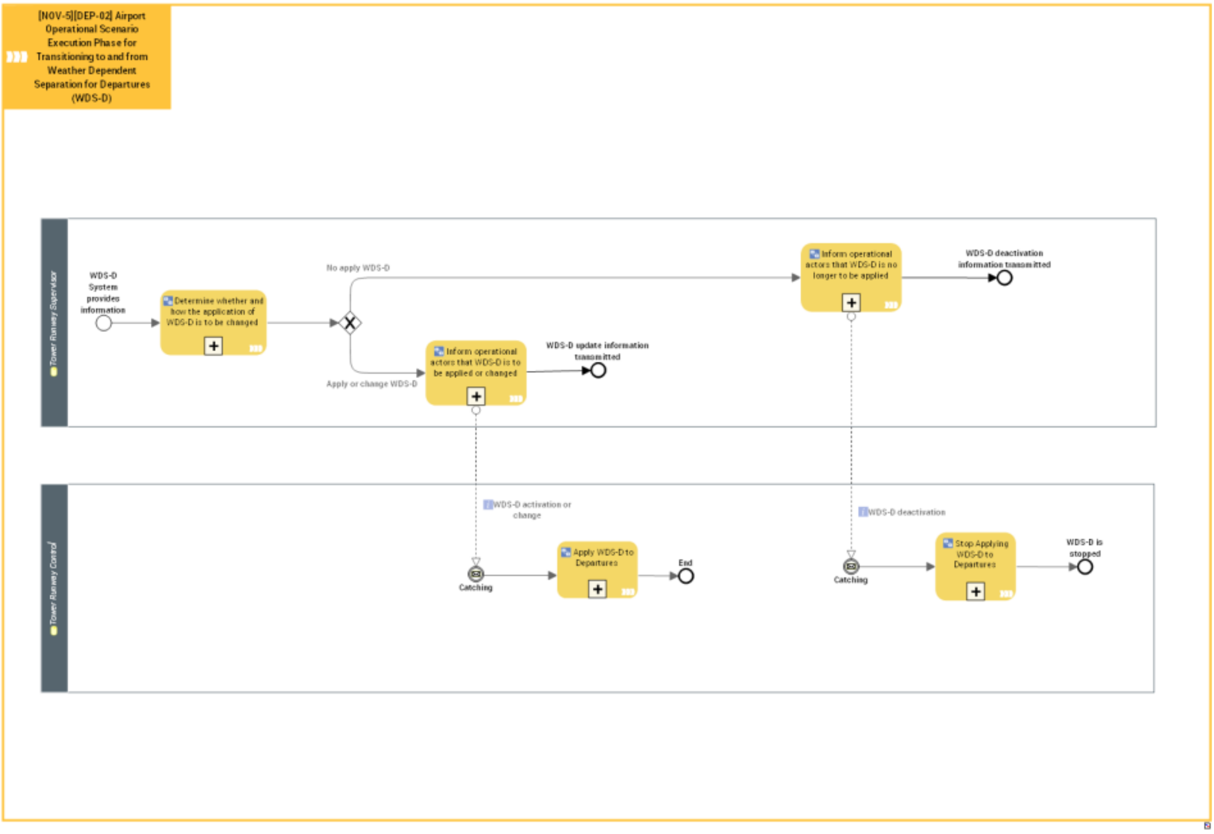


Figure 29: [NOV-5] Process Diagram for [DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)

The Process Diagram for [DEP-02] in Figure 29 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-DEP-02.pdf

The activity descriptions and information exchange information for the process diagram are provided in Table 42 and Table 43 respectively.

Activity	Description
Tower Supervision	
Determine whether and how the application of WDS-D is to be changed	The WDS-D system support provides a GO / NO GO indication of whether the WDS-D wake separation reduction can be applied for the departure runway-in-use. The Tower Supervisor evaluates the possibility to apply or change the WDS-D wake separation reduction, using the WDS-D system GO / NO GO indication, and the nowcast and forecast wind conditions stability and trends, and other operational criteria such as the queued departure traffic situation. This may be supported by automatic changing of the WDS-D wake separation reduction to keep in step with the nowcast and forecast crosswind speed and total wind speed. The Tower Supervisor evaluates when to end the application of the WDS-D wake separation reduction taking into account the nowcast and forecast wind conditions stability and trends and other operational criteria such as the queued departure traffic situation. This may be supported by automatic monitoring and switching to NO GO when the nowcast and forecast crosswind speed or total wind speed is no longer sufficient to support the WDS-D wake separation reduction.
Inform operational actors that WDS-D is to be applied or changed	The Tower Supervisor coordinates with and informs all other operational actors that the WDS-D wake separation reductions are to be applied or changed. The Tower Runway Controller is informed that the WDS-D wake separation reductions are to be applied or changed, with the WDS-D system support GO indication activated when first authorised to be applied. The Enhanced OSD system support is informed that the WDS-D wake separation reductions are to be applied or changed, together with the associated wake separation reductions in the case where there are several pre-defined wake separation reductions depending on the crosswind speed or total wind speed. The Tower Clearance Delivery Manager and the Tower Ground Movement Controllers may be informed that the WDS-D wake separation reductions are to be applied or changed so that this can be taken into account in the process of delivering the appropriate pressure of departure traffic to the runway holding points. The TMA Supervisor and TMA Departure Controller may be informed that the WDS-D wake separation reductions are to be applied or changed so that the necessary TMA flow measures may be applied. The Airspace Users and the Flight Crew may be informed when WDS-D wake separation reductions are being applied.
Inform operational actors that WDS-D is no longer to be applied	The Tower Supervisor coordinates with and informs all other operational actors that the WDS-D wake separation reductions are no longer being applied. The Tower Runway Controller is informed that the WDS-D wake separation reductions are no longer to be applied, with the WDS-D system support NO GO indication activated.

	The Enhanced OSD system support is informed that the WDS-D wake separation reductions are no longer to be applied. The Tower Clearance Delivery Manager and the Tower Ground Movement Controllers may be informed that the WDS-D wake separation reductions are no longer being applied so that this can be taken into account in the process of delivering the appropriate pressure of departure traffic to the runway holding points. The TMA Supervisor and TMA Departure Controller may be informed that the WDS-D wake separation reductions are no longer being applied. The Airspace Users and the Flight Crew may be informed when WDS-D wake separation reductions are no longer being applied.
Tower Runway Control	
Apply WDS-D to Departures	When the WDS-D wake separation reduction is authorised the WDS-D wake separation reductions are applied to the associated wake pairs with the aid of the Enhanced OSD tool support.
Stop Applying WDS-D to Departures	When the WDS-D wake separation reductions is no longer authorised the PWS-D wake separations are applied to all wake pairs with the aid of the Enhanced OSD tool support.

Table 42: Activity Descriptions for [NOV-5] [DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Tower Supervision	Inform operational actors that WDS-D is to be applied or changed o--> Catching	Tower Runway Control	WDS-D activation or change	SeparationMode
Tower Supervision	Inform operational actors that WDS-D is no longer to be applied o--> Catching	Tower Runway Control	WDS-D deactivation	SeparationMode

Table 43: Information Exchange Descriptions for [NOV-5] [DEP-02] Airport Operational Scenario Execution Phase for Transitioning to and from Weather Dependent Separation for Departures (WDS-D)

3.3.2.5.3 Wake Risk Monitoring and Wake Decay Enhancing Concept Solutions

3.3.2.5.3.1 [NOV-2] Wake Turbulence Separation Optimisation for Wake Risk Monitoring and Wake Decay Enhancing Devices

The Operational Node View summarise the information exchanges for PJ02-01 concepts for departures described in the following Use Cases:

Use case	[NOV-5][WRM-01] Airport Operational Scenario Execution Phase for Wake Risk Monitoring
Use case	[NOV-5][WDE-01] Airport Operational Scenario Execution Phase for Wake Decay Enhancing Devices

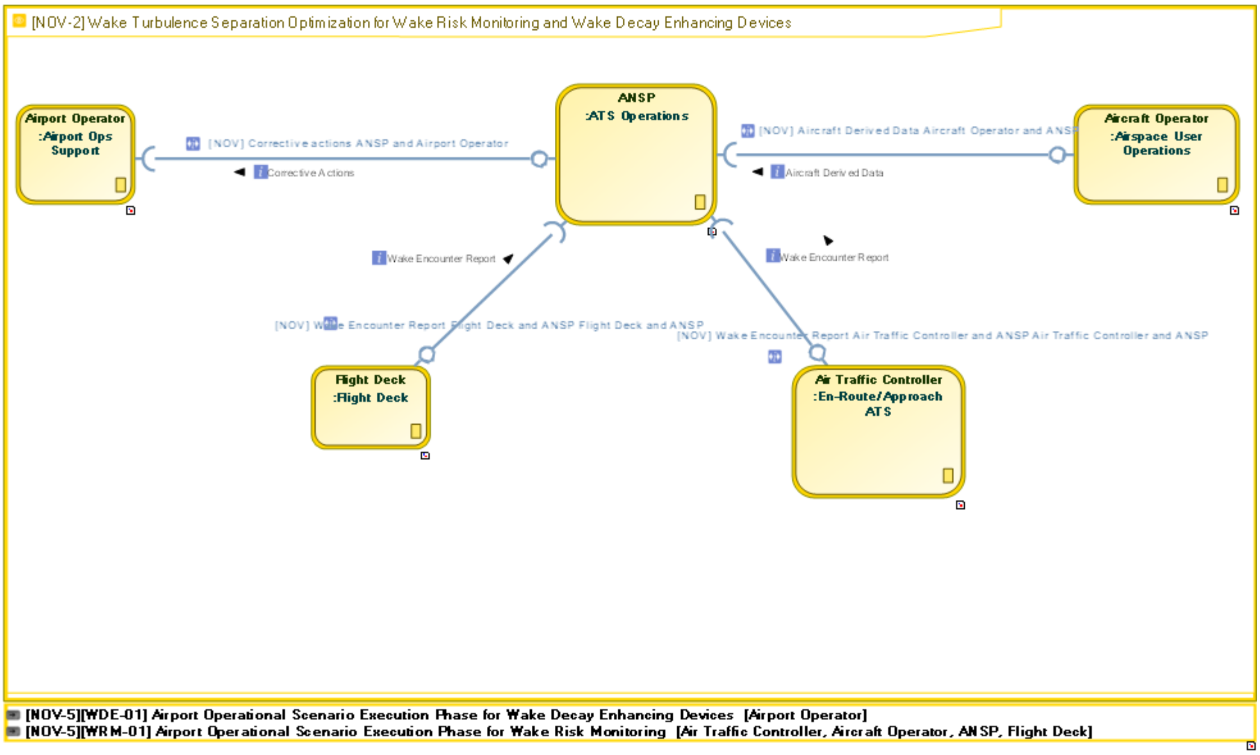


Figure 30: [NOV-2] Operational Node View for Wake Turbulence Separation Optimisation for Wake Risk Monitoring and Wake Decay Enhancing Concepts Solutions

The Operational Node View Diagram for [NOV-02] in Figure 30 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the operational node view diagram is also provided below.

NOV-2
WRM-WDE.pdf

3.3.2.5.3.2 [NOV-5][WRM-01] Airport Operational Scenario Execution Phase for Wake Risk Monitoring

The Wake Risk Monitoring tool is used for monitoring of the impact on wake turbulence encounter risk as a result of introducing wake turbulence separation optimisation regulations at a given aerodrome to ensure continued safety after their introduction. The tool collects in-flight data from aircraft in operation and analyses it to identify possible wake turbulence encounters. If wake encounters are found, a corresponding wake risk report is created containing relevant data. The analysis carried out by the tool also supports crosschecking with wake encounter reports submitted by Flight Crew or Air Traffic Controllers. In case the analysis over an extended time frame suggests an unacceptable increase in wake encounter risk, corrective actions may be taken by the involved stakeholders.

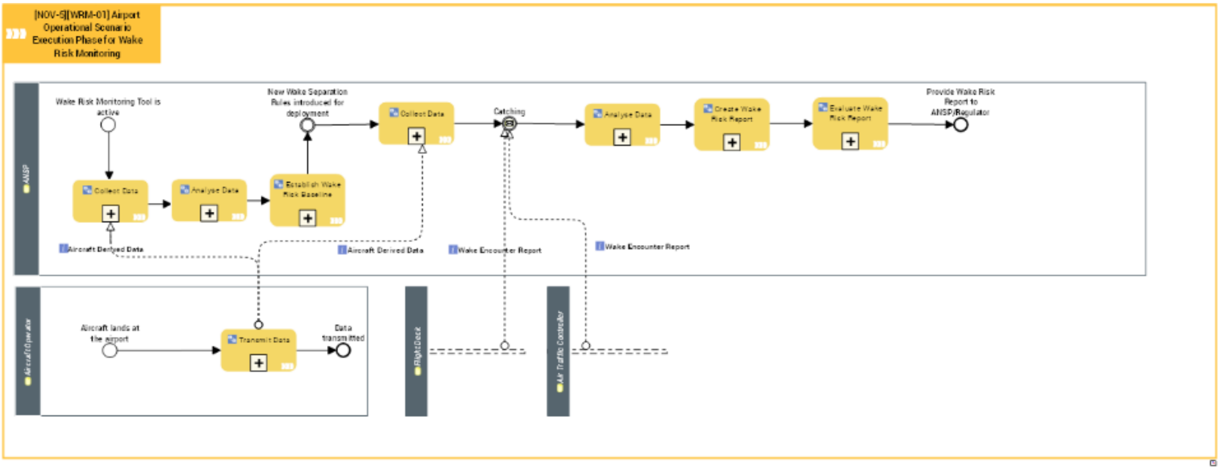


Figure 31: [NOV-5] Process Diagram for [WRM-01] Airport Operational Scenario Execution Phase for Wake Risk Monitoring

The Process Diagram for [WRM-01] in Figure 31 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-WRM-01.pd
f

The activity descriptions and information exchange information for the process diagram are provided in Table 44 and Table 45 respectively.

Activity	Description
Analyse Data	The Wake Risk Monitoring solution analyses collected data in order to identify possible wake turbulence encounters in the flights of the aircraft providing data. This analysis may be provided by a Service Provider.
Collect Data	The Wake Risk Monitoring solution collects data which is necessary for subsequent analysis from aircraft in operation. This data collection may be provided by a Service Provider.
Create Wake Risk Report	The Wake Risk Monitoring solution creates a report containing relevant information in case wake turbulence encounters are identified in the data, to facilitate subsequent evaluation.
Establish Wake Risk Baseline	Before operations using new wake separation rules, a baseline for frequency and severity of wake encounters is established that can be compared to the situation after introduction of the new rules. This baseline can be established by the same Wake Risk Monitoring solution applied during a time period before change of separation rules.
Evaluate Wake Risk Report	The Wake Risk Report created by the solution is evaluated by the ANSP and compared to the Wake Risk Baseline in order to decide if the wake risk is acceptable or not.
Transmit Data	Aircraft transmit data necessary for subsequent analysis to the Wake Risk Monitoring solution after the flight.

Table 44: Activity Descriptions for [NOV-5] [WRM-01] Airport Operational Scenario Execution Phase for Wake Risk Monitoring

Issuer	Info Exchange	Addressee	Info Element	Info Entity
Air Traffic Controller	Air Traffic Controller o--> Catching	ANSP	Wake Encounter Report	
Flight Deck	Flight Deck o--> Catching	ANSP	Wake Encounter Report	
Aircraft Operator	Transmit Data o--> Collect Data	ANSP	Aircraft Derived Data	AircraftDerivedData
Aircraft Operator	Transmit Data o--> Collect Data	ANSP	Aircraft Derived Data	AircraftDerivedData

Table 45: Information Exchange Descriptions for the Process Diagram for [WRM-01] Airport Operational Scenario Execution Phase for Wake Risk Monitoring

3.3.2.5.3.3 [NOV-5][WDE-01] Airport Operational Scenario Execution Phase for Wake Decay Enhancing Devices

Plate lines constitute a passive, robust and relatively inexpensive method to increase safety and potentially also airport capacity by accelerating the decay of the longest lived and thus most critical wake vortices during final approach. While descending the vortices interact with the plates generating disturbances that propagate both in and against flight direction. These disturbances reduce the lifetime of the longest lived and potentially most hazardous wake vortices by at least 20%.

The devices do neither require any procedural changes nor human activities. They just need to be installed at the runway ends and will accelerate wake vortex decay by interaction with the wake vortices during their descent and divergence.

Crosswinds below 2 m/s combined with tailwinds and low turbulence conditions favour long-lived wake vortices lingering in the flight track of a follower aircraft. Exactly in this critical situation the plate lines are advantageous by accelerating wake vortex decay and thus increasing safety.

After approval of the authorities two temporary plate lines are installed at Vienna airport that will be removed after the completion of the live trial. During the six-month measurement campaign three lidars will be used to measure the wake vortex behaviour in five measurement planes situated aloft and next to the plate lines. The accelerated wake vortex decay will be quantified by comparing the strength of the most long-lived wake vortices with and without plate lines within suitable weather classes and aircraft type classes.

A cost-benefit analysis will demonstrate whether the achieved safety gain may justify the installation of permanent plate lines. After the development of a technical plate line design for permanent installation that is compatible with airport requirements (e.g. stability, frangibility) and the required approval of authorities, plate lines can be readily installed at airports. Based on the measurement data the potential reduction of separation minima will be assessed for the arrival concepts WDS, S-PWS and dynamic pairwise separations in future wake turbulence separation optimisation research.

This Use Case takes place across the deployment and tactical execution phases. It describes the steps necessary to establish the safety gains starting with the installation of temporary plate lines in order to quantify the accelerated wake vortex decay through wake measurements, followed by the installation of permanent plate lines with the opportunity for wake measurements to be used to provide evidence to review the wake separation rules.

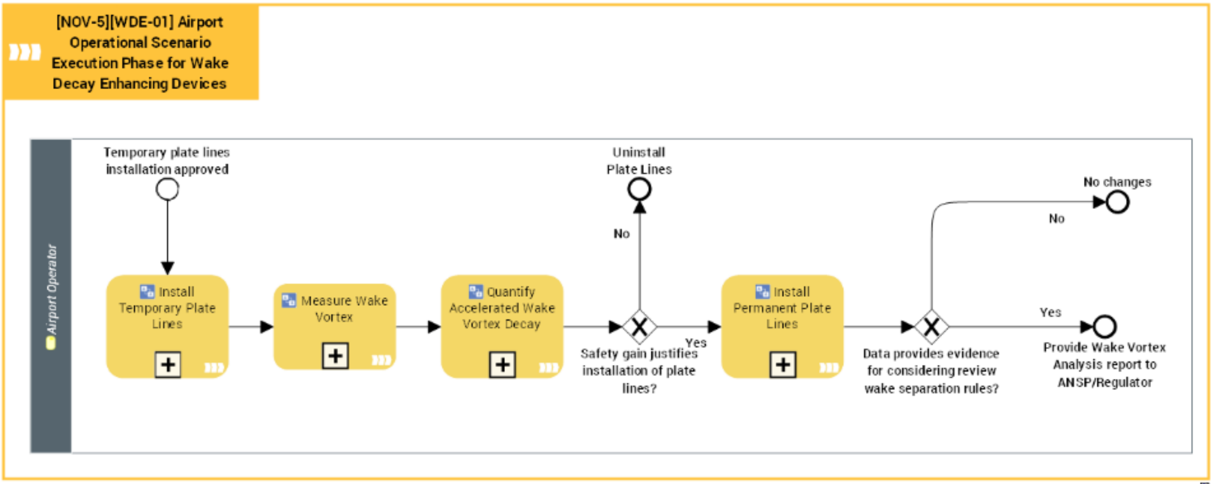


Figure 32: [NOV-5] Process Diagram for [WDE-01] Airport Operational Scenario Execution Phase for Wake Decay Enhancing Devices

The Process Diagram for [WDE-01] in Figure 32 is obtained from the EATMA model OSED generation script. This is of poor resolution and so the PDF file of the process diagram is also provided below.

NOV-5-WDE-01.pdf

The activity descriptions for the process diagram are provided in Table 46.

Activity	Description
Install Permanent Plate Lines	A technical plate line design for permanent installation has to be elaborated that is compatible with airport requirements (e.g. stability, frangibility) and has obtained approval of authorities.
Install Temporary Plate Lines	A plate line consists of eight plates with a length of 9 m and a height of 4.5 m and the plates are separated by 20 m. The first plate line is installed below the glide slope at a distance of about 400 m to threshold and another plate line 340 m further away. Plate lines accelerate the decay of the longest lived and thus most critical wake vortices during final approach. After the live trial the temporary plates will be removed.
Measure Wake Vortex	Wake vortex transport and decay will be measured with 3 lidars. Lidars emit laser pulses that are reflected by aerosols moving with the vortices. From the Doppler effect the velocity field of the vortices is estimated.
Quantify Accelerated Wake Vortex Decay	Comparison of strength of long-lived wake vortices with and without plate lines within suitable weather classes and aircraft type classes is performed.

Table 46: Activity Descriptions for [NOV-5] [WDE-01] Airport Operational Scenario Execution Phase for Wake Decay Enhancing Devices

3.3.3 Differences between new and previous Operating Methods

3.3.3.1 Arrivals Concepts Solutions

Activities (in EATMA) that are impacted by the SESAR Solution	Current Operating Method	New Operating Method
Present separation to Arrival Controller (ORD)	ATCOs apply separation by observing the headings, distances, and speeds, between consecutive aircraft. The separation distance limits are determined by the Controller by the use of scales on the radar map and through the observation of catch-up from the separation distance progression observed between the follower aircraft and the lead aircraft.	ATCOs will apply separations by using a separation delivery tool and target distance indicators for giving headings and speeds between consecutive aircraft.
Apply PWS Separation (PWS-A)	Controllers use standard separations scheme where aircraft types are grouped on categories	Controllers will apply separations scheme where separations are based on each aircraft type pair
Adjust arrival WT separations according to WDS rules	Wake Turbulence separations are not reduced due to weather conditions.	Wake Turbulence separations are reduced/removed due to weather conditions.
Decide and agree to the application of WDS	WDS is never applied	Supervisor will monitor the weather conditions, decide whether to apply WDS and coordinate the activation.
Send landing data	Landing data (landing runway and landing conditions) are sent by Ground System to the Flight Crew on its request	No Change

Table 47: Difference between new and previous Operating Method for Arrivals Concepts Solutions

Table 48 is the table of differences exported from EATMA.

OI Step code – title (OI Step CR)		
AO-0306 - Wake Turbulence Separations (for Arrivals) based on Static Aircraft Characteristics **(CR 03430 Update AO-0306 (PJ.02-01))**		
Activity	Impact	Change
Assess operational situation and conditions at the airport	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)

Assess operational situation and conditions at the approach	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Assess Separation/Spacing Infringement	Update	The ATCO has a target indicator and supporting alerts on the CWP to assess the infringement of the ITD/FTD.
Coordinate with Approach Supervisor	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Coordinate with Tower Supervisor	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Identify Aircraft	Update	The ATCO matches the new incoming aircraft with its corresponding ITD on the CWP.
Monitor Aircraft Spacing	Update	The ATCO has a target indicator and supporting alerts on the CWP to monitor the potential infringement of the ITD/FTD.
Provide Aircraft Spacing	Update	The ATCO has a target indicator (ITD/FTD) and supporting alerts on the CWP when he gives instructions to follower aircraft for providing safe spacing and separation from the leader aircraft
Sequence, Merge, Space Aircraft	Update	The ATCO uses the ITD displayed on the CWP to sequence, merge and space the aircraft behind it
Switch to new mode of operations in Approach Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
Switch to new mode of operations in Tower Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.

AO-0310 - Weather-Dependent Reductions of Wake Turbulence Separations for Final Approach

(CR 03431 Update AO-0310 (PJ02-01))

Activity	Impact	Change
Assess operational situation and conditions at the airport	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Assess operational situation and conditions at the approach	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Assess Separation/Spacing Infringement	Update	The ATCO has a target indicator and supporting alerts on the CWP to assess the infringement of the ITD/FTD.
Coordinate with Approach Supervisor	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)

Coordinate with Tower Supervisor	Update	In addition to current method the assessment includes aspects related to separation delivery tool (activation of WDS, system availability, ..)
Identify Aircraft	Update	The ATCO matches the new incoming aircraft with its corresponding ITD on the CWP.
Monitor Aircraft Spacing	Update	The ATCO has a target indicator and supporting alerts on the CWP to monitor the potential infringement of the ITD/FTD.
Provide Aircraft Spacing	Update	The ATCO has a target indicator (ITD/FTD) and supporting alerts on the CWP when he gives instructions to follower aircraft for providing safe spacing and separation from the leader aircraft
Sequence, Merge, Space Aircraft	Update	The ATCO uses the ITD displayed on the CWP to sequence, merge and space the aircraft behind it
Switch to new mode of operations in Approach Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
Switch to new mode of operations in Tower Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
AO-0328 - Optimised Runway Delivery on Final Approach **CR 03432 Update AO-0328 (PJ02-01))**		
Activity	Impact	Change
Assess departures vs GAP spacing	Update	The ATCO has a target indicator on the CWP and spacing information in the sequence list to assess whether the spacing between the next two arrival aircraft is sufficient or not for the planned departure(s).
Assess GAP spacing vs planned departing a/c	Update	The ATCO has a target indicator on the CWP and spacing information in the sequence list to assess whether the spacing between the next two arrival aircraft is sufficient or not for the planned departure(s).
Assess operational situation and conditions at the airport	Update	In addition to current method the assessment includes aspects related to separation delivery tool (gap spacing scenarios, system availability, ..)
Assess operational situation and conditions at the approach	Update	In addition to current method the assessment includes aspects related to separation delivery tool (gap spacing scenarios, system availability, ..)
Assess Separation/Spacing Infringement	Update	The ATCO has a target indicator and supporting alerts on the CWP to assess the infringement of the ITD/FTD.
Cancel the GAP during Final Approach Control	Introduce	The ATCO cancel the requested GAP spacing in the separation delivery tool. A new computation of ITD/FTD is triggered and displayed on ATCO's CWP.
Coordinate with Approach Supervisor	Update	In addition to current method the coordination includes aspects related to separation delivery tool (gap spacing scenarios, system availability, ..)
Coordinate with	Update	In addition to current method the coordination includes aspects related

Tower Supervisor		to separation delivery tool (gap spacing scenarios, system availability, ..)
Identify Aircraft	Update	The ATCO matches the new incoming aircraft with its corresponding ITD on the CWP.
Insert GAP spacing	Update	The ATCO inserts the requested GAP spacing in the separation delivery tool. A new computation of ITD/FTD is triggered and displayed on ATCO's CWP
Modify the GAP during Final Approach Control	Update	The ATCO modifies the requested GAP spacing in the separation delivery tool. A new computation of ITD/FTD is triggered and displayed on ATCO's CWP.
Monitor Aircraft Spacing	Update	The ATCO has a target indicator and supporting alerts on the CWP to monitor the potential infringement of the ITD/FTD.
Provide Aircraft Spacing	Update	The ATCO has a target indicator (ITD/FTD) and supporting alerts on the CWP when he gives instructions to follower aircraft for providing safe spacing and separation from the leader aircraft
Sequence, Merge, Space Aircraft	Update	The ATCO uses the ITD displayed on the CWP to sequence, merge and space the aircraft behind it
Switch to new mode of operations in Approach Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.
Switch to new mode of operations in Tower Control	Introduce	The ATCOs use a separation delivery tool, separations management is not always the same and can be changed depending on the situation.

Table 48: Difference between new and previous Operating Method for Arrivals Concepts Solutions exported by EATMA

3.3.3.2 Departures Concepts Solutions

The equivalent activities to the arrivals are listed in the first column and the new operating method descriptions added from the OFA 01.03,01 Enhanced Runway Throughput Consolidated Final Step 1 OSED [56].

Activities (in EATMA) that are impacted by the SESAR Solution	Current Operating Method	New Operating Method
Present the departure separation to the Tower Runway Controller	Tower Runway Controller provided with an aide-memoire table of the wake category based departure wake separations. In some local environment Tower Runway Controller provided with count-down support for the wake category based wake separations.	Tower Runway Controller provided with an aide-memoire table of RECAT EU 6-CAT wake category based departure wake separations. Tower Runway Controller presented with the required PWS-D or wake category-based 20-CAT wake separation for each wake separated departure pair and supporting related earliest rotation time or clearance to take-off time when standard wake separations are to be applied. Tower Runway Controller presented with

		the required WDS-D reduction in separation for each wake separated departure pair and supporting earliest rotation time or clearance to take-off time when reduced wake separations are authorised to be applied.
Apply PWS-D wake separation rules	N/A to current operations.	Changing the Tower Runway Controller separation procedures to be consistent with the application of reduced wake separations including the transition in / out of the concept. Changing the Tower and Approach Supervisor procedures regarding coordinating a change in wake separation rules for departures.
Adjust departure wake separation rules according to WDS-D rules	N/A to current operations	Wake separation rules for departures are reduced depending on the magnitude of the wind.
Decide and agree to the application of WDS-D rules	N/A to current operations	Improved wind measurement and forecast capability is required for the initial climb phase to predict when the concept can be implemented.
Inform Airspace Users of the application of WDS-D rules	N/A to current operations	Airspace Users will need to be briefed on the applicable concept and made aware of the current mode of operation (i.e. via D-ATIS).

Table 49: Difference between new and previous Operating Method for Departures Concepts Solutions

Table 50 is the table of differences exported from EATMA.

OI Step code – title **(OI Step CR)**		
AO-0304 - Weather-Dependent Reductions of Wake Turbulence Separations for Departures **(CR 03427 Update AO-0304 (PJ.02-01))**		
Activity	Impact	Change
Apply WDS-D to Departures	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new.
Commence take-off roll	Update	Pilots will experience clearances to take-off earlier than current day operations when applying an optimised wake turbulence separation.
Determine the most restrictive Time satisfying Wake Separation or SID Separation	Update	The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake

		Separation or a more constraining SID Separation.
Determine the most restrictive Wake Separation or SID Separation Distance	Update	The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation.
Determine Wake Separation Distance to preceding aircraft	Update	The determination of the Wake Separation will be supported by the OSD tool.
Determine Wake Separation Time to preceding aircraft and associated Time	Update	The determination of the Wake Separation will be supported by the OSD tool.
Determine whether and how the application of WDS-D is to be changed	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new.
Formulate optimised sequence order for departing aircraft	Update	Controllers need to take into account the wake separation requirements when formulating the optimised sequence order either as today without ATC tool support or possibly in the future with ATC tool support.
Inform operational actors that WDS-D is no longer to be applied	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new.
Inform operational actors that WDS-D is to be applied or changed	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new.
Issue take-off clearance and Monitor and Record Roll Time	Update	The take-off will be earlier than current day operations when applying an optimised wake turbulence separation.
Monitor separation on initial departure path	Update	The Tower Runway Controller will need to take into account the optimised wake separation being applied.
Stop Applying WDS-D to Departures	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new.
AO-0323 - Wake Turbulence Separations (for Departures) based on Static Aircraft Characteristics (CR 03477 Update AO-0323 (PJ02-01))		
Activity	Impact	Change
Commence take-off roll	Update	Pilots will experience clearances to take-off earlier than current day operations when applying an optimised wake turbulence separation.

Determine the most restrictive Time satisfying Wake Separation or SID Separation	Update	The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation.
Determine the most restrictive Wake Separation or SID Separation Distance	Update	The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation.
Determine Wake Separation Distance to preceding aircraft	Update	The determination of the Wake Separation will be supported by the OSD tool.
Determine Wake Separation Time to preceding aircraft and associated Time	Update	The determination of the Wake Separation will be supported by the OSD tool.
Formulate optimised sequence order for departing aircraft	Update	Controllers need to take into account the wake separation requirements when formulating the optimised sequence order either as today without ATC tool support or possibly in the future with ATC tool support.
Issue take-off clearance and Monitor and Record Roll Time	Update	The take-off will be earlier than current day operations when applying an optimised wake turbulence separation.
Monitor separation on initial departure path	Update	The Tower Runway Controller will need to take into account the optimised wake separation being applied.
AO-0329 - Optimised Separation Delivery for Departure **(CR 03433 Update AO-0329 (PJ02-01))**		
Activity	Impact	Change
Apply WDS-D to Departures	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new. When WDS-D is being employed the Enhanced OSD tool will need to support the switching to applying the WDS-D reduced wake turbulence separations.
Determine earliest take-off clearance time taking into account any other separation	Update	All separation criteria may optionally be supported by the OSD tool.
Determine preceding aircraft earliest distance position taking into account	Update	All separation criteria may optionally be supported by the OSD tool.

any other separation		
Determine SID Separation and earliest Time to each preceding aircraft	Update	SID Separation criteria may optionally be supported by the OSD tool.
Determine SID Separation Distance to each relevant preceding aircraft	Update	SID Separation criteria may optionally be supported by the OSD tool.
Determine the most restrictive Time satisfying Wake Separation or SID Separation	Update	The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a SID separation.
Determine the most restrictive Wake Separation or SID Separation Distance	Update	The determination of the Wake Separation will be supported by the OSD tool and the determination of the SID Separation may optionally be supported by the OSD tool. When the determination of the SID Separation is being supported the OSD tool is able to inform the Tower Runway Controller of the most restrictive constraint; the Wake Separation or a more constraining SID Separation.
Determine Wake Separation Distance to preceding aircraft	Update	The determination of the Wake Separation will be supported by the OSD tool.
Determine Wake Separation Time to preceding aircraft and associated Time	Update	The determination of the Wake Separation will be supported by the OSD tool.
Inform operational actors that WDS-D is no longer to be applied	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new. The Enhanced OSD tool will need to support being informed to not applying the WDS-D reduced wake turbulence separations.
Inform operational actors that WDS-D is to be applied or changed	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new. The Enhanced OSD tool will need to support being informed to applying the WDS-D reduced wake turbulence separations.
Issue take-off clearance and Monitor and Record Roll Time	Update	The take-off will be earlier than current day operations when applying an optimised wake turbulence separation.
Monitor for aircraft becoming airborne and record Airborne Time	Update	There is a need to assure the recorded airborne time provided to the OSD tool when "airborne time" procedures are being applied.
Monitor separation on initial departure	Update	The Tower Runway Controller will need to take into account the optimised wake separation being applied.

path		
Stop Applying WDS-D to Departures	Introduce	The application of reduced wake turbulence separations dependent on the crosswind conditions is new. When WDS-D is being employed the Enhanced OSD tool will need to support the stopping of applying the WDS-D reduced wake turbulence separations.

Table 50: Difference between new and previous Operating Method for Departures Concepts Solutions exported by EATMA

3.3.3.3 Wake Risk Monitoring Concept Solution

Activities (in EATMA) that are impacted by the SESAR Solution	Current Operating Method	New Operating Method
Reporting of wake turbulence encounter by the Flight Crew	Currently, Flight Crews either • Submit a wake encounter report manually as part of post-flight activities • Notify ATC of a suspected wake encounter during flight	In the new operating method, Flight Crews notify ATC of a suspected wake encounter during or after the flight. They do not need to fill out and submit a separate report form
Reception and processing of a wake turbulence encounter report from the Flight Crew by the Controller	Currently, controllers may receive a wake encounter report from a Flight Crew, and subsequently fill out a report form containing any information they have about the event.	In the new operating method, controllers receive a wake encounter report from a Flight Crew. It is then sufficient to "tag" the flight to identify it later in the detection and monitoring tool database.

Table 51: Difference between new and previous Operating Method for the Wake Risk Monitoring Concept Solution

Table 52 is the table of differences exported from EATMA.

OI Step code – title (OI Step CR)		
AO-0327 - Reduction of Wake Turbulence Risk through Wake Risk Monitoring **(CR 01985 Update AO-0327 (PJ02-01))**		
Activity	Impact	Change
Analyse Data	Introduce	This is the main activity of the Wake Risk Monitoring, which is to provide a reliable way to identify wake encounters not currently available.
Collect Data	Introduce	The algorithms used by the Wake Risk Monitoring need a certain number of data recorded by the aircraft, which is currently not readily available.
Create Wake Risk Report	Introduce	In order to make the results easily available to external stakeholders after the analysis step, the Wake Risk Monitoring aggregates data in a specific report format.
Establish Wake Risk	Introduce	In order to perform a meaningful comparison, a reference level of wake

Baseline		risk has to be established.
Evaluate Wake Risk Report	Introduce	The Wake Risk Monitoring provides an additional way for ANSPs to evaluate the safety of new wake turbulence separation rules after their introduction.
Transmit Data	Introduce	To supply the data collection for the Wake Risk Monitoring, aircraft need to transmit the required data.

Table 52: Difference between new and previous Operating Method for Wake Risk Monitoring Concept Solution exported by EATMA

3.3.3.4 Wake Decay Enhancing Concept Solution

Activities (in EATMA) that are impacted by the SESAR Solution	Current Operating Method	New Operating Method
Wake Decay Enhancing Concept Solutions do not impact any operating method.		

Table 53: Difference between new and previous Operating Method for Wake Decay Enhancing Concept Solution

4 Safety, Performance and Interoperability Requirements (SPR-INTEROP)

This section provides the Safety, Performance and Interoperability Requirements applicable to:

- Arrival Concepts Solutions
- Departures Concepts Solutions
- Wake Risk Monitoring Concept Solution
- Wake Decay Enhancing Concept Solution

To facilitate the traceability between requirements and relevant concept the provided identifiers have the following structure:

- REQ-02.01-SPRINTEROP-XXXZ.YYYY where:
  - XXX is
    - ARR for Arrivals Concepts Solutions
    - DEP for Departures Concepts Solutions
    - WRM for Wake Risk Monitoring Concept Solution
    - WDE for Wake Decay Enhancing Concepts Solution
  - Z is:
    - 1 for Static Pair Wise Separation
    - 2 for Weather Dependent Separation
    - 3 for the Tools (ORD or OSD depending on XXX)
    - 0 for wake monitoring concept, for wake decay concept, for arrival and departure concepts when it applies to more than 1 concept
  - YYYY is:
    - A progressive number.

4.1 Arrivals Concepts Solutions

The latest consolidated list of requirements for the Arrivals Concepts Solutions has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0010
Title	TBS concept
Requirement	The TBS concept shall apply time based wake turbulence separation rules on final approach.
Status	<validated>
Rationale	The time separation rules are defined as the time to fly the applicable DBS wake turbulence separation in reference wind conditions (i.e. low wind). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR1.0020
Title	S-PWS concept
Requirement	The S-PWS concept shall apply wake turbulence separation rules defined between aircraft type pairs or between S-PWS wake categories on final approach.
Status	<validated>
Rationale	The S-PWS rules are defined as the applicable DBS wake turbulence separation according to the RECAT PWS safety case submitted to EASA. This requirement has been validated in RTS2, RTS3a, RTS4a, RTS4b.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0030
Title	WDS concept
Requirement	The WDS concept shall apply weather dependent wake turbulence separation rules on final approach.
Status	<validated>
Rationale	The WDS separation rules are defined as function of the actual crosswind and its effect on the wake transportation, of the actual total wind and its effect on the wake decay and of the speed profiles of leader and follower aircraft. For example: In TB-modes where WDS is applied (WDS-Xw and WDS-Tw) the separation delivery tool shall be provided with time separation tables (for each cross-wind and respectively total wind value and each aircraft pair category) derived from: - the time required for a sufficient vortex decay - the time required for the vortex to be transported away from the path of the follower aircraft - the reference speed profile for the leader and follower aircraft This requirement has been validated in RTS1.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0040
Title	ORD concept
Requirement	The ORD concept shall support Controllers in delivering separation / spacing at the delivery point by considering the effects of compression caused by the leader and follower being at different stages of final approach speed management which results in different leader and follower speeds.
Status	<validated>
Rationale	ORD is needed to facilitate ATCOs in their work, to reduce the workload and improve the accuracy of separation/spacing delivery. ORD aim to simplify the complexity of Final Approach ATCOs as there is no need to calculate the compression between aircraft pair (historically identified as an ATCO need). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0050
Title	Separation Delivery Tool
Requirement	The Intermediate Approach, Final Approach and Tower Controllers shall be provided with a Separation Delivery Tool displaying Target Distance Indicators (TDI) to enable consistent and accurate application of TBS, PWS-A, DBS and/or WDS-A wake turbulence separation rules on final approach and landing.
Status	<validated>
Rationale	This is applicable for any wake turbulence separation rules that cannot feasibly be applied without tool support because the Controllers are unable to remember or calculate the required separation. This is a characteristic of a range of wake turbulence separation schemes including TBS, S-PWS and WDS. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0060
Title	TBS wake separation rules
Requirement	In TBS mode, the separation delivery tool shall be provided with time separation rules.
Status	<validated>
Rationale	Required as input into the FTD calculation. The time separation rules are defined as the time to fly the applicable DBS wake turbulence separation in reference wind conditions (i.e. low wind). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR1.0070
Title	S-PWS wake separation rules
Requirement	S-PWS wake separation rules shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	Required as input as these values will be the FTD if the S-PWS concept is being applied. This requirement has been validated in RTS2, RTS3a, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0080
Title	DBS wake separation rules
Requirement	In DB- modes the separation delivery tool shall be provided with a range of wake turbulence distance-based separation rules based on ICAO Aircraft Type (e.g. ICAO, RECAT-EU, RECAT-EU-PWS) depending upon the airport needs.
Status	<validated>
Rationale	Required input for the separation delivery tool. Could be used when is required a transition from a TBS to a DBS mode. This requirement has been validated in RTS1.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0100
Title	Separation Delivery Tool Modes
Requirement	The tool shall operate under Distance Based modes (DB- modes: DBS, S-PWS) and Time Based modes (TB- modes: TB S-PWS, TB-WDS-Tw, TB-WDS-Xw, TB-WD-PWS-TW, TB-WD-PWS-XW), with the possibility to switch between DB- modes and corresponding TB- modes.
Status	<validated>
Rationale	There is a need to change wake separation rules if applying a conditional version of the concept (e.g. WDS) or if there is insufficient information for the normal mode of operation (such as reversion to DBS if the GWCS fails). This requirement has been validated in RTS1.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0110
Title	FTD indicator
Requirement	The Separation Delivery tool shall provide to ATCOs a visualisation (FTD indicator) of the required minimum separation or spacing on final approach that needs to be delivered after considering all in-trail and if applicable not-in-trail constraints.
Status	<validated>
Rationale	The Controller will not know the required separation or spacing using either TBS, S-PWS or WDS in all different runway operation modes. Hence needs a visualisation of the required separation or spacing on the CWP HMI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0120
Title	ITD indicator
Requirement	If the ORD concept is considered, the Separation Delivery tool shall provide to ATCOs a visualisation (ITD indicator) of the required spacing on final approach to be delivered at the deceleration fix in order to deliver the required minimum separation / spacing at the delivery point.
Status	<validated>
Rationale	The Controller will not know the predicted compression after the DF hence needs a visualisation of the required spacing to deliver at the DF on the CWP HMI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0130
Title	FTD computation
Requirement	In TB mode, the FTD computed by the tool to indicate the wake separation applicable at the delivery point shall take into consideration: • The time separation from the wake turbulence separation table (for WDS the separation tables might be more than one depending on the total/cross wind values); • The aircraft pair (from the arrival sequence list); • The glideslope headwind profile; • The follower time-to-fly profile obtained either from modelled time-to-fly profile in the considered headwind conditions • The time separation buffer considering uncertainties of final approach speed profiles of the a/c pair and of the glide slope wind prediction
Status	<validated>
Rationale	Time separations or spacing need to be converted into equivalent distances so they can be displayed on the CWP HMI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0131
Title	FTD computation II
Requirement	For the time based separation modes (TB-modes i.e. TBS, TB-PWS-A, TB-WDS-A or A-TB-WD-PWS), for which FTD (Final Target Distance standing for the separation indication) is computed based on a time separation, the risk of under-separation induced by the uncertainty in glideslope headwind prediction and in the actual final approach speed profile shall be mitigated.
Status	<validated>
Rationale	To manage risk of under-separation the separation delivery tool needs to provide accurate/safe FTD indicators. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0132
Title	FTD computation II
Requirement	For the Time based separation modes, the risk of under-separation induced by the uncertainty in glideslope headwind prediction and in the actual final approach speed profile shall be mitigated by one or a combination of the following means: • Adding a time separation buffer in the design of the FTD indicators displayed to Controllers. These buffers may vary depending on the considered applicable separation minima and wind conditions • The conditional application of any TB- mode (e.g. WDS shall be locally pre-determined and used as a wind-based criterion for the activation of that mode • For the TB- mode, taking a buffer in the design of TBS minima (e.g. higher headwind conditions when selecting reference baseline minima) • The selection of most appropriate mean(s) shall be based on the local operational conditions, local wind behaviour, wind profile and aircraft speed profile prediction system accuracy
Status	<validated>
Rationale	To manage risk of under-separation the separation delivery tool needs to provide safe FTD indicators. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0139
Title	TDI display
Requirement	TDIs shall be displayed on the extended runway centreline behind each lead aircraft established on final approach and shall be linked to the actual lead aircraft position along the runway axis.
Status	<validated>
Rationale	For being used by the ATCOs. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0133
Title	TDI display II
Requirement	TDI position shall provide the accurate information about the required separation/spacing for each aircraft pair.
Status	<validated>
Rationale	For being used by the ATCOs. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Assess Separation/Spacing Infringement Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0140
Title	FTD computation III
Requirement	Before the Leader reaches the separation delivery point, the FTD shall be “static” (i.e. the separation distance between the Leader position and the displayed FTD shall be static, the FTD shall hence move at the Leader speed). It shall be computed accounting for the expected time-to-fly of the Follower aircraft until the separation delivery point. After the Leader passes the separation delivery point and until the Follower reaches the separation delivery point, the FTD shall be disconnected from the Leader (e.g. move at the expected Follower speed to reach zero when the Follower is expected to reach the delivery point).
Status	<validated>
Rationale	To provide an FTD that is reliable and does not provide wrong separation or spacing information to the Tower Controller (e.g. infringement of FTD when the leader aircraft already landed). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0143
Title	Relation FTD/ITD with speed profile
Requirement	For all modes (where FTD and/or ITD are based on a pre-defined aircraft speed profile of the follower), the APP and TWR Controllers shall be made aware with respect to the impact on the TDIs correctness when actual aircraft speed profile is different from the pre-defined TAS profile used by the separation delivery tool.
Status	<validated>
Rationale	Speed profile is one of the main inputs of the tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0141
Title	FTD computation IV
Requirement	In WDS modes (total wind/cross wind) the Separation Delivery tool shall use the relevant separation table for the FTD computation based on the measured total/cross wind.
Status	<validated>
Rationale	The separation Delivery tool might have more than one WDS separation table (corresponding to e.g. 8kts, 10kts, 13kts, etc.). The separation table used for calculating the TDIs will depend on the measured total/cross wind at that moment. This requirement has been validated in RTS1.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0142
Title	Conservative wind for FTD computation
Requirement	If the required inputs to calculate a time based separation are temporarily not available (duration to be determined based on local wind forecast accuracy) a conservative wind input may instead be used to calculate the FTD.
Status	<validated>
Rationale	This may be possible if the Runway Surface Wind Service is used in conjunction with the Glideslope Wind Conditions Service. For example, if the Runway Surface Wind Service fails it may be possible to use a conservative runway surface wind value to allow time based FTDs to still be calculated. See Safety requirement SR1.301 as an example in the SAR. This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0144
Title	Total wind monitoring function
Requirement	In WDS total wind modes (A-TB-WDS-Tw), the Approach and Tower Controllers and Supervisors shall be alerted by the total wind monitoring function about a significant difference between actual reference total wind and the reference total wind used for the TB computation, i.e. when the predicted allowed time separation (based on the total wind prediction used for Target Distance Indicator computation) compared to the actual allowed time separation (based on the actual total wind measurement) exceeds a threshold to be determined locally.
Status	<in progress>
Rationale	Wind has an impact on TDI displayed. The requirement was proposed in workshops in previous SAF work, but the final need of this requirement is still to be assessed in the local deployment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Assess operational situation and conditions at the approach Switch to new mode of operations in Approach Control Assess operational situation and conditions at the airport Coordinate with Tower Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0145
Title	Cross wind monitoring function
Requirement	In WDS cross wind modes (A-TB-WDS-Xw), the Approach and Tower Controllers and Supervisors shall be alerted by the cross wind monitoring function about a significant difference between actual reference cross wind and the reference cross wind used for the TB computation, i.e. when the predicted allowed time separation (based on the cross wind prediction used for Target Distance Indicator computation) compared to the actual allowed time- separation (based on the actual cross wind measurement) exceeds a threshold to be determined locally.
Status	<in progress>
Rationale	Wind has an impact on TDI displayed. The requirement was proposed in workshops in previous SAF work, but the final need of this requirement is still to be assessed in the local deployment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control Assess operational situation and conditions at the airport Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0146
Title	Headwind monitoring function
Requirement	In TBS and TB-PWS-A modes, in case there is a significant difference between actual glideslope headwind profile and the glideslope headwind profile used for the TDI computation, the Separation Delivery Tool shall re-compute the TDIs based on the correct headwind value and inform the ATCO about the re-computation.
Status	<in progress>
Rationale	Wind has an impact on TDI displayed. The requirement was proposed in workshops in previous SAF work, but the final need of this requirement is still to be assessed in the local deployment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0150
Title	ITD computation I
Requirement	The ITD computed by the tool for all separation and spacing constraints (wake separation in DB and TB modes, MRS, ROT and other spacing constraints) shall take in consideration: • The FTD for the considered aircraft pair • The glideslope headwind profile • The leader and follower time-to-fly profiles obtained either from modelled time-to-fly profile in the considered headwind conditions • The time separation buffer considering uncertainties of final approach speed profiles of the a/c pair and of the glide slope wind prediction
Status	<validated>
Rationale	The ITD needs to be calculated depending on the difference in groundspeed of the leader and follower aircraft types from the time the leader passes the DF until the leader reaches the delivery point. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0151
Title	ITD computation II
Requirement	For all separation modes, for which an ITD (Initial Target Distance standing for the compression indication) is used, the risk of under-separation after Deceleration Fix induced by the uncertainty in glideslope headwind prediction and in the actual final approach speed profile shall be mitigated.
Status	<validated>
Rationale	To manage risk of under-separation the separation delivery tool needs to provide safe ITD indicators. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0152
Title	ITD computation II
Requirement	For all separation modes, for which an ITD is used, the risk of under-separation after Deceleration Fix induced by the uncertainty in glideslope headwind prediction and in the actual final approach speed profile shall be mitigated by adding a time separation buffer in the design of the ITD indicators displayed to Controllers. These buffers may vary depending on the considered applicable separation minima and wind conditions.
Status	<validated>
Rationale	To manage risk of under-separation the separation delivery tool needs to provide safe ITD indicators. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0160
Title	ITD computation III
Requirement	Before the Leader reaches its Deceleration Fix (DF), the ITD shall be "static" (i.e. the separation distance between the Leader position and the displayed ITD shall be static, the ITD shall hence move at the leader speed). It shall be computed accounting for the compression/ pull-away effect for the aircraft pair expected from the leader DF until the separation delivery point. After the Leader passes the DF, the ITD shall move towards the FTD, accurately account for compression/pull-away effect for the aircraft pair expected from the actual leader position until the separation delivery point.
Status	<validated>
Rationale	The ITD shall be able to take in account the difference in compression after the leader passes the DF (e.g. difference in wind conditions). To not provide wrong spacing information to the Approach Controller (e.g. infringement of ITD by the follower aircraft when the leader aircraft already passed the DF). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0161
Title	Spacing constraint computation
Requirement	The spacing constraint computation shall take into consideration the same inputs as for the ITD and FTD plus: • The time separation value representing the spacing constraint (ROT, GAP, scenario specific spacing, etc.)
Status	<validated>
Rationale	Spacing constraints might represent bigger distances between aircraft than the separation spacing. To be computed they follow the same logic of the other constraints plus an addition time value that represents the extra spacing requested. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0162
Title	TDI greatest constraint
Requirement	The tool in any mode shall display TDIs representing the greatest constraint out of all applicable in-trail or not in-trail separation constraints. The constraints can be the high priority separation (e.g. Wake and MRS) and the low priority runway spacing (ROT) and other spacing constraints (e.g. departure GAP, runway inspections, etc.).
Status	<validated>
Rationale	The ATCOs need to comply with the biggest separation/spacing displayed by the separation delivery tool. With the display of the TDIs, the indication of the safety contract is considered mandatory, as ATCOs will exclusively rely on the TDIs, because they will no longer calculate the required separation, expecting the chevrons to correctly displayed the most constraining separation/spacing minima. The distance between the lead aircraft and the FTD associated to the preceding aircraft shall not be less than the applicable Minimum Radar Separation value (e.g. with TB-WDS the wake separation minima could go below 2.5nm, nonetheless the highest constraint applicable in this case would be the applicable MRS value). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0163
Title	ITD value not smaller than FTD
Requirement	If the ITD calculation is smaller than the FTD (e.g. pull away scenario) then it shall be changed to the same value as the FTD.
Status	<validated>
Rationale	There could be cases where very small follower aircraft have performances that lead to deceleration and stabilization slower than leader aircraft. In these rare cases the ITD value cannot be smaller than FTD to avoid under-separation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0164
Title	FTD main TDI for Tower Controller
Requirement	The FTD indicator shall be the main TDI to be used by the Tower Controller.
Status	<validated>
Rationale	The Tower Controller is monitoring the delivered separation or spacing. This is represented by the FTD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0165
Title	FTD main TDI for Tower Controller II
Requirement	The Tower Controller shall monitor and ensure that there is no infringement of the FTD.
Status	<validated>
Rationale	The Tower Controller is monitoring the delivered separation or spacing. This is represented by the FTD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0166
Title	FTD infringement
Requirement	Clear guidelines with regard to the list of possible actions to be made in the case of an FTD infringement (in the APP and in the TWR) shall be described per position for the local implementation.
Status	<validated>
Rationale	Local implementation needs to define local procedures in case of FTD infringement. Based on the simulations, ATCOs were asked to give speed instructions prior to the deceleration fix - if they thought based on their knowledge and experience that this action will maintain the a/c behind the FTD. On the other hand if the ATCO thought that the FTD will be infringed based on the status of the FTD and the position of a/c in relation to FTD, as well as the speed of a/c (if a/c not flying as planned) then they were required to instruct a go-around. After the deceleration fix, the ATCOs were required to instruct a go-around. Similar guidelines shall be made available to the ATCOs covering various examples in nominal, abnormal ad degraded conditions. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0167
Title	ITD main TDI for APP Controller
Requirement	If both the FTD and ITD are available, the ITD indication (“compressions indicator”) shall be the main indicator to be used by the final approach controller.
Status	<validated>
Rationale	The ITD represents the spacing to be delivered at the DF. The detail of the procedure to establish on the localiser and catch-up the ITD will depend on the local implementation of the ITD. APP ATCOs found working with ITD alone (with the FTD automatically appearing if and when the ITD was infringed), just as easy /usable as working with both the ITD and FTD displayed all the times but overall ATCOs preferred working with the ITD alone as there was less clutter on the CWP HMI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0168
Title	Toggle on and off
Requirement	If the functionality to toggle on and off the ITDs/ FTDs is available there shall be an indication on the HMI that shows whether it has been toggled on or off on purpose by the Controller or Supervisor or if it is a system error.
Status	<validated>
Rationale	This option is required to ensure ATCOs have an appropriate level of situation awareness and this in turn would reduce the potential for human error, making it easier to identify potential system errors. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0169
Title	Buffers
Requirement	Training shall ensure Controllers understand the rationale behind the buffers inserted in the Separation Delivery Tool parameters, in order to avoid the risk of under separations.
Status	<validated>
Rationale	Knowing that the tool parameters contain a safety buffer (locally defined) some Controllers might be prone to "interpreting" the under separations (e.g. not give a go-around if slightly infringing the separations). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0170
Title	Respect of ITD spacing
Requirement	If the ORD concept is implemented, the Approach controller shall vector the follower aircraft so that it stays on or behind the corresponding ITD.
Status	<validated>
Rationale	ATCOs to manage the proper compression and avoid under-spacing shall space aircraft on or behind the ITD in all the situations: - For the turn on decision for merging on to final approach, - For vectoring the follower aircraft to intercept the final approach - For further spacing management during interception The ITD accounts for the separation compression on final approach due to the landing stabilisation speed characteristics of both the leader and follower aircraft and the glideslope headwind conditions. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0180
Title	Surveillance data inputs

Requirement	The Surveillance system shall provide the Separation Delivery Tool with aircraft position, speed and altitude for all arrival aircraft.
Status	<validated>
Rationale	Position and altitude data is required by the Separation Delivery tool to be able to correctly calculate and display TDIs. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0190
Title	Surveillance data inputs II
Requirement	There shall be surveillance coverage down to the separation delivery point to allow the separation tool to display Target Distance Indicators on the runway extended centreline including the last part of the final approach.
Status	<validated>
Rationale	Position and altitude data is required by the Separation Delivery tool to be able to correctly calculate and display TDIs. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Monitor Aircraft Spacing Provide Aircraft Spacing Provide landing clearance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0200
Title	Minimum runway spacing rule inputs
Requirement	All applicable runway configuration spacing rules shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	The runway configuration spacing rules (both in-trail and if applicable not-in-trail) are needed in the TDI calculation to find the largest constraint. E.g. CSPR or dependant parallel runways. This requirement has been validated in RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0220
Title	Flight data inputs
Requirement	Aircraft identifier, ICAO aircraft type and wake category for all arrival aircraft, including subsequent updates to this information, shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	ICAO aircraft type and wake category are an important input into the Separation Delivery tool as they determine the required wake separation and spacing (e.g. ROT) between aircraft pairs. The aircraft identifier is needed to correlate flight data from different sources. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0230
Title	MRS constraint input
Requirement	All applicable Minimum Radar Separation (MRS) rules shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	The MRS constraints (both in-trail and if applicable not-in-trail) must be respected by the Separation Delivery tool when calculating the FTD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0240
Title	Other spacing rule inputs
Requirement	All applicable runway-related spacing rules other than those related to runway configuration shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	All applicable spacing rules (both in-trail and if applicable not-in-trail) to be considered by the Separation Delivery tool are needed in the TDI calculation to find the largest constraint. E.g. runway inspection, temporary closure of runway, dependent parallel runway operations or closely spaced parallel runway operations. If in a local implementation the tool is required to consider separation or spacing constraints dependant on the runway visibility conditions, and runway conditions, then the runway visibility conditions, and runway conditions, shall be provided to the Separation Delivery tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0250
Title	Scenario specific spacing inputs
Requirement	Scenario specific spacing gaps between aircraft pairs shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	The separation delivery tool shall take in account scenarios that require extra spacing such as departure gaps or runway inspection in order to find the largest constraint applicable to aircraft pair. Scenarios can be applicable for a determined period of time/number of aircraft or created ad-hoc for single aircraft pair. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Insert GAP spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0251
Title	Capability to manage gap spacing between consecutive arrivals
Requirement	The separation delivery tool shall provide ATCOs the possibility to manage gap spacing between consecutive arrival flights.
Status	<validated>
Rationale	Gap spacing (e.g. a distinguishable TDI corresponding to gaps only) could be used to insert one or more departures between arrivals, for runway inspection, for aircraft with special separation to be applied and other situations where a specific spacing is required. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Insert GAP spacing Coordinate the GAP Spacing modification with Final Approach Controller Request GAP insertion Assess departures vs GAP spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0253
Title	Feedback on gap spacing insertion
Requirement	The separation delivery tool shall provide confirmation to the ATCO that the gap spacing insertion is successful or not.
Status	<validated>
Rationale	If the gap spacing insertion is successful, the Controller shall see that the gap value was accepted in the tool and the corresponding TDI is updated. If the gap spacing insertion is not successful, the Controller shall receive a negative feedback (e.g. an alert on the CWP) from the tool. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Insert GAP spacing Coordinate the GAP Spacing modification with Final Approach Controller Request GAP insertion

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0254
Title	Capability to insert automatic gap spacing
Requirement	The ATCOs shall be able to insert automatic gap spacing based on pre-defined scenarios in the sequence manager.
Status	<validated>
Rationale	Predefined scenarios of gap requests set forehand by the Supervisor/Approach controllers and are valid for the next X arrivals and/or Y minutes, depending on the mode of runway operation (mixed mode), the procedure and arrival management system information provided. This requirement has been validated in RTS3a, RTS4a.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Insert GAP spacing Request GAP insertion

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0255
Title	Gap spacing update and cancelling
Requirement	The tool shall provide ATCOs the ability to update and cancel any gap spacing previously inserted.
Status	<validated>
Rationale	For ATCOs to be able to cover potential errors as well as cover coordination between Tower and Final approach ATCO leading to gap update or cancellation. This requirement has been validated in RTS3a, RTS4a.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Coordinate the GAP Spacing modification with Final Approach Controller Cancel the GAP during Final Approach Control Modify the GAP during Final Approach Control Request new GAP spacing and/or position to Final Approach Controller Request cancel GAP to Final Approach Controller

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0257
Title	TDI representation
Requirement	The separation delivery tool shall be able to represent each spacing constraint information (e.g. MRS/ROT/WAKE/Additional GAP) with a TDI shape.
Status	<validated>
Rationale	For the ATCO to be able to easily identify what is the highest constraint influencing the spacing, and thus maintain ATCOs situation awareness. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess departures vs GAP spacing Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Assess GAP spacing vs planned departing a/c

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0270
Title	ROT spacing constraint
Requirement	The tool shall allow the runway occupancy time (ROT) constraints to be configurable for each aircraft based on multiple parameters.
Status	<validated>
Rationale	More efficient wake separations mean the ROT is a more common constraint. ROT spacing depends on many variables including (but not exhaustive) aircraft type, runway exit and airline operator. A suitable ROT spacing model needs to be defined to ensure the spacing constraint is reliable and efficient. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0280
Title	Glideslope wind conditions input
Requirement	The Separation Delivery tool shall be provided with the predicted headwind profile on the glideslope (ideally from ground to the published localiser interception altitude) to compute the ITD in all modes and the FTD in TB-modes. The used profiles shall ensure smooth temporal evolution of the ITD on the final approach.
Status	<validated>

Rationale	The glideslope wind conditions is required to convert time based separation in equivalented distance based separation This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0290
Title	Runway surface wind conditions
Requirement	If in a local implementation the tool is required to consider the actual runway surface wind conditions, then the runway surface wind conditions shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	The actual runway surface wind conditions may be required as input into the ITD calculation. Also, if applying a conditional version of a concept (e.g. WDS) then the actual runway surface wind needs to be monitored to ensure the Separation Delivery tool is being used in the correct mode of operation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0300
Title	Approach arrival sequence service
Requirement	The approach arrival sequence information shall be provided to the Separation Delivery tool.
Status	<validated>
Rationale	Approach arrival sequence information is required by the Separation Delivery tool to allow aircraft pairs (both in-trail and not-in-trail) to be utilised in calculating the FTD and ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0310
Title	Speed or time-to-fly model for the FTD
Requirement	An expected aircraft speed or time-to-fly profile model on the final approach glideslope shall be provided to the Separation Delivery tool for the FTD calculation.
Status	<validated>
Rationale	An expected aircraft speed or time-to-fly profile is needed to convert distance based separation into equivalent time separation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR1.0320
Title	Speed or time-to-fly model for ITD
Requirement	An expected aircraft speed or time-to-fly profile model on the final approach glideslope shall be provided to the Separation Delivery tool for the ITD calculation.
Status	<validated>
Rationale	An expected aircraft speed or time-to-fly profile is needed for the ITD calculation to convert between time and distance. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0321
Title	Aircraft Time-to-fly profiles inputs
Requirement	Aircraft time-to-fly profiles used in the FTD and ITD calculations shall be based on a time-to-fly model representative of nominal aircraft speed behaviour on final approach, in the local environment.
Status	<validated>
Rationale	The separation delivery tool requires these model inputs for calculating the requested separations or spacing in the form of a TDI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0370
Title	Management of data inputs
Requirement	Local implementation shall ensure that roles and responsibilities are clearly defined regarding the management of data inputs into the Separation Delivery tool including runway policy, runway spacing constraints, visibility conditions and runway conditions.
Status	<in progress>
Rationale	The Separation Delivery tool relies on these data inputs for the calculation of separation and spacing hence it is important that clear roles and responsibilities are defined to ensure this information is maintained in a timely manner. Requirement in progress has it is to be locally defined.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0380
Title	Quality assurance of speed / time-to-fly and wake turbulence configuration data
Requirement	A quality assurance process shall be put in place to validate the time separation table configuration file (in TB- modes) or the distance separation table configuration file of the separation delivery tool.
Status	<validated>
Rationale	The wake turbulence configuration data are critical inputs into the TDI calculation hence the importance to ensure their reliability. This is to be done at implementation of the applicable concept and after changes are made. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0390
Title	Quality assurance of speed / time-to-fly and wake turbulence configuration data II
Requirement	Separation delivery tool verification shall be carried-out after modification of the time separation table configuration file (in TB-modes) or the distance separation table configuration file before the system returns in operational service.
Status	<validated>
Rationale	The wake turbulence configuration data are critical inputs into the TDI calculation hence the importance to ensure their reliability. This is to be done at implementation of the applicable concept and after changes are made (for example for accommodating a new aircraft type or updating the database with a fine tuning of the aircraft model used). This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0400
Title	Input data integrity
Requirement	It shall be demonstrated that the data inputs including flight data, approach arrival sequence information and glideslope wind conditions to the Separation Delivery are sufficiently robust.
Status	<in progress>
Rationale	The flight data, approach arrival sequence information and glideslope wind conditions impact the separation / spacing that is calculated by the Separation Delivery tool. Still in progress as this demonstration remains to be done at local level.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0410
Title	Software assurance level
Requirement	The software assurance level of the Separation Delivery tool and supporting tools shall be determined by the V4 Safety assessment.
Status	<in progress>
Rationale	The software assurance level (outside SESAR 2020 wave 1 scope) will depend on the ability of the Controllers to make checks of the TDIs. If Controllers are unable to make checks due to too many variables used in the calculation, then greater reliance is placed on the software. In the latter situation, the fact that ATCOs will manage to actively and correctly check the TDIs is considered a rather poor mitigation and shall not be one of their responsibility. They shall follow the tool in which they should confidently rely on, the reliance ultimately is placed on the software. Still in progress as the software assurance remains to be done in the V4 safety assessment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0420
Title	Separation delivery tool verification after modification of the time-to-fly/airspeed profile configuration file
Requirement	Separation delivery tool verification shall be carried-out after modification of the time-to-fly/airspeed profile configuration file (new A/C types or modification of existing A/C speed profiles) before the System returns in Operational service.

Status	<validated>
Rationale	The speed / time-to-fly profile and wake turbulence configuration data are critical inputs into the TDI calculation hence the importance to ensure their reliability. This is to be done at implementation of the applicable concept and after changes are made. This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0430
Title	Flight data inputs error
Requirement	When a flight data input error (e.g. missing or wrong ICAO aircraft type or wake category) is detected, it shall be possible to update the corresponding information into the input for the separation delivery tool.
Status	<validated>
Rationale	ICAO aircraft type and wake category are major safety-related data input to the tool as they determine the required wake separation and spacing (e.g. ROT) between aircraft pairs. The aircraft identifier is needed to correlate flight data from different sources (e.g. CAT62 field). This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Identify Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0440
Title	Change of runway configuration
Requirement	In case of a change of runway configuration, the Approach and/or Tower supervisors shall be able to input to the separation tool the new arrival runway to be considered for Target Distance Indicators computation.
Status	<validated>
Rationale	The runway intent is one of the requested inputs for the TDI computation. A change in the runway intent results in the separation / spacing of each affected TDI being updated. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0441
Title	Change of runway configuration II
Requirement	In case of a change of runway configuration, the Approach and/or Tower supervisors shall coordinate prior to inserting the new arrival runway into the tool.
Status	<validated>
Rationale	It has been concluded that the prior coordination will ensure an appropriate level of situation awareness is shared between the APP and TWR supervisors and ATCOs respectively. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0450
Title	Insufficient information to calculate a TDI
Requirement	If there is insufficient information to calculate a TDI then that TDI shall not be provided, together with a visual warning.
Status	<validated>
Rationale	If the Separation Delivery tool is unable to provide a TDI then the Controller needs a clear indication, so they know to use the procedure for no TDI available which is to apply a DBS separation ahead and behind the affected aircraft. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0460
Title	Insufficient information to calculate time based FTD
Requirement	If the required input to calculate a time based wake separation is not available and a conservative wind input is not used, then the distance based wake separation minima may instead be used to calculate the FTD provided that the change in computation is clearly displayed to the ATCO.
Status	<validated>
Rationale	Even without sufficient information to convert between time and distance the FTD can still be displayed using a DBS separation. the change in computation must be clearly displayed or communicated to the ATCO. An example could be Safety requirement SR1.301 in the Safety Assessment Report. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0470
Title	Turn on support
Requirement	The Separation Delivery tool and associated procedures shall support the Controller decision to turn onto final approach.
Status	<validated>
Rationale	When aircraft are approaching from downwind or baseleg, Controllers need information about the expected spacing to be applied on final approach path in order to support the decision to turn onto the final approach path. This can be achieved either through early display of TDIs (e.g. extended centreline or baseleg) or by another support tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0480
Title	Timely display of TDI
Requirement	The TDIs shall be displayed to the Intermediate and Final Approach Controllers sufficiently early in order to allow correct interception.
Status	<validated>
Rationale	The Final Approach Controller requires a stable TDI to be available for preparing the interception as the aircraft are merging towards the final approach. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0490
Title	TDI position
Requirement	The follower TDI shall be linked to the actual aircraft position of the leader: - If the leader is aligned with the runway axis, then the follower TDIs are to be displayed behind the actual leader position; - If the leader is not yet aligned with the runway axis and the perpendicular projected position on the runway extended centreline is behind its own ITD then the follower TDIs are to be displayed behind the perpendicular projected position on the runway extended centreline; - If the leader is not yet aligned with the runway axis and the perpendicular projected position on the runway extended centreline is ahead its own ITD, then the follower TDIs are to be displayed behind the position of ITD ahead. In case several aircraft have not yet intercepted the glide, this leads to a train of ITDs, each one being attached to the previous one and all moving at the speed of the last aircraft on the extended runway centreline.
Status	<validated>
Rationale	TDI needs to be properly displayed on the extended runway centreline of the CWP and their position shall provide the good information about the required separation/spacing for each aircraft pair. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Provide landing clearance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0500
Title	ITD interception
Requirement	Once the follower aircraft has been positioned w.r.t ITD and before the leader reaches its deceleration point, the Controller shall apply speed instructions in accordance to the reference glide slope air speed used for ITD calculation.
Status	<validated>
Rationale	In order to keep consistent with the model assumptions used to compute in the separation delivery tool the ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0510
Title	Availability of wake category and aircraft type information
Requirement	Wake category and aircraft type information shall be always available in the aircraft labels so that this information remains visible for Controllers.
Status	<validated>
Rationale	This information will be required to support Controllers in delivering distance based separations without Target Distance Indicators if the Separation Delivery tool fails. With the separation delivery tool the ATCOs report that they do not need to know the a/c type and WV category when working under nominal conditions, however, in case of a degraded mode the controllers may need this information, e.g. they might need information with regard to the aircraft behaviour and this information must be easily retrievable thus it is required that the a/c type is displayed in the a/c label. The WTC might not be required for RECAT-PWS. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Assess Separation/Spacing Infringement Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0520
Title	Separation Delivery tool failure alert
Requirement	Approach and Tower Supervisors shall be made aware if any tool / monitoring / alerting features are lost or inoperative.
Status	<validated>
Rationale	The Controllers and Supervisors need to remain aware of failures in the Separation Delivery tool or any supporting tools to ensure a controlled transition to a degraded mode if required. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0530
Title	Consistent operating mode across Controller Working Positions
Requirement	The System architecture shall ensure all applicable Controller Working Positions (e.g. per runway) operate in the same mode(s).
Status	<validated>
Rationale	To ensure that all Controllers are delivering the same separation or spacing. Note that two modes (e.g. WDS and RECAT-EU) could be applicable at the same runway in the case of transition. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.

Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0920
Title	Approach arrival sequence display I
Requirement	The runway final approach sequence order shall be displayed on the HMI so that it is visible to the Approach, Tower and Supervisor positions.
Status	<validated>
Rationale	The sequence order is an input for the separation delivery tool. ATCOs might need to make sure that the sequence order is consistent in order to have correct TDI displayed on the CWP. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0930
Title	Approach arrival sequence display II
Requirement	The sequence order of each aircraft in the sequence may be displayed in the radar label.
Status	<validated>
Rationale	ATCO might use the sequence order information on the radar label to manually change the sequence or look at the sequence order. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0940
Title	Approach arrival sequence change I
Requirement	In case of a change of the arrival sequence order position of an aircraft, the Approach controller shall check that the arrival sequence order has been updated to reflect the change.
Status	<validated>
Rationale	Any change in the sequence order shall be correctly reflected in the sequence list, it is important to establish procedures for the ATCOs to make sure that the changes to the sequence order are put in place. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0941
Title	Approach arrival sequence change III
Requirement	The sequence manager shall ensure that for the change of the sequence order there is no overlap (or lack of awareness) between the actions taken by the Intermediate Approach Controller and the Final Approach Controller, by allowing only one change at a time.
Status	<validated>
Rationale	The system needs to ensure there that sequence changes are not input into the system simultaneously by more than one controller. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0960
Title	Go-around impact for sequence and TDI
Requirement	The Target Distance Indicators associated to a leader aircraft executing a go-around shall be removed from the sequence and new Target Distance Indicators shall be computed for the following a/c, considering the new arrival pairs created due to this go-around. The aircraft could be removed from the sequence manually by the ATCO or automatically.
Status	<validated>
Rationale	The landing sequence will change due to the go-around, so it is important that the sequence order input for the separation delivery tool represents the current traffic situation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0560
Title	TDI update after sequence change
Requirement	For every change in the arrival sequence (aircraft swapping positions, aircraft removed or missed approach, late change of the runway intent, etc.) the tool shall immediately re-compute all affected TDIs and reflect the change on the HMI accordingly.
Status	<validated>
Rationale	A change in the sequence means the currently displayed TDIs will no longer be correct meaning an update is required considering the new sequence of aircraft pairs. The separation delivery tool and associated sequence manager shall always show the most up to date image of the traffic, regardless of what changes in the arrival sequence have been made. The parameters behind the tool shall be re-computed as soon as changes of any sort (wind, go-arounds, insertion of new aircraft etc.) have been made. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0550
Title	Check TDIs after sequence update
Requirement	If there is a change to the sequence order or runway intent, the Approach Controller should check that each indicator for each affected aircraft pair have been updated.
Status	<validated>
Rationale	A change in the sequence or runway intent results in the separation / spacing of each affected TDI being updated. A procedure checking the TDIs update correctly helps maintain the high integrity sequence information. For example, a temporary visual confirmation message of the TDIs recalculation could be displayed on the CWP to support the ATCO. However, if the approach arrival sequence information is demonstrated to have sufficient integrity then this may not be required. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0910
Title	Input the arrival runway intent
Requirement	The separation delivery tool shall be given the arrival runway intent including eventual updates for each aircraft such that it is considered for the computation of the Target Distance Indicators.
Status	<validated>
Rationale	Displaying the approach arrival sequence information allows the Controllers to cross check the displayed information. Note this may not be required if the approach arrival sequence is demonstrated to have sufficient integrity. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0561
Title	TDI update after runway intent change
Requirement	For a late change of the runway intent, the tool shall immediately re-compute all affected TDIs and reflect the change on the HMI accordingly (i.e. the TDIs corresponding to the affected aircraft disappear from the extended runway centreline of the old runway and is displayed on the extended runway centreline of the new runway).
Status	<validated>
Rationale	A late change in the runway intent requires the adaptation of the arrival sequence for the affected runways. This requirement has been validated in RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0950
Title	Change of aircraft landing runway intent I
Requirement	When the aircraft is already inserted into the sequence with a runway intent and there is a change of aircraft landing runway intent, the Approach controller shall check that Target Distance Indicators reflect the change of aircraft landing runway intent.
Status	<validated>
Rationale	A change in the runway intent results in the separation / spacing of each affected TDI being updated. A procedure checking the TDIs update correctly helps maintain the high integrity sequence information. This requirement has been validated in RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0540
Title	Approach arrival sequence check
Requirement	Controllers shall be trained to check the aircraft landing runway intent and that the aircraft order is correct and coherent with the arrival sequence list. They shall check if and that the aircraft order is displayed in the arrival sequence list and/or if the aircraft sequence number is displayed in the radar label in accordance with their intended sequence.
Status	<validated>
Rationale	The Approach Arrival Sequence must have a high integrity level as technical errors could lead to under separations occurring without the Controller being aware of. A checking procedure will help maintain the high integrity. However, if the approach arrival sequence information is demonstrated to have sufficient integrity then this may not be required. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0570
Title	TDI update after separation or spacing constraint change
Requirement	If there is a change to the separation / spacing constraint (e.g. Gap) the TDI for the affected aircraft pair shall be re-computed.
Status	<validated>
Rationale	A change to the separation / spacing constraint may mean the currently displayed TDIs for the affected aircraft pairs are no longer correct hence the need to re-calculate TDIs for those pairs. This requirement has been validated in RTS3a, RTS4a.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0580
Title	TDI display options
Requirement	The display option for the indicator shall be configurable depending on the type of separation / spacing.
Status	<validated>
Rationale	Controllers may need the ability to display certain types of TDI (e.g. ITD in the TWR) or to suppress the display of certain types of TDI to reduce clutter (e.g. ROT indication). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0590
Title	TDI display across applicable CWPs
Requirement	TDIs shall be displayed on all applicable ATCO and SUP CWPs (Tower Runway, Final Approach and Intermediate Approach), according to the local implementation rules.
Status	<validated>
Rationale	The Intermediate Approach and Final Approach Controller is required to set up and monitor the required separation or spacing. The Tower Runway Controller is required to monitor the required separation or spacing. As a result, local implementation rules shall specify the use of the TDIs (ITD and FTD) in both the Approach and Tower positions. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0620
Title	TDI update rate
Requirement	The indicators shall have the same update rate as the radar and be displayed with no discernible difference from the radar update time of the associated aircraft.
Status	<validated>
Rationale	This is to ensure the distance between the aircraft and the TDI always represents the intended separation or spacing. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0630
Title	TDI display timing criteria
Requirement	Criteria to determine the time for displaying indicators for each CWP shall be specified depending upon the local operation's needs.
Status	<validated>
Rationale	The usage and display of TDIs shall be locally defined, depending on whether or not both the ITD and the FTD are desired (APP and/or TWR), depending on whether the TDIs are used in both DBS and TBS conditions etc. The time to display TDIs depends upon each local implementation. TDIs can be displayed late (such as when the aircraft is on base leg) if another form of tool support is provided to support the initial turn from downwind. Example criteria for indicator display can include altitude, perpendicular distance from the extended runway centreline, distance to the runway threshold parallel to the runway centreline and heading. As an example, the TDI for the leader/follower aircraft pair shall be computed and displayed by the tool as soon as the two aircraft satisfy the following: • distance to the runway extended centreline is within a defined parameter; • altitude is below a defined parameter; and in addition, the leader has a difference between runway heading and aircraft track less than a defined parameter. These parameters shall be configurable within the tool based on the local environment. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0650
Title	FTD display on Approach CWP
Requirement	The Approach controller shall have the possibility to globally select the display of the FTD, however the FTD shall automatically be displayed when some alerts are active (e.g. risk of imminent FTD infringement).
Status	<validated>
Rationale	The Approach Controllers normally has only the ITD displayed. However, if the FTD is only a short distance ahead of it then crossing the ITD may result in the aircraft accidentally crossing the FTD as well. Without the FTD ATCOs might not be aware of the separation infringement. Functionality should be designed to prevent that scenario such as automatic display of the FTD if the aircraft crosses the ITD or is within a defined distance of the FTD. This should be considered for both in-trail and not-in-trail scenarios. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0651
Title	FTD display on Approach CWP II
Requirement	In case the ITD is the main display on the final approach, the ATCOs shall be able to display the FTD, depending upon the local operation's needs.
Status	<validated>
Rationale	As a result, the APP ATCO can have a look at the compression for each a/c pair quickly & easily. In the APP, in order to avoid clutter, ATCOs have mentioned their preference for the usage of the ITD as the main indicator. Example of local implementation: The FTD shall be automatically displayed with the highlighted ITD when: - the mouse is placed on the corresponding follower aircraft flight label - the mouse is placed on ITD indicator. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.0660
Title	ITD display on Tower CWP
Requirement	The Tower controller shall have the possibility to globally select the display of the ITD (in addition to FTD which shall always be displayed).
Status	<validated>
Rationale	The Tower Controller is monitoring the delivered separation or spacing. This is represented by the FTD. However, it might decide to select also the ITD display to have a look at the spacing delivered by the Final Approach Controller. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0670
Title	TDI update due to changing glideslope wind conditions
Requirement	Local implementation shall define the latest time that a stable TDI is required by the Controller for spacing, so that the FTD and ITD indicators may be re-calculated due to changing glideslope wind conditions.
Status	<in progress>
Rationale	This can be used to accommodate variation in the glideslope wind conditions to ensure the latest possible measurement is used before the TDI needs to be fixed. In progress as local parameters need to be defined.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0680
Title	HMI integration in CWP
Requirement	The HMI layout (i.e. shape, colour, size and display priority) of the FTD and ITD indicator shall be adequately integrated into the air traffic surveillance display.
Status	<validated>
Rationale	To ensure clear display of required information to deliver consistent and accurate separation or spacing. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b. To be locally defined in deployment.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0681
Title	HMI integration in CWP II
Requirement	The design of the TDIs shall be made in order to ensure they are easy to read and interpret, being in line with the design philosophy (shape, colour etc.) of the other ATC tools used in the local environment.
Status	<validated>
Rationale	In order to ensure acceptability of the new tool and to avoid confusions in relation to the new display, it is important to consider HF design principles when locally implementing the new tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0690
Title	TDI display robustness/stability
Requirement	TDI display shall be robust to ensure they do not keep switching on and off as aircraft perform normal manoeuvres.
Status	<validated>
Rationale	Indicator display shall be robust to the variety of ways that aircraft merge onto final approach, typical path stretching manoeuvres and acceptable deviation from the final approach path while accommodating late runway change scenarios. However other scenarios when TDIs are expected to be removed or updated need to also be accommodated such as missed approach or runway change. Priority will be given to robust display resulting in slight delay for updates caused by genuine departures from the final approach path. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0691
Title	TDI HMI design I
Requirement	The Controllers shall be able to visually distinguish (via colour or symbol) if Target Distance Indicators are relative to WT, MRS or ROT (or other spacing constraint).
Status	<validated>
Rationale	The type of constraint will influence the Controllers' actions if they infringe it. Customising the HMI display of the TDIs (such as different colours or symbols) will allow them to know the type of separation or spacing constraint to aid in their decision making. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0700
Title	HMI consistency
Requirement	Approach and Tower shall have access to consistent information (on their CWP HMI) relating to separation delivery to be able to communicate effectively with each other.
Status	<validated>
Rationale	In order to communicate effectively the ATCOs cannot be misled by information that in the CWP is describing a different traffic situation. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0710
Title	Automatic display of FTD
Requirement	The tool shall automatically display the FTD (if not already displayed) if the aircraft comes within a defined distance of the computed FTD. This distance shall be configurable within the tool.
Status	<validated>
Rationale	The Approach Controllers may only have the ITD displayed. However, if the FTD is only a short distance ahead of it then crossing the ITD may result in the aircraft accidentally crossing the FTD as well. Functionality should be designed to prevent that scenario such as automatic display of the FTD if the aircraft crosses the ITD or is within a defined distance of the FTD. This should be considered for both in-trail and not-in-trail scenarios. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0720
Title	Automatic display of FTD II
Requirement	The Approach controller shall be able to remove the FTD from the radar display, but not when the FTD has been automatically displayed by the System.
Status	<validated>
Rationale	Normally the Approach Controller can select to display or not the FTD, however there might be alerts that are displaying the FTD automatically (e.g. infringement of ITD), in these situations, as long as the alert is active, the FTD information shall be kept. The FTD automatic display, is alerting the APP ATCO that a separation infringement may occur, therefore it is important that this alert remains on the CWP HMI until the compression buffer has been restored and the aircraft is back behind the ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational> , <Safety> , <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0730
Title	TDI removal for MRS constraint
Requirement	The TDIs corresponding to the high priority MRS separation constraint shall remain visible on the radar display until the leader aircraft reaches the separation delivery point.
Status	<validated>
Rationale	The separation constraint shall be respected between leader and follower when leader is at touchdown. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0740
Title	TDI removal for Wake constraint
Requirement	The TDIs corresponding to the high priority Wake separation constraint shall remain visible on the radar display until the leader aircraft reaches the separation delivery point.
Status	<validated>
Rationale	The separation constraint shall be respected between leader and follower when leader is at touchdown. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0750
Title	TDI removal for ROT constraint
Requirement	The TDIs corresponding to the low priority Runway Occupancy Time constraint shall remain visible on the radar display until the leader aircraft reaches the separation delivery point.
Status	<validated>
Rationale	The spacing constraint shall be respected between leader and follower when the leader is at touchdown. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0760
Title	TDI removal for GAP constraint
Requirement	The TDIs corresponding to the low priority Gap spacing constraint shall remain visible on the radar display until the follower aircraft reaches the separation delivery point.
Status	<validated>
Rationale	For separation constraints is sufficient that the TDI disappears when the leader crosses the delivery point, however in the situation of spacing (e.g. GAP) these TDI might result in high distances between aircraft (e.g. 8/12 NM) so it is useful for the controller to keep a reference TDI displayed when the leader has already passed the delivery point. This requirement has been validated in RTS3a, RTS4a.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0770
Title	FTD and ITD consistent between CWPs
Requirement	The displayed indicator distance and shape shall be consistent between all applicable CWPs.
Status	<validated>
Rationale	To ensure consistent information when Controllers are communicating with each other. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0780
Title	TDI step resolution
Requirement	The Separation Delivery tool shall display indicators to at least a distance step resolution of 0.1NM.
Status	<validated>
Rationale	This is the smallest step distance that the Controllers can visualise and use. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0790
Title	TDI HMI design II
Requirement	If more than one type of indicator is displayed on the CWP HMI, then indicator HMI design shall be clearly distinguishable to avoid ambiguity.
Status	<validated>
Rationale	There needs to be clarity between FTD and ITD indicators on the HMI display. There also needs to be clarity between in-trail and not-in-trail TDIs. ATCOs require a timely and accurate display of the FTD that would allow them to adapt their instructions if needed, without having a negative impact on the traffic. For this reason, a clear distinction between the indicators (FTD or ITD) shall be made (e.g. colour, shape etc.). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0791
Title	TDI to be displayed in case of infringement
Requirement	When spacing ITD is infringed by the aircraft, the ATCOs shall be aware of the next most constraining separation factor ITD and FTD (e.g. Wake or MRS) on the APPROACH and TOWER positions.
Status	<validated>
Rationale	The ATCO needs this information to be able to assess if the actual separation meets separation criteria (e.g. MRS or WAKE) and if he can proceed safely with landing even when spacing TDI are infringed. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0792
Title	TDI to be displayed in case of infringement II
Requirement	For the Tower HMI, in case of high priority ITD infringement, the Tower Controller shall be able to assess if he can proceed safely with landing.
Status	<validated>
Rationale	To reduce the risk of an infringement of the FTD for the Tower Controller, keeping in mind that in some implementations the ITD is not displayed by default in the Tower HMI. Below an example for implementation for the TWR HMI: -If the first most constraining ITD corresponding to a high priority separation indicator (e.g. WAKE or MRS) is infringed, then its already displayed corresponding FTD shall be accompanied by the distance countdown to the FTD of the corresponding aircraft such that the TWR controller is aware that a high priority ITD has been infringed - if the second most constraining ITD corresponding to a high priority separation is infringed, the system shall display the corresponding FTD accompanied by the distance countdown to the FTD, in addition to the already displayed first most constraining FTD such that the TWR controller is aware that a high priority ITD has been infringed (FTD displayed according to the rules defined for the high priority separation indicators) Note this countdown to the FTD applies only to the high priority separation indicators (WAKE and MRS). The scope of this distance is to show the TWR ATCO when an ITD has been infringed keeping in mind that the ITD is not displayed by default for the TWR controller. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Provide landing clearance Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0793
Title	TDI to be displayed in case of infringement III
Requirement	For the Tower HMI, in case the high priority ITD is no longer infringed, the Tower Controller shall be informed that he can proceed safely with landing.
Status	<validated>
Rationale	Below an example for implementation: For the TWR HMI, if the high priority ITD is no longer infringed: - In case the FTD corresponding to this high priority ITD is the first most constraining FTD the corresponding countdown distance to the FTD shall be hidden by the system and - In case the FTD corresponding to this high priority ITD is the second most constraining FTD, the FTD shall be hidden together with the countdown to the FTD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide landing clearance Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0795
Title	TDI to be displayed in case of infringement IV
Requirement	For the Approach HMI, in case of high/low priority ITD infringement, the Approach Controller shall be able to assess if he can proceed safely.
Status	<validated>
Rationale	The ATCO needs this information to be able to assess if the actual separation meets separation criteria (e.g. MRS or WAKE) and if he can proceed safely even with a high/low priority ITD infringement. Below an example for implementation for the APP HMI: - For the APP HMI, if the most constraining ITD corresponding to a high priority separation (e.g. WAKE, MRS) indicator is infringed or the aircraft comes within a defined distance of the computed FTD, then its corresponding FTD shall be displayed in a manner adequate to an alert (e.g. red colour) - If the most constraining ITD corresponding to a low priority spacing (ROT, gap, other spacing constraints) indicator is infringed or the aircraft comes within a defined distance of the computed FTD, then its corresponding FTD shall be displayed in a manner other than the one used for a high priority separation FTD (e.g. yellow colour) - if the second and/or third most constraining ITD corresponding to a low/high priority spacing/separation is infringed the system shall display the corresponding FTDs in addition to the already displayed first most constraining FTD (FTD displayed according to the rules defined for the high priority separation and low priority spacing indicators) This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Clear Aircraft for Approach Assess Separation/Spacing Infringement Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0796
Title	TDI to be displayed in case of infringement V
Requirement	For the Approach HMI, in case the high/low priority ITD is no longer infringed, the Approach Controller shall be informed that he can proceed safely.
Status	<validated>
Rationale	Below an example for implementation: - if the first/second and/or third most constraining ITD is no longer infringed, the corresponding FTDs shall be hidden by the system This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Clear Aircraft for Approach Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0800
Title	TDI pairing functionality
Requirement	The HMI design shall allow Controllers to identify the aircraft associated with each displayed indicator.
Status	<validated>
Rationale	Controllers need to be able to relate a TDI with its associated aircraft to maintain good situation awareness. For example, the Final Approach and Tower Controller shall be able to show which aircraft is linked with which TDI through a pairing functionality. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Identify Aircraft Identify Pairing between ITD/FTD and aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0810
Title	FTD or ITD value displayed
Requirement	The value of the FTD or ITD (which TDI depends on what is most useful for the Controller) may be displayed.
Status	<validated>
Rationale	To aid in the refinement and monitoring of the spacing set up on final approach. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0820
Title	Relative distance to TDI displayed
Requirement	The distance the follower aircraft is ahead or behind the FTD or ITD (which TDI depends on what is most useful for the Controller) may be displayed.
Status	<validated>
Rationale	It has been concluded that this could aid in the refinement and monitoring of the spacing set up on final approach. For example, the distance from FTD could be activated in case of infringement of ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0830
Title	Relative distance to FTD displayed
Requirement	When the follower aircraft is within a certain distance from the FTD, the Separation Delivery Tool might display to the ATCO the FTD and the distance between the follower aircraft and the FTD.
Status	<validated>
Rationale	This functionality is implemented in the tool for the specific case when the FTD and ITD are very close to each other when calculated the first time (e.g. if the compression is just 0.3 NM) or when the ITD is infringed, then this distance to the FTD is displayed. It could also be an alternative to the catch-up alert. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0840
Title	Display of minimum separation and spacing information
Requirement	Spacing and separations minima information may be displayed on the Approach and Tower CWPs.
Status	<validated>
Rationale	To keep the Approach and Tower Controllers informed of the separations and spacing minima being used in the Separation Delivery tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0850
Title	Selective suppression of TDIs
Requirement	The HMI design shall allow ATCO to hide/unhide indicators for a specific aircraft pair, and current and forthcoming alerts/warnings for that aircraft as a follower (e.g. infringement, catch-up, speed, …).
Status	<validated>
Rationale	It has been concluded that this functionality may be required for example in case of delegating responsibility for wake separation to flight deck. Depending on local implementation, the TDIs should be either removable, either change colour or display, in order to clearly indicate the situation for the ATCO. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0851
Title	Selective suppression of TDIs II
Requirement	Local procedures shall define the procedures related to the use of the TDIs and the specific instances in which they can be removed.
Status	<validated>
Rationale	For example, in case of delegating responsibility for wake separation to flight deck a procedure that dictates to suppress the related TDIs might be used. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0852
Title	Procedures assisting with tool reliability w.r.t certain behaviour of aircraft tracks
Requirement	If required in local implementation, training and procedures shall be developed to ensure that Controllers can manage correctly the Approach Arrival Sequence and display of Target Distance Indicators.
Status	<validated>
Rationale	Certain parts of the functionality including the display of Target Distance Indicators and the Approach Arrival Sequence service (if using an automatic sequence detection solution) rely on the aircraft tracks. Certain behaviour of aircraft tracks could reduce the reliability of these functions hence training and procedures could be developed to mitigate against this. For example, procedures could encourage the avoidance of non-standard vectoring where possible. An example could be safety requirement SR065 in the safety assessment report. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0860
Title	Measuring tool for inter a/c spacing
Requirement	ATCOs shall continue to have a 'click and drag' distance measuring tool so they can accurately measure inter a/c spacing when required (e.g. for building confidence in the tool or during degraded modes).
Status	<validated>
Rationale	The 'click and drag' distance measuring tool can support the ATCOs in providing the correct separation/spacing also when the Separation Delivery Tool is used, being as well a potential aid in detecting separation infringements. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0870
Title	Maintain surveillance separation on intercept
Requirement	The Approach controller shall maintain applicable surveillance separation minima at any point during approach. This includes the case of a leader aircraft established on the final approach axis and a follower not yet established.
Status	<validated>
Rationale	The Approach Controllers remain responsible for ensuring surveillance separation rules are maintained before the aircraft intercept the final approach. This is irrespective of the displayed TDI as there may be scenarios where an indicator is displaying a separation before that separation can be applied. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0880
Title	TDIs update for WDS
Requirement	When applying WDS the Separation Delivery tool may support updates of the TDIs when both leader and follower aircraft are established on the final approach.
Status	<validated>
Rationale	For safety reasons WDS separations are applicable only to the final leg. ATCOs might decide to use the separation delivery tool with the standard wake separation scheme and then update the TDIs or having WDS TDIs immediately available. It is a choice depending on local environment. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0890
Title	TDI update for wake separations II
Requirement	The separation delivery tool shall support ATCOs in the delivery of wake separations that are allowed only when leader and follower aircraft are aligned on the centreline.
Status	<validated>
Rationale	When applying WDS or any other dynamic wake separations scheme that is valid only when leader and follower aircraft are aligned on the glide, the separation delivery tool can compute TDIs based on the standard separation scheme before aircraft turns to intercept the glideslope. Then reflect with TDIs update new dynamic wake separations once both leader and follower aircraft are aligned on the centreline. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0900
Title	Separation/spacing computation update upon separation delegation to flight deck
Requirement	Following the ATCO action to suppress the TDIs for specific aircraft the tool shall • remove any information on the spacing/separation (ITD and FTD) • remove its ongoing or not display the forthcoming Separation Delivery Tool alerts (e.g. Catchup/Speed/Sequence Number/Infringement)
Status	<validated>
Rationale	As the separation responsibility is delegated to the flight deck, the spacing/separations indication (TDIs) and associated alerts becomes irrelevant. No displaying help maintain a good situation awareness. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0970
Title	Spacing procedure with FTD when ORD is not implemented
Requirement	If ORD is not implemented, the Final Approach Controller shall maintain the aircraft behind the FTD with sufficient buffer due to the effect of compression, caused by different leader and follower groundspeed profiles, and shall reduce aircraft's speed to the final approach procedural airspeed.
Status	<validated>
Rationale	Without an ITD indicator the Controllers will only be provided with the information regarding the separation or spacing to deliver. The effect of compression needs to be considered by the Controller when setting up the spacing. This requirement has been validated in SESAR1 P06.08.01 RTS.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.0971
Title	Spacing procedure with FTD II
Requirement	The Tower Controller shall ensure that the actual spacing behind the leader aircraft is not infringing the FTD and in case of imminent infringement he shall apply adequate corrective action like delegating visual separation to Flight Crew or instructing go-around.
Status	<validated>
Rationale	In case of FTD infringement the Tower controller shall apply the adequate measure to mitigate the related safety risk. For example, an infringement of the wake separations is treated differently from an infringement of ROT (where the follower aircraft can still land safely if the preceding aircraft vacated the runway). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0980
Title	Separation and spacing constraint management
Requirement	The Tower Supervisor in coordination with the Approach Supervisor (and occasionally the Tower and Approach Controllers - in line with defined local procedures) shall determine the final approach separation mode and runway spacing constraints that are to be applied at any time by the separation delivery tool.
Status	<validated>

Rationale	To ensure consistency between Approach and Tower and the tool inputs, for example in case of conditional mode activation/deactivation or scenarios for specific gap spacing or additional spacing due to runway inspection. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.0990
Title	Controller responsibility for separation infringement
Requirement	The Approach and Tower Runway Controllers shall remain responsible for monitoring for separation infringements and for timely intervention actions to resolve or prevent them.
Status	<validated>
Rationale	The FTD and ITD calculations make assumptions regarding the expected speed profile. The Controller is still needed to monitor for infringements due to variability in actual speed profiles. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.1000
Title	Spacing procedure with ITD
Requirement	If the ORD concept is implemented, the Final Approach Controller shall maintain the aircraft on or behind the ITD on the final approach and reduce to the final approach procedural airspeed until the transfer to the Tower controller.
Status	<validated>
Rationale	The ITD represents the spacing to be delivered at the DF. The detail of the procedure to establish on the localiser and catch-up the ITD will depend on the local implementation of the ITD. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1010
Title	Procedures for missing TDIs
Requirement	Local Operational procedures shall be developed for handling traffic situations with missing Target Distance Indicators in different WT separation modes for both controllers and supervisors.
Status	<validated>
Rationale	If there is insufficient information to calculate a TDI then the Controllers will need to set up the required separation or spacing without a TDI. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1020
Title	TDIs Training
Requirement	Controllers and Supervisors shall regularly receive training on reversal procedures (TB to DB modes) and contingency measures in case of abnormal and degraded modes of operation (e.g. loss of one TDI, loss of all TDIs, etc.).
Status	<validated>
Rationale	Controllers and Supervisors shall feel comfortable with the procedures linked to abnormal and degrade modes of operations. This requirement has been validated in RTS2.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Coordinate with Tower Supervisor Coordinate with Approach Supervisor Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1021
Title	Management of mode transitions/ Training
Requirement	The transition tasks (activation and deactivation of TB modes) shall be defined for all actors involved, for both a spontaneous transition (e.g. sudden change of wind conditions, etc.) as well as for a planned transition, where a collaborative approach for the ATCO and SUPs in APP and TWR shall apply.
Status	<validated>

Rationale	Clear procedures need to be defined regarding mode transitions to ensure Controllers can plan ahead. For example, see SR010 in the Safety Assessment Report and PJ02.01 HPLOG. This requirement has been validated in RTS1.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1022
Title	Acceptability of procedures
Requirement	ATCOs, supervisors and pilots shall be involved in the local development of the definition of roles and responsibilities and associated procedures/ tasks with regard to the transition in conditional modes, in order to ensure their acceptability and feasibility.
Status	<validated>

Rationale	Particularly under WDS there will be a significant reduction of separation between a/c hence it is important that each actor understands their role and responsibility under WDS. The main changes with regard to the roles and responsibilities refer to the conditional application of the WDS, hence the transition modes, where especially the SUP and the ATCO have the responsibility of monitoring and applying the correct separations. Due to the lack of a reliable separation indication in the cockpit, the pilot`s responsibility in regard to transition modes remains to apply to separation as indicated by the ATCO. This requirement has been validated in RTS1.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Switch to new mode of operations in Approach Control Coordinate with Approach Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1023
Title	Roles & responsibilities / tasks
Requirement	Local implementation shall define the distribution of tasks and responsibilities associated to the implementation of the separation delivery tool and the associated procedures (nominal, abnormal and degraded), taking into account the local environment (traffic load, number of APP ATCOs, etc.).

Status	<in progress>
Rationale	Given the different local environments, with different densities and hence a different number of ATCOs handling the traffic, it is important to locally define the responsibility of each of the actors involved. For example, during the validation activities carried out under the WDS-A umbrella, the simulations have been based on the CDG environment, where the final approach is divided into 2 positions: the Initial Final Approach ATCO (INI) and the Intermediate Final Approach ATCO (ITM) that eventually transfers the a/c to the TWR ATCO. The final approach positions were responsible for ensuring the a/c are on or just behind the ITD at 160knots before handing over the a/c to the TWR. The final approach ensured the a/c are flying the required speed at the specified point on the final approach (in RTS1 160knots at 10NM). In the same way, the exact procedures shall be defined at the local level. Furthermore, the TWR ATCO was responsible for monitoring the a/c in relation to the FTD and intervening if they considered the a/c would infringe the FTD by either using speed instructions (if the a/c was before the DF) or giving a go-around. In the same way for the TWR, the exact rules / procedures regarding speed instructions and go-arounds to be defined at the local level). With the ORD tool, the INI and the ITM had a common picture of the a/c sequence, that allowed the INI to hand over the traffic at a later stage than in current operations. By doing this, the INI took over part of the workload of the ITM, presenting a change in the working method. When working with WDS and the ORD tool with a high traffic pressure the distribution of tasks between the ITM and INI changed slightly, as the INI approach ATCO held on the a/c for longer than under RECAT-EU with no tool and setting up the aircraft to intercept the axis. Therefore, the INI approach ATCO takes on a more pro-active role to facilitate the ITM/final approach ATCO`s work. As a result. the ITM/final approach ATCO shares some of the workload with the INI ATCO, having more resources to focus on the final approach. No new responsibilities have been identified.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing Assess Separation/Spacing Infringement Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1024
Title	Roles & responsibilities / tasks II
Requirement	A local description of procedures and roles and responsibilities with regard to the coordination on the final approach (in case more than one ATCO ensures final approach control) shall be available in case the Separation delivery tool is used.
Status	<validated>
Rationale	As in certain environments approach services are offered by the INI and the ITM ATCOs, the procedures should clearly define the roles and responsibilities and related communication between the 2 ATCOs with regard to the sequence change. It could imply a verbal communication or a highlight on the HMI of the change. In conformance with good HF practices. This requirement has been validated in RTS1, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Transfer Flight to Final Approach Controller Identify Aircraft Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1025
Title	Mixed mode I- gap
Requirement	The gap functionality procedures for mixed mode operations shall be clear and acceptable in order to enhance situation awareness for the Controllers, without increasing their workload.
Status	<validated>
Rationale	Controllers (APP and TWR) shall be at ease working with the gap functionality, knowing how to request a gap, how to collaborate in changing a gap spacing etc. This requirement has been validated in RTS3a, RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess departures vs GAP spacing Coordinate the GAP Spacing modification with Final Approach Controller Cancel the GAP during Final Approach Control Request cancel GAP to Final Approach

		Controller Insert GAP spacing Request new GAP spacing and/or position to Final Approach Controller Request GAP insertion Modify the GAP during Final Approach Control Assess GAP spacing vs planned departing a/c

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1026
Title	Mixed mode II- gap
Requirement	The Controllers shall be able to identify whether an inserted gap is no longer compatible with the planned sequence.
Status	<validated>
Rationale	The gap functionality shall be interoperable with all the other displays associated with the Separation delivery tool (e.g. an alert can pop-up in the sequence when the gap is not sufficient for the planned departures). This requirement has been validated in RTS3a, RTS4a.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess GAP spacing vs planned departing a/c Assess departures vs GAP spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1027
Title	Mixed mode III- gap
Requirement	The gap functionality/display shall ensure an enhanced team situation awareness between APP and TWR Controllers.
Status	<validated>
Rationale	The gap functionality shall ensure the APP and TWR Controllers share the same awareness with regard to mixed mode operations. The information needs to be presented in a distinguished way (as compared to other distance indicators) and in a timely manner. This requirement has been validated in RTS3a, RTS4a.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Insert GAP spacing Cancel the GAP during Final Approach Control Modify the GAP during Final Approach Control Request new GAP spacing and/or position to Final Approach Controller Request cancel GAP to Final Approach Controller Coordinate the GAP Spacing modification with Final Approach Controller Request GAP insertion

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1030
Title	Safe mode transition
Requirement	The Approach or Tower Controller shall be able to safely perform their separation duties during transition between separation modes.
Status	<validated>
Rationale	Mode transitions must remain safe. This requirement has been validated in RTS1.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1031
Title	Safe mode transition II
Requirement	Mode transitions (planned) should take place outside peak hours.
Status	<validated>
Rationale	The transitions during peak hours should be considered a non-nominal event. The ATCOs consider the transitions shall be planned as such so that they are not affecting peak hours. Unless the wind conditions are considered to be stable enough, it is advised to avoid making transition during peak hours. This requirement has been validated in RTS1.

Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1032
Title	Transition procedure
Requirement	In order to minimize the impact on the ATCOs work, the supervisor or the co-ordinator shall try to initiate the transition from WDS to standard WT scheme starting with an aircraft pair involving no or limited change in applicable wake separation with the new scheme.
Status	<validated>
Rationale	Such a transition would minimise safety risks and an increase in the workload of the ATCOs. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1033
Title	Transition roles
Requirement	The ATCOs shall be able to start the transition with another a/c than the one proposed by the SUP or by the tool, by collaborating with the SUP.
Status	<validated>
Rationale	In certain cases, it could be that due to a wake encounter queue on the ground, low visibility etc., the ATCO has a different vision that the SUP or the support tool that could propose transitions. In this case, the ATCO shall be able to propose a different approach by discussing with the SUP. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1034
Title	Transition roles II
Requirement	Approach and Tower Controllers shall be informed in advance by their respective Supervisor prior to the planned activation or planned de activation of TB- modes.
Status	<validated>
Rationale	For an enhanced awareness and appropriate preparation for the mode transition. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1040
Title	Mode transition Training
Requirement	All licenced Approach and Tower controllers (and Supervisors) shall be fully trained to switch between the time based and distance based modes of operation.
Status	<validated>
Rationale	To maintain safe operations when transition between modes is put in place. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1041
Title	Working Methods
Requirement	A set of working methods / guidelines to cover the proposed TB or DB procedures and associated tools (i.e. Separation Delivery Tool) should be locally defined.
Status	<in progress>
Rationale	Working methods and procedures shall be tailored locally and tested before going in operations.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1050
Title	Activation of WDS mode
Requirement	The Separation Delivery tool implementation shall forbid the Approach and/or Tower Controller the possibility to activate the TB-WDS-A modes.
Status	<validated>
Rationale	Helps avoid confusion regarding roles and responsibilities for managing mode changes including the switching on / off of the Separation Delivery tool. This requirement has been validated in RTS1.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1060
Title	Conditional mode activation coordination
Requirement	For TB- modes the Approach and Tower Supervisors shall collaboratively decide when the conditional (TB) mode should be activated or de activated based on meteorological data information and predefined activation criteria and on prior coordination with Controllers.
Status	<validated>
Rationale	To ensure both Approach and Tower can prepare for a change in mode in good time. Parameters to be taken into account for the change shall be locally defined (MET indicators/ forecast, a/c type, time to inform ATCO before transition e.g. 2-3 min before the a/c will intercept the localizer). Note: Activation of a WT separation mode encompasses both starting operations at the beginning of the day and transition to a different WT separation mode during the day. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Coordinate with Approach Supervisor Coordinate with Tower Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1070
Title	Large number of WTEs
Requirement	Supervisors must reconsider the mode of operation if Controllers report having received WTE reports from pilots over a short period of time.
Status	<validated>
Rationale	Several WTE reports in a short time interval may mean the incorrect mode of operation is activated hence Supervisors should reassess the decision. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1222
Title	Conditional mode deactivation coordination
Requirement	Timely reversion from conditional mode to standard mode of operations shall be triggered by the Supervisor or automatically by the System depending on the local implementation. The possibility for the ATCOs spontaneous reversal (e.g. in case of sudden loss of indicators) shall be locally defined.
Status	<validated>
Rationale	The timely reversion is required for safety reasons (e.g. in case of sudden wind drop). There could be different situations for reversal from conditional to standard modes of ops: a) EITHER automatically changed by the tool- with a clear indication on the screen of both the Supervisor and the ATCO of the new mode of operation and additionally with an indication of the a/c from which the reversal to the conventional mode of operation applies (e.g. highlighting the a/c in the sequence list). OR An alert on both ATCO`s and Supervisor`s HMI, indicating the immediate required transition (to be manually changed by the Supervisor and/or ATCO). -- the above mentioned options are mostly applicable for spontaneous changes that were not foreseen (e.g. degraded mode or loss of wind conditions). b) Spontaneous change made by the ATCO- given consecutive WTE reported by pilots that confirm inadequate wind conditions OR the refusal of reduced separations by one pilot (in which case the reversal to conventional separations can be made for one a/c pair only and the ATCO must record this pair as such). For a change for one aircraft pair only, the ATCO is responsible to record the chance either of flight strips or with a "bear and range" indication on the screen so that they recall the reason for enhanced separations for an aircraft pair only, given the fact that the mode of operation would be still displaying reduced separations overall. The ATCO may use the (optional) function of the tool to remove TDIs for a single aircraft. c) Planned by the Supervisor whom, based on the MET info and

	traffic situation, is able to anticipate wind changes and verbally communicate to the ATCO the first aircraft from which the reversal to the conventional mode of operation applies. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1080
Title	Minimal number of mode changes
Requirement	The frequency of separation mode switches shall be done in a way that would avoid controller confusion and unnecessary workload.
Status	<validated>
Rationale	The Controllers need consistency hence will require a minimal number of mode changes. Excessive fluctuations in mode transition will lead to ATCOs mistrusting the System and could also have a negative impact on their Performance in terms of situational awareness and workload. This requirement has been validated in HP-SAF workshop.

Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1090
Title	Automatic transition Information
Requirement	In case the reversion from a TB mode is triggered automatically by the Separation Delivery Tool (e.g. due to the wind falling below the applicable minima), the Separation Delivery Tool shall indicate to the ATCO the aircraft to be separated according to the new separation mode. A notification shall indicate to the Controller and the Supervisor the change and preferably the reason behind it.
Status	<validated>
Rationale	ATCOs need to be aware of the current separation mode applied by the separation delivery tool. In case the reversal is done automatically, in order to ensure an appropriate level of situation awareness, the Controllers and the Supervisors shall be notified about the change and preferably the reason behind it (e.g. inadequate wind conditions). This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1100
Title	TDI display during mode transition I
Requirement	Upon reversion to (activation of) a new separation mode, the separation delivery tool shall display the adequate FTD (separation indication) and ITD (compression indications) to the Approach ATCO for all aircraft starting with the first aircraft in the arrival sequence to be separated according to the new mode.
Status	<validated>
Rationale	A transition might be applied for the entire aircraft sequence or only a part of it. In case the transition is applied only for a part of the traffic, it is important that TDIs are updated to reflect the new constraints starting from where the new mode is put in place. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1110
Title	TDI display during mode transition II
Requirement	The Approach and Tower Runway ATCO shall continue to use the TDIs that are already displayed (as per the previous separation mode) for the aircraft in the arrival sequence preceding the first one to be separated according to the new mode.
Status	<validated>
Rationale	The TDIs that were calculated based on the previous mode of operations are still valid for the part of the sequence that still use the previous mode of operations. This requirement has been validated in RTS1.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1120
Title	Mode of operation HMI
Requirement	The mode of operation shall be clearly displayed to the controllers (Tower and Approach) and Supervisors (Tower and Approach) at all times.
Status	<validated>
Rationale	This is to allow the appropriate level of situation awareness ensuring the Controllers and Supervisors to know what procedures to apply. This requirement has been validated in RTS1.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Switch to new mode of operations in Approach Control Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1221
Title	New mode of operation activation coordination
Requirement	The Supervisor/ATCO coordinator shall be responsible for the activation of the conditional (TB) mode under all conditions.
Status	<validated>
Rationale	The results of the workshop addressing transition modes indicated that Supervisors and ATCOs agree that the transition from nominal to conditional mode should be initiated by the Supervisor, given the applicable wind conditions. Furthermore it was suggested that an activation button (e.g. for WDS-A) should not be available on the ATCO`s HMI, in order to avoid confusion with regard to whom should be responsible for the activation and also in order to avoid enhanced monitoring for wind conditions from the ATCO`s side. This requirement has been validated in RTS1.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1222
Title	New mode of operation activation
Requirement	The Approach and Tower Supervisors shall inform the respective Controller when the conditional (TB) mode will be activated or de activated by indicating the first aircraft in the arrival sequence to be separated according to the new mode (e.g. at least 2 min before interception- to be locally defined).
Status	<validated>
Rationale	Given the applicable wind conditions, the Supervisor shall confirm the activation by an input in the system as well as verbally communicating the transition to the ATCOs (with the mention of the first a/c from which the new mode of operations applies). ATCOs prefer the verbal instruction as well, which is seen as enhancing their situation awareness with regard to the transition. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1223
Title	Mode of operation HMI II
Requirement	The ATCOs and the Supervisors shall always have a clear indication in the CWP from which aircraft in the sequence the new mode of operations or the reversion to standard mode are applied.
Status	<validated>

Rationale	A clear indication on the screen of both the Supervisor and the ATCO of the new mode of operation and additionally with an indication of the a/c from which the reversal to the conventional mode of operation applies (e.g. highlighting the a/c) is necessary to maintain awareness for the separation delivery task. This requirement has been validated in RTS1.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Sequence, Merge and Space Aircraft Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1130
Title	WDS-TW activation
Requirement	The WDS-TW mode shall be activated only when the runway surface and glide-slope reference total wind (as used in the separation minima design) is equal or greater than the WDS-Tw threshold.
Status	<validated>
Rationale	The WDS Total Wind mode can be activated only when the criteria that justify the safe reduction of wake turbulence separations are respected. This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Coordinate with Tower Supervisor Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor Switch to new mode of operations in Approach Control Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1140
Title	WDS-XW activation
Requirement	The WDS-Xw mode shall be activated only when the runway surface and glide-slope reference cross wind (as used in the separation minima design) is equal or greater than the WDS-Xw threshold.
Status	<validated>
Rationale	The WDS Cross Wind mode can be activated only when the criteria that justify the safe reduction of wake turbulence separations are respected. This requirement has been validated in RTS1.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Coordinate with Tower Supervisor Switch to new mode of operations in Approach

		Control Coordinate with Approach Supervisor Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1150
Title	Wind thresholds for conditional application
Requirement	The WDS-Tw and WDS-Xw activation thresholds shall be determined to mitigate the risk of wake vortex encounter due to the uncertainties on the wind prediction data and on the lateral aircraft deviation from RWY extended centreline.
Status	<validated>
Rationale	The WDS Cross Wind and Total Wind modes can be activated only when the criteria that justify the safe reduction of wake turbulence separations are respected and there is sufficient margin on the wind measured. This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control Coordinate with Approach Supervisor Coordinate with Tower Supervisor Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1160
Title	Wind Forecast WDS-A
Requirement	In order to enable the modes activation/deactivation, the Tower Supervisor and the Approach supervisor shall be provided with a meteorological situation picture that includes the nowcast and forecast data regarding the wind speed and direction at different locations and altitudes covering the area encompassing the final approach phase of arrival flights. Such information shall in particular display the relevant wind component for the application of WDS-A concept reduced wake separations.
Status	<validated>
Rationale	Supervisors need a clear visual indicator of the wind conditions; first to reduce the mental effort and human error risk associated with the supervisor making the decision about whether or not it is appropriate to apply the WDS-A X-Wind concept reduced wake separations and secondly to help ensure overall compliance with the procedure This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport Coordinate with Tower Supervisor Switch to new mode of operations in Approach Control Switch to new mode of operations in Tower Control Coordinate with Approach Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1170
Title	Wind Forecast Service WDS-A (X-Wind or T-Wind)
Requirement	The Wind Forecast Service shall be provided to the users to plan or execute WDS-A (Xw or Tw) concept operations. The service shall include standard meteorological information and WDS-A (Xw or respectively Tw) concept specific information with respect to wind nowcast and forecast, wind speed, direction and trends, in particular the crosswind component (glide-slope and surface cross winds) or respectively the total wind (glide-slope and surface total winds) with respect to each runway direction.
Status	<validated>
Rationale	Controllers need a clear visual indicator of the wind conditions; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-A (Xw or Tw) concepts reduced wake separations and secondly to help ensure overall compliance with the procedure. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Switch to new mode of operations in Tower Control Assess operational situation and conditions at the airport Coordinate with Approach Supervisor Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1190
Title	Wind Forecast Service WDS-A Suspension and Separation Delivery Tool
Requirement	If the Wind Forecast service detects WDS-A concept suspension, the information shall be transmitted to the Separation Delivery tool and a corresponding alert shall be displayed to the CWPs of the Controllers and Supervisors.
Status	<validated>
Rationale	The two Systems shall be interfaced so that the display of the correct TDI based on safe conditions is applied. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1210
Title	WDS-A System Interface
Requirement	The TWR and APP supervisors shall access the Airport Weather Data Display System through a human-machine interface integrated into their working environment. The interface will be developed on purpose for WDS-A or will result from an upgrade of the current interfaces. The WDS-A System interface shall display information about: 1. Current and forecast headwind speed and direction 2. Current and forecast crosswind speed for each runway direction. 3. Applicability of WDS-A (Xw and Tw) concept reduced wake separation 4. Which concept(s) in use in the separation delivery tool for the arrival sequence These items will be displayed together or separately.
Status	<validated>
Rationale	To enable the use of WDS-A Xw and Tw concepts and facilitate the coordination process between the different actors. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1240
Title	Concept of operations training
Requirement	Supervisors and Controllers shall be trained on the TBS, S-PWS, WDS and / or ORD concept of operations.
Status	<validated>
Rationale	The Supervisors and Controllers need a good understanding of the concept of operations to be able to apply it in the operational environment. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1250
Title	Controller training on Separation Delivery tool, supporting Systems and new separation modes
Requirement	Approach and Tower Controllers shall be fully trained to apply the procedures for the new separation modes and to use of the Separation Delivery Tool and supporting Systems (e.g. alerts) with indicators prior to deployment.
Status	<validated>
Rationale	To ensure Controllers are sufficiently competent to apply the applicable concept. Controllers and Supervisors must feel at ease working with the Separation Delivery Tool and the associated procedures before deployment. They need to have high trust in the tool- which is associated with a high understanding of the procedures and the mechanisms of the tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1260
Title	Controller training on Separation Delivery tool, supporting Systems and new separation modes II
Requirement	All Approach and Tower controllers and Supervisors shall be fully trained in the operating procedures for the new WT separation modes prior to deployment.
Status	<validated>
Rationale	To ensure Controllers are sufficiently competent to apply the applicable concept. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1270
Title	Controller training on Separation Delivery tool, supporting Systems and new separation modes III
Requirement	ATCO training shall ensure that the operation in new WT separation modes will not lead to more un-stabilized approaches due to late/rush aircraft stabilisation as a result of tighter spacing and more frequent speed adjustments. However, a greater number of instructions might temporarily occur during the introduction of the new concept.
Status	<validated>
Rationale	To ensure Controllers are sufficiently competent to apply the applicable concept. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1280
Title	Controller training on Separation Delivery tool, supporting Systems and new separation modes IV
Requirement	In case of WDS cross wind, when the leader and follower are established on the glideslope, the Approach and Tower controllers shall be able to give heading instructions (e.g. break-off) to the follower only upwind and not downwind.
Status	<validated>
Rationale	To mitigate risk of wake encounter in cross wind. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1281
Title	Controller and Supervisor training on Separation Delivery tool, supporting Systems and new separation modes
Requirement	Controller and Supervisor training shall ensure they understand the logic behind the TDIs and related alerts.
Status	<validated>
Rationale	An appropriate understanding of the tools available on the CWP and the associated procedures is associated with better trust and acceptance from the ATCOs side. There is expected to be a change of paradigm for APP ATCOs, where instead of aiming for a distance behind a leading aircraft they would be aiming now for a target (vector for interception behind the ITD). This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1282
Title	Training Separation Delivery Tool I
Requirement	Training shall ensure the Separation Delivery Tool indicators are not used as a mean to assess individual or team performance.
Status	<validated>
Rationale	The TDIs could potentially (and unintentionally) be used for assessing individual or team performance which might increase the risk of ATCOs trying to overperform, which could eventually bring a Safety risk. Through adequate training for both ATCOs and Supervisors these potential issues could be clarified and avoided. It is important that a "just" culture is fostered within the organisation as opposed to a competitive culture, so that ATCOs do not feel pressure from the TDIs to over-perform, or that they are used by supervisors to assess performance. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1283
Title	Training Separation Delivery Tool II
Requirement	Training shall ensure Controllers are taught a scanning pattern to maintain situation awareness when working with the separation delivery tool.
Status	<validated>

Rationale	The training of a scanning pattern in dual arrival environments (such as Roissy CDG with North and south arrivals) should include training to ensure controllers systematically scan and check the altitude of the a/c corresponding to the other ITM as they would when working currently with no separation delivery tool. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1284
Title	Training WDS
Requirement	Local training plans shall take into account that WDS specific issues might require additional training requirements, such as understanding problems with wind forecasting and the relationship between wind conditions and WT (to be defined locally).
Status	<validated>
Rationale	The WDS concept may bring another facet into the algorithm of the TDIs, such as different wind forecasting problems and the relationship between wind conditions and WT, which need to be well understood by the controllers, especially if there are problems. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1290
Title	Maintain aircraft performance knowledge
Requirement	Regular trainings shall ensure ATCOs maintain sufficient competency to safely revert to and manage air traffic in DBS operations without Target Distance Indicators (i.e. implementation of the separation tool shall not adversely affect the controller's air traffic- vectoring skills- using DBS WT Category without Target Distance Indicators).
Status	<validated>
Rationale	As Similar with all technical components- the Separation Delivery tool will might occasionally fail, it is mandatory that the Controllers need to maintain sufficient knowledge of aircraft characteristics and behaviours to be able to deliver separations without tool support. This requirement has been validated in RTS2.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1300
Title	Performance levels II
Requirement	Trainings shall ensure ATCOs reach a specified level of Performance before they can go Operational on TB operations with the separation delivery tool. The level of Performance needs to be locally defined.
Status	<in progress>
Rationale	To ensure all controllers are fully trained and competent working with the new procedures and associated tools a specified level of Performance shall be reached before ATCOs can work in live operations. To be locally defined.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1301
Title	New recruits
Requirement	New recruits shall be trained to work with conventional modes of operations without tool support as well as with the support of the separation delivery tool.
Status	<validated>
Rationale	All controllers must be able to work competently without the separation delivery tool in case of degraded modes where the fallback procedures will require the ATCOs to work without the separation delivery tool and to know separation schemes based on WV category applied in such conditions. In conformance with good HF practices. This requirement has been validated in RTS2.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1302
Title	Trust
Requirement	The training shall extensively cover the new working methods associated with introduction of the Separation delivery tool in order to ensure high trust in the tool and acceptability of the related procedures.
Status	<validated>
Rationale	ATCOs must become confident that the ORD tool significant value to their work, admitting though the fact that they do not question the ORD features. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1310
Title	DBS look up tables
Requirement	Approach and Tower Controllers shall be provided with look-up tables for DBS minima to support DBS operations with no TDIs when necessary.
Status	<validated>
Rationale	There will be times when the Controllers need to revert to DBS with no TDIs hence may need a reminder of the DBS wake separations. This requirement has been validated in RTS2.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1320
Title	TBS Distance Display
Requirement	A TBS Distance Display may be provided to the Approach and Tower Runway CWPs.
Status	<validated>
Rationale	This is to provide ensure Controllers with have an appropriate level of situation awareness of the separation reductions to expect when applying the TBS concept. This requirement has been validated in SESAR1 P06.08.01 RTS.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1330
Title	Wind information Display in TBS mode
Requirement	In TB modes, relevant wind information shall be displayed on Approach / Tower Controller working positions for awareness purposes (e.g. to enable significant discrepancy check with the displayed TDI).
Status	<validated>
Rationale	When applying TBS the stronger the headwind component the bigger are the wake reductions. By looking at the wind conditions and measuring the distance between aircraft and FTD for wake constrained pair the Controller can verify whether significant discrepancies is present between expected separations and what is computed by the Separation Delivery Tool. This requirement has been validated in HP-SAF workshop.

Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1340
Title	Separation rule training and procedures
Requirement	The current Operational procedures for transitioning from intermediate separations (3NM) to final approach separations (e.g. 2.5NM MRS) shall continue to apply.
Status	<validated>
Rationale	Clarity is needed regarding the transition from both intermediate MRS to final approach MRS and from intermediate wake separations to final approach wake separations to avoid loss of separation during the transition. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1350
Title	Infringement procedures
Requirement	Procedures shall be defined regarding required actions if catching up or infringing the ITD or FTD.
Status	<validated>
Rationale	Controllers need clarity regarding the actions to be taken during catch up or infringement situations in order to correctly manage risk. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1351
Title	Infringement procedures III
Requirement	In a dual approach arrival environment, ATCOs shall have supporting alert, for identifying vertical and horizontal infringements for the crossing aircraft (e.g. North runways to South runways).
Status	<validated>
Rationale	By focusing on the target distance indicators, in a dual arrival environment (North and South arrivals) there could be a potential risk of the APP Controller overlooking the altitude of the a/c corresponding to the other APP sector, as they would in RECAT EU with no ORD tool, with potential for separation loss. This requirement has been validated in RTS1, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1360
Title	Procedure regarding non conformant speed or non-standard approach 1
Requirement	The Approach Controller shall take into account any notified inability to fly the standard approach procedure and any non-conformant final approach procedural airspeed issues when setting up the spacing on final approach.
Status	<validated>
Rationale	The TDI calculation assumes a certain speed or time-to-fly profile. Any significant deviations from this need to be taken into account by the Controller when setting up the spacing. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1370
Title	Procedure regarding non conformant speed or non-standard approach 2
Requirement	Pilots shall notify ATC of an inability to fly the standard approach procedure, and of any non-conformant final approach procedural airspeed issues, in a timely manner.
Status	<validated>
Rationale	The TDI calculation assumes a certain speed or time-to-fly profile. Any significant deviations from this need to be taken into account by the Controller when setting up the spacing. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Fly aircraft and intercept glideslope Fly aircraft on approach route

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1380
Title	Spacing request and runway change procedures
Requirement	Procedures shall be locally defined for the handling of scenario specific spacing requests and runway changes.
Status	<in progress>
Rationale	Scenario specific spacing can impact the TDI calculation and needs to be managed in a timely manner through clear procedures to ensure the TDI for the affected aircraft pair is calculated in sufficient time. Still in progress as these procedures need to be locally defined.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1390
Title	Impact on external systems and processes
Requirement	Consideration shall be given to the impact of mode changes on external Systems and processes such as AMAN and flow management.
Status	<validated>
Rationale	Different modes of operation can result in different runway throughput. For example, a degraded DBS mode in strong wind conditions would reduce the runway throughput compared with TBS mode. This can impact other systems or processes that rely on knowledge of the current and / or planned runway throughput. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport Coordinate with Tower Supervisor Coordinate with Approach Supervisor Switch to new mode of operations in Tower Control Switch to new mode of operations in Approach Control

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1400
Title	Concept of operations published in AIP
Requirement	An overview of the key principles of the TBS, S-PWS, WDS and / or ORD concept of operations (ConOps) shall be published in AIP.
Status	<validated>
Rationale	To ensure airspace users have access to the information to understand the concept. Source: HP-SAF workshop. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Fly aircraft on approach route Fly aircraft and intercept glideslope

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1410
Title	Airspace user briefing
Requirement	The Flight Crew shall be made aware of the locally applied separation mode and minima via appropriate means (e.g. from ATIS, AIP, NOTAM, information campaigns).
Status	<validated>
Rationale	Keeping Airspace Users informed of the concept and procedures / practises will increase the chances of a successful implementation. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Fly aircraft on approach route Fly aircraft and intercept glideslope

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1420
Title	Airspace user briefing II
Requirement	For all modes (where FTD and/or ITD are based on a pre-defined aircraft speed profile of the follower), Flight Crew shall be briefed and reminded (e.g. via information campaigns) on the importance to respect on the Final Approach path the ATC speed instructions until the start of the deceleration and/or the published procedural airspeed on final approach and to notify Controller in a timely manner in case of inability to conform to one of those.
Status	<validated>
Rationale	As the separation delivery tool will manage the TDI separation/spacing basing on the expected aircraft speed, it is necessary for the Airspace Users to comply with ATC instructions. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Fly aircraft and intercept glideslope Fly aircraft on approach route

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1421
Title	Airspace user briefing III
Requirement	Information campaigns shall familiarise the flight crew/ airspace users with all novel concepts associated to the implementation of reduced separations.
Status	<validated>
Rationale	It is paramount for the flight crew to understand and feel comfortable with the novel concepts for reduced separations. It is important as well for the flight crew to understand the support tool available on the ATC side, in order to enhance their trust. In concordance with HF principles. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Fly aircraft and intercept glideslope Fly aircraft on approach route

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1430
Title	Airspace user briefing III
Requirement	With regards to WDS modes (total wind or cross wind) Flight Crew shall be briefed and reminded on the importance to respect the Final Approach path in terms of lateral deviation from the glide path and to notify Controller in a timely manner in case of inability to conform to it.
Status	<validated>
Rationale	As in WDS mode the TDI separation/spacing computation is based on the expected aircraft speed, it is necessary for the Airspace Users to comply with ATC instructions. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Fly aircraft and intercept glideslope

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1440
Title	check the validity of Flight Plan information used by the Separation Delivery tool
Requirement	Approach control shall check the validity of Flight Plan information displayed on the CWP (ICAO aircraft type, wake category).
Status	<validated>
Rationale	Aircraft type is an important input into the Separation Delivery tool. An incorrect aircraft type can result in a large under separation without the Controllers being aware. It is important that mitigations are applied to ensure a highly reliable aircraft type input. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Identify Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1441
Title	Provide aircraft type for verification
Requirement	At the first contact with the Approach, the flight crew shall provide the Aircraft type or alternatively this information could be provided to the Approach Controller via data link and the Approach Controller shall cross check this information with the information displayed on the CWP.
Status	<validated>
Rationale	in order to check the validity of Flight Plan information used by the Separation Delivery tool. This requirement has been validated in RTS4b.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Fly aircraft on approach route

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1450
Title	Pilot requesting extra space
Requirement	Pilots must still be able to request extra spacing behind an aircraft (as they do today).
Status	<validated>
Rationale	Occasionally pilots may have a need to request extra space behind an aircraft. Although this should be rare it should be accommodated in the procedures. This requirement has been validated in SESAR1 P06.08.01 activities.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Fly aircraft and intercept glideslope

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1500
Title	Speed conformance alert I
Requirement	The Approach and/or Tower controller shall be alerted by the speed conformance alert function when the actual aircraft speed differs by more than a locally defined threshold from the aircraft speed profile used for the TDIs computation.
Status	<validated>
Rationale	The speed conformance alert is a mandatory alert for safety reasons - if the a/c - is not flying at the required speed at a given point as defined in the ORD algorithm, the FTD displayed will not be correct and this has serious safety implications as a/c might be flying too close to be safe. The FTD and ITD calculation assumes a certain speed / time-to-fly profile. If the actual speed / time-to-fly profile deviates from this expected speed / time-to-fly profile, then the Controllers need to be alerted as there is increased risk of an infringement. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1510
Title	Speed conformance alert II
Requirement	The triggering value used for the speed conformance alert shall be determined on the basis of the used buffers in the TDI computation. The region on the glideslope where the alert is active shall be defined locally (e.g. 8 NM from RWY threshold).
Status	<validated>
Rationale	Depending on the buffer applied a certain difference between leader and follower speed profiles will be covered by the tool, thus might not be necessary to trigger alerts for those cases. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.1520
Title	Separation infringement alert ITD
Requirement	The Separation Delivery tool shall provide automatic monitoring and alerting of imminent separation infringement.
Status	<validated>
Rationale	To reduce the risk of an infringement of the FTD. See SRyy1 and SRyy3 as examples in the safety assessment report. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1530
Title	Wrong aircraft turned onto TDI alert (sequence error alert)
Requirement	The Approach Controllers shall be alerted in case the aircraft instructed to turn onto the Target Distance Indicator on the runway extended centreline is not the one planned in the Arrival Sequencing Tool list.
Status	<validated>
Rationale	An aircraft turning onto the wrong TDI could result in a large under separation without the Controller being aware. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1560
Title	Sequence error alert procedure
Requirement	In case of sequence error alert, the Approach Controllers shall perform corrective action to re-establish consistency between the actual sequence order and the Arrival Sequencing Tool list.
Status	<validated>
Rationale	The sequence order is an input for the separation delivery tool. ATCOs might need to take actions in order to have correct TDI displayed on the CWP. The system could also automatically update the sequence order. In case the update is done manually by the Controller, this system shall allow the sequence change in a simple and timely manner without having an adverse impact on workload. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR3.1540
Title	ITD catch-up warning
Requirement	The Separation Delivery tool may provide automatic monitoring and warning of catch up of the ITD.
Status	<validated>
Rationale	This is to support the ATCO in monitoring separations and reduce risk of an aircraft crossing the ITD which also reduces the risk of an infringement scenario occurring further along the final approach. An alert or a tool that would inform ATCOs that the ITD will be infringed imminently if they do not reduce a/c speed should be implemented to support the final approach controllers` work. The parameters of the tool will depend on whether this functionality is implemented as a tool or as an alert - this is to be decided and a local implementation level. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1570
Title	Aircraft missing input in sequence
Requirement	If an aircraft that needs to be inserted in the arrival sequence cannot be input into the Arrival Sequence Service, the Approach Controller shall inhibit the Target Distance Indicator corresponding to the follower aircraft whose position in the actual sequence is taken by the newly inserted aircraft and the Approach Controller shall observe DBS WT Category separation for the impacted pairs of aircraft.
Status	<validated>
Rationale	If the aircraft is not inserted in the sequence there is a set of TDI information wrong, the ATCO shall ignore those TDI by hiding them and apply DBS WT separation for the leader - follower (new aircraft) and for the leader (new aircraft) - follower pairs. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Provide Aircraft Spacing Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1581
Title	ITD display
Requirement	After start of the compression, the ITD shall be displayed in a coherent way along the glideslope, in order to avoid negatively impacting the Controllers` performance.
Status	<validated>
Rationale	At the start of the compression, the ITD starts merging with the FTD. The ITD displayed on the CWP shall not confuse/degrade ATCO's performance. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1640
Title	Separation Delivery tool failure III
Requirement	In case of Separation Tool Failure, the Supervisors and Controllers shall receive a message containing the source of the tool failure.
Status	<validated>
Rationale	The ATCOs need to be aware of the source of the problem. In conformance with good HF practices. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1670
Title	Total Wind Monitoring Alert
Requirement	In WDS total wind modes (A-TB-WDS-Tw), in case of total wind monitoring alert, the Approach and Tower Controllers shall revert to the correspondent distance based or time based (e.g. TB-PWS) separation mode using the FTD and ITD indicators and when needed take corrective actions during the transition phase like instructing go-around.
Status	<validated>
Rationale	If the WDS Total Wind can no longer be applied the controllers shall switch to the standard separation mode in use. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1680
Title	Cross Wind Monitoring Alert
Requirement	In WDS crosswind modes (WDS-Xw), in case of cross wind monitoring alert, the Approach and Tower Controllers shall revert to the correspondent distance based or time based (e.g. TB-PWS) separation mode, using the FTD and ITD indicators and when needed take corrective actions during the transition phase like instructing go-around.
Status	<validated>
Rationale	If the WDS Cross Wind can no longer be applied the controllers shall switch to the standard separation mode in use. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR2.1690
Title	Trigger for Headwind, Total and Cross Wind Monitoring Alert
Requirement	The triggering values of the headwind, total wind and cross wind monitoring alerts shall be determined on the basis of the used buffers in the TDI computation.
Status	<validated>
Rationale	The wind safety buffer in the TDI computation is used to cover the differences between measured wind and actual situation. Depending on the buffer used, an additional buffer on the wind can be used when defining the triggering values for WDS activation (e.g. WDS Cross wind reductions could start to be applied with 7 knots crosswind but then 9 knots is decided to be used as activation value). This requirement has been validated in HP-SAF workshop.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1700
Title	Speed conformance alert III
Requirement	In TB-modes, in case of speed conformance alert before the stabilisation fix, the Final Approach or Tower Controllers shall check whether the actual spacing behind the leader aircraft is below the distance-based WTC separation minima and if positive shall apply adequate corrective actions: airspeed instructions, path stretching instructions (if allowed after localiser interception), delegation of visual separation to Flight Crew and, if necessary, missed approach instruction, and shall manage the impact on subsequent aircraft in the arrival sequence.
Status	<validated>
Rationale	If an aircraft lands faster than what predicted by the speed profile in the separation delivery tool the compression information represented by the ITD might not be correct, thus the controllers need to assess the situation and apply the relevant corrective action. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1710
Title	Speed conformance alert IV
Requirement	For all modes, in case of speed conformance alert the Final Approach and Tower Controllers shall be aware that ITD indicators are no longer accurate if the same speed is kept until the deceleration fix (ITD computation impacted by pre-defined glideslope airspeed profile of both follower and leader) thus shall manage compression without indicators as per today operations.
Status	<validated>
Rationale	The Separation Delivery tool assumes in the speed profile that the aircraft will be at a certain speed at the deceleration fix. If at the deceleration fix the aircraft is flying faster and the speed conformance alert is triggered the compression information represented by the ITD might not be correct. The controllers need then to assess the situation and apply the relevant corrective action. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1720
Title	Approach arrival sequence failure
Requirement	If the Approach Arrival Sequence Service fails, the Separation Delivery tool shall continue displaying TDIs for aircraft already established and shall stop displaying TDIs for all other aircraft.
Status	<validated>
Rationale	The loss of the Approach Arrival Sequence Service does not impact aircraft that are already established hence TDIs should continue to be displayed to reduce the impact on the Controllers. For aircraft not already established there will be no way to know if the sequence information remains reliable hence TDIs will not be displayed. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Monitor Aircraft Spacing Assess Separation/Spacing Infringement Sequence, Merge and Space Aircraft Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1721
Title	Separation tool failure with loss of all TDIs (aircraft already established and aircraft going to intercept)
Requirement	In case of separation tool failure with loss of all TDIs (aircraft already established and aircraft going to intercept), the Controllers shall revert to DBS without indicators for all aircraft (one or several aircraft might be instructed to break-off).
Status	<validated>
Rationale	To mitigate Hz06b. This requirement has been validated in RTS2.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1730
Title	Separation tool failure with loss of TDI computation (TDIs preserved for aircraft already established)
Requirement	In case of separation tool failure with loss of TDI computation (TDIs preserved for aircraft already established) a specific separation tool failure alert shall be provided, and the Controllers shall revert to DBS without indicators for aircraft without TDIs. Only for aircraft already established, TDIs that continue to be displayed can be used up to the separation delivery point.
Status	<validated>
Rationale	A complete failure of the Separation Delivery tool means TDIs will turn off suddenly meaning Controllers have to revert to DBS without TDIs. This requirement has been validated in RTS2.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Sequence, Merge and Space Aircraft Provide Aircraft Spacing Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Assess Separation/Spacing Infringement Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1600
Title	Separation Delivery tool glideslope headwind profile status information

Requirement	For all modes, in case of loss of glideslope headwind profile input to the separation tool, the alert for loss of glideslope headwind profile service shall be displayed to the Controllers and Supervisors.
Status	<validated>
Rationale	The Controllers and Supervisors need to remain aware of the health of the Separation Delivery tool or any supporting tools to ensure a controlled transition to a degraded mode if required. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1650
Title	Degraded mode when glideslope headwind profile is missing in TB mode
Requirement	In TB-modes, in the degraded situation where glideslope headwind profile input is missing: - The Controllers shall revert to the correspondent DB- mode (DBS or S-PWS) with use of FTDs only whilst ITDs shall no more be displayed (manual management of compression) or shall revert to an acceptably safe TB-mode with ITD and FTD computed using a conservative wind profile (until the glideslope headwind profile is available again); OR - The Separation Delivery Tool shall automatically revert to the correspondent DB-mode or to an acceptably safe TB-mode (FTD and ITD computed using a conservative wind profile). A notification of the automatic switch shall be provided to the ATCOs and Supervisors.

Status	<validated>
Rationale	Depending on the local implementation several options could be used to manage the unavailability of headwind glideslope profile. Both FTD and ITD could still be displayed to ATCOs (but in a conservative way) or only FTD. The transition could be manual or automatic by the system. This is applicable for the local implementation where reversal to DBS is done using the ORD tool. This requirement has been validated in HP-SAF workshop.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1660
Title	Degraded mode when glideslope headwind profile is missing in DB mode
Requirement	In DB- modes, in the degraded situation where glideslope headwind profile input is missing, the Approach Controller shall use only the FTD for the turn-on decision for merging on to final approach (whilst ITDs shall no more be displayed), vectoring the follower aircraft to intercept the final approach and further spacing management during interception whilst adding extra buffer to the FTD to manually account for compression or shall revert to an acceptably safe DB-mode with ITD and FTD computed using a conservative wind profile (until the glideslope headwind profile is available again).
Status	<validated>

Rationale	Without the headwind profile information in DBS mode the ITD information might not be accurate. The controllers can work using only the FTD or keep displaying the ITD but computed with a conservative wind profile (e.g. low wind conditions) to not negatively impact the compression spacing task. This is applicable when the reversal to DBS is done using the ORD tool. This requirement has been validated in HP-SAF workshop.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor Aircraft Spacing Provide Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1760
Title	Runway surface wind alert
Requirement	In case of conditional application in TB-modes, the Supervisors (Tower and Approach) and Controllers (Tower and Approach) shall be alerted automatically in advance when the predefined activation criteria will not be met anymore hence the imminent need to transition from one separation mode to another, in order to temporarily limit or regulate the flow of inbound traffic (e.g. through metering) prior to the switch of separation mode in order to manage the change and controllers workload.
Status	<validated>

Rationale	A conditional application of a concept (e.g. WDS) relies on the total runway surface wind being above a defined threshold to ensure sufficient wake dissipation or transport to allow for the reduced separations while considering the uncertainty in the speed / wind profile. The Supervisors and Controllers will need to be aware if the wind drops below the required threshold so they can complete a controlled reversion (e.g. back to DBS) with TDIs. This requirement has been validated in RTS1.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the airport Assess operational situation and conditions at the approach Coordinate with Tower Supervisor Coordinate with Approach Supervisor

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1770
Title	Loss of wind monitoring functions
Requirement	Approach and Tower Supervisors shall be alerted when the wind monitoring function for the conditional application of the TB modes (glideslope headwind, total wind, cross wind) are lost or inoperative (encompassing loss of wind input).
Status	<validated>
Rationale	This information is required to assess whether transition shall be put in place. This requirement has been validated in HP-SAF workshop.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess operational situation and conditions at the approach Assess operational situation and conditions at the airport

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1771
Title	Controller/ Supervisor Working Position
Requirement	The working positions shall ensure that with the introduction of the Separation Delivery tool related indicators and alerts the displays do not become unnecessarily cluttered.
Status	<validated>
Rationale	The amount of information available on the screens shall be minimised as much as possible. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Sequence, Merge and Space Aircraft Monitor Aircraft Spacing Provide Aircraft Spacing

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1772
Title	Controller/ Supervisor Working Position II
Requirement	The input devices shall be designed in a way that allows ATCOs to set up the HMI according to personal preferences, when applicable.
Status	<validated>
Rationale	ATCOs should be able to set up the HMI according to personal preferences, allowing for an enhanced SA and confidence in working with the tools. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement Monitor Aircraft Spacing Sequence, Merge and Space Aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ARR0.1773
Title	General alerts
Requirement	All proposed alerts shall be salient and easy to identify and interpret so that Controllers and Supervisors can react as necessary in a timely and accurate manner.
Status	<validated>
Rationale	Alerts shall be developed in line with human factors in design principles. This requirement has been validated in RTS1, RTS2, RTS3a, RTS3b, RTS4a, RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Assess Separation/Spacing Infringement

4.2 Departures Concepts Solutions

The latest consolidated list of requirements for the Departures Concepts Solutions has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0001
Title	Provision of optimised departure sequence plan for pushback and taxi-out
Requirement	The Tower ATC Roles should be provided with an initial optimised departure sequence plan for pushback and taxi-out.
Status	<validated>
Rationale	The level of support which is currently given would need to be enhanced in the new operating environment (i.e. the allocation of the task between human actors and technical systems would shift to placing the onus on the technical system). This should help to mitigate any risks associated with reduced or lost information processing capacity. It is anticipated that A-CDM/DMAN support will be provided to formulate and optimise the departure sequence order and departure rate for coordinating the TOBTs and TSATs and managing the taxi-out flow of departure aircraft to the runway holding points. This support is primarily provided to the Ground Movement Planner Controller and possibly to the Ground Movement Controllers. In order to optimise the departure rate, the A-CDM/DMAN support should take into account the optimised wake turbulence separations that are being employed. In NATS RTS5 the departure rate was increased by 10% above that of the traffic from the recorded operational day in order to provide the appropriate sustained pressure of departure traffic on taxi-out to the runway holding points.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.1001
Title	Provision of optimised departure sequence plan for line-up and take-off
Requirement	The Tower ATC Roles should be provided with an optimised departure sequence plan for line-up and take-off.
Status	<validated>
Rationale	The level of support which is currently given may need to be enhanced in the new operating environment (i.e. the allocation of the task between human actors and technical systems would shift to placing the onus on the technical system). This should help to mitigate any risks associated with reduced or lost information processing capacity. It is considered as optional as to whether this support is provided to the Tower Runway Controller and whether this support extends to supporting late changes to departure sequence order due to for example aircraft not being ready to line-up and take-off or because of a change of CTOT. This support was not provided in NATS RTS5 where controller feedback suggested that this support should be considered in the future. An outcome of ECTL RTS4b is that If the OSD tool is to be applied in partially segregated / mixed mode runway operations, additional HMI support is required to visualise the planned arrivals and departures sequence on the runway and so this requirement is mandatory for partially segregated / mixed mode. This could be supported by electronic flight strips, or by an AMAN/DMAN or by a bespoke sequencing tool.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Formulate optimised sequence order for departing aircraft Determine next aircraft to be given a line-up clearance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0002
Title	Aircraft separation monitoring for distance-based separation
Requirement	The Tower Runway Controller shall be able to check the delivery conformance to the required wake separation distance on the HMI.
Status	<validated>
Rationale	Part II SAR SR#D35 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D). Part II SAR SR#D60 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). The Controller shall be able to check on the HMI if the right wake separation distance is delivered between aircraft to avoid separation minima infringement and to confirm the appropriate application of the OSD tool support. This applies to the application of both standard static wake separation rules (e.g. ICAO, RECAT-EU, RECAT-EU-PWS) and dynamic WDS-D Xw reduced wake separation rules. For the delivery of the wake separation distance, the controller shall be able to check that the required wake separation distance is delivered as the follower aircraft becomes airborne using the situation view display. In the ECTL RTS4a and RTS4b ATCO were measuring with ''click and drag'' tool the distance delivered between aircraft, this has also been assessed and discussed in RTS4b report.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.1002
Title	Aircraft separation monitoring for time based separation
Requirement	The Tower Runway Controller shall be able to check the delivery conformance to the required wake separation time on the HMI.
Status	<validated>
Rationale	Part II SAR SR#D37 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D). Part II SAR SR#D62 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). The Controller should be able to check on the HMI that the required wake separation time has been delivered between aircraft to confirm the appropriate application of the OSD tool support so as to avoid inadvertently inducing further wake separation time infringements if this has not been the case. For example if inadvertently employing an anticipated roll time that is more than the actual roll time in the prevailing operating conditions resulting in an earlier airborne time than anticipated. This applies to the application of both standard static wake separation rules e.g. (ICAO, RECAT-EU, RECAT-EU-PWS) and dynamic WDS-D Xw reduced wake separation rules. For wake separation time procedures the controller should be able to check that the required wake separation time is delivered as the follower aircraft becomes airborne from the recorded airborne times of the follower and preceding aircraft with the appropriate checking support in the electronic environment. In NATS RTS5 no automatic checking support was provided in the electronic environment. As a result the controllers were hand

	recording the seconds field of the NBAT on the FDE in the runway bay so that this was retained for checking when the FDE was moved to the airborne bay. This requirement is validated as a result of the actions of the controllers in NATS RTS5. The automated HMI support has still to be developed and validated.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Monitor for aircraft becoming airborne and record Airborne Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0003
Title	Amendment of departure sequence plan
Requirement	The Tower Runway Controller shall be able to amend the departure sequence plan/order used by the OSD tool as required.
Status	<validated>
Rationale	Part II SAR SR#D73 in relation to the SO#D16: Maintain the ability of ATCOs to tactically rearrange the departure sequence. It was recognised that whilst many of the factors which determine the departure sequence are predictable and/or stable over time, controllers still needed to retain the ability to override system algorithms and amend sequences on a tactical basis. There is always the need to be able to react to situations where an aircraft may not be able to line-up and take-off at the associated position and time in the departure sequence plan/order. From a safety perspective, if an aircraft which was expected to depart is not able to anymore, the departure sequence provided to the OSD tool needs to be updated so that the OSD tool can invoke the clearance of any stale displayed separation information associated with the departure aircraft not able to depart any more, and so that the OSD tool can correctly calculate the

	separation information for the next departure aircraft. This was validated in NATS RTS5.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Formulate optimised sequence order for departing aircraft Determine next aircraft to be given a line-up clearance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0004
Title	Wake separation time remaining to next departure
Requirement	In the case of wake separation time application, the Tower Runway Controller shall be presented with a means to monitor the remaining time to satisfy the wake separation.
Status	<validated>
Rationale	Part II SAR SR#D34 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D) and SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). To help the Controller in providing the right time based wake separation between each departure, they shall be supported with an indication of the time left until the next departure to satisfy the wake separation, either the "airborne time" separation or "start of take-off roll time" separation depending on local procedures. NATS RTS5 validated the "airborne time" wake separation procedures. A countdown timer was evaluated where the zero of the countdown corresponded to the earliest airborne time to satisfy the required wake separation time. When using the countdown timer the Tower Runway Controller was required to wait until the countdown corresponded to their anticipated time

	that it would take the aircraft to become airborne before issuing the take-off clearance. ECTL RTS4b validated the "start of take-off roll time" wake separation procedures. A countdown timer was evaluated where the zero of the countdown corresponded to the earliest take-off clearance time to satisfy the required wake separation time.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Time to preceding aircraft and associated Time Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0005
Title	SID separation minima support
Requirement	The Tower Runway Controller should be informed of the SID separation to apply by the OSD tool support.
Status	<validated>
Rationale	The Tower Runway Controller should be informed of the SID separation minima to apply by the OSD tool support. In NATS RTS5 the controllers decided that they did not require the OSD tool to support the SID separation. SID separation support was provided and validated in ECTL RTS4a.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0006
Title	Calculating time to next departure
Requirement	Time until next departure shall be calculated to correctly and accurately represent the WDS (departure) or standard wake separation (according to the wake separation in use) for all departure pairs, in all normal ranges of weather and operating conditions.
Status	<validated>

Rationale	Part II SAR SR#D23 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircrafts and SO#D18: Provision of reliable tool-based information regarding departure intervals. The time to next departure shall be calculated taking into account the wake separation rules in use. For time separation procedures this shall include adding 60s if taking off from an intermediate position relative to the preceding departure aircraft take-off position. In NATS RTS5 the Enhanced OSD tool applied either the PWS-D wake separation rules or the WDS-D Xw reduced wake separation rules depending on whether there were appropriate crosswind conditions with authorisation to apply the WDS-D Xw reduced wake separation rules. When applying the WDS-D Xw reduced wake separation rules, the PWS-D wake separation was applied if it was equal to or less than the WDS-D reduced wake separation or when the planned SID of the follower departure aircraft was not upwind of the planned SID of the lead departure aircraft beyond the position of the first SID turn. This is a system requirement and so should also be in the TS/IRS.
Category	<System>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0007
Title	Radar separation minima support
Requirement	The Tower Runway Controller should be informed of the radar separation minima to apply by the OSD tool support.
Status	<validated>
Rationale	The Tower Runway Controller should be informed of the radar separation minima to apply. In NATS RTS5 the controllers did not require support for applying the radar separation minima. The separation delivery performance of non-wake pairs was acceptable. Radar separation minima support was provided and validated in ECTL RTS4a and RTS4b.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine earliest take-off clearance time taking into account any other separation Determine preceding aircraft earliest distance position taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0008
Title	Wake separation provision
Requirement	The Tower Runway Controller (ATC Departure Controller) shall be provided with a tool that provides accurate and robust information on the required wake turbulence separation interval between each successive departing aircraft.

Status	<validated>
Rationale	Part II SAR SR#D29 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D). Part II SAR SR#D57 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). The Controller shall provide the correct wake separation between each pair of departure aircraft whether the WDS-D Xw concept or standard departure wake separation rules such as ICAO, RECAT-EU or RECAT-PWS-EU are in use. This applies to both wake separation time procedures and the wake separation distance-based procedures. NATS RTS5 validated the "airborne time" wake separation procedures. ECTL RTS4a validated the "start of take-off roll time" wake separation procedures. ECTL RTS4a validated the distance-based wake separation procedures.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0009
Title	Determining when aircraft become airborne

Requirement	The Tower Runway Controller should be supported through automatically determining when aircraft become airborne.
Status	<validated>
Rationale	Part II SAR SR#D32 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D) and SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). When separations are reduced it is important that decisions as to when to issue take-off clearances are based on accurate information. Currently the time that an aircraft is deemed to have become airborne is when the runway controller completes the actions necessary to move a flight's FDE strip from the runway bay into the airborne bay. Whilst this is suitable for current operations, it is possible that the level of accuracy will be unacceptable from both a safety (too early could be unsafe) and service delivery (too late is inefficient) perspective for the future. NATS RTS5 validated using the event time of the controller "airborne hide" action which resulted in the FDE being automatically moved from the runway bay to the airborne bay. On some occasions the controller was late in recognising the aircraft becoming airborne due to being busy with other tasks. The downlinked Mode S airborne parameter is known to be unreliable due to triggering early as the aircraft is rolling on the runway. The use of conventional surveillance data (e.g. radar surveillance, multilateration) is also known to be unreliable with respect to determining precisely when an aircraft becomes airborne. It remains to be investigated as to whether video/optical sensor/camera based surveillance could be used in determining precisely when an aircraft becomes airborne.
Category	<Operational>, <Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor for aircraft becoming airborne and record Airborne Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.1009
Title	Determining when aircraft start their take-off roll
Requirement	The Tower Runway Controller shall be supported through automatically determining when aircraft start their take-off roll.
Status	<validated>
Rationale	Part II SAR SR#D33 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D) and SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). When separations are reduced it is important that decisions as to when to issue take-off clearances are based on accurate information. Whilst a manual approach to determining the "start of take-off roll" may be suitable for current operations, it is possible that the level of accuracy will be unacceptable from both a safety (too early could be unsafe) and service delivery (too late is inefficient) perspective for the future. The "start of take-off roll" may be able to be reliably determined using conventional surveillance (radar surveillance, multilateration). Validated in ECTL RTS4a and RTS4b.
Category	<Operational>, <Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0010
Title	WTE risk for unmanaged under separation
Requirement	The probability per departure of imminent wake encounter under unmanaged under-separation on the Initial Common Departure path shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline).
Status	<deleted>
Rationale	There is a need to cap the safety risk from the case where the correctly defined WT separation minima are not correctly applied, with potential for severe wake encounter higher than if those minima were correctly applied. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor for aircraft becoming airborne and record Airborne Time Monitor separation on initial departure path Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0011
Title	WTE risk for unmanaged under separation 1
Requirement	The probability per departure of unmanaged under-separation (WT or radar) in adequate separation mode on the Initial Common Departure path shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline).
Status	<deleted>
Rationale	There should be no increase in unmanaged under-separation (WT or radar) in adequate separation mode on the Initial Common Departure path. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time Determine Wake Separation Time to preceding aircraft and associated Time Determine Wake Separation Distance to preceding aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0012
Title	WTE risk for unmanaged under separation 2
Requirement	The probability per departure of unmanaged under-separation (WT or radar) on the Initial Common Departure path shall not increase due to inadequate selection of or transition between any adequate modes of operation.
Status	<deleted>
Rationale	There should be no increase in unmanaged under-separation induced by inadequate selection and management of separation modes; that is selection and transition between the adequate modes of operation of ICAO, RECAT-EU, PWS-RECAT-EU, WDS-Xw and WDS-Tw. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Apply WDS-D to Departures Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0013
Title	Imminent infringement
Requirement	The probability per departure of Imminent infringement (WT or radar) on the Initial Common Departure path shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline).
Status	<deleted>
Rationale	There should be no increase of imminent infringement (WT or radar) on the Initial Common Departure path due to ineffective separation management of spacing conflicts on departure performed when the follower aircraft is not yet airborne. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor for aircraft becoming airborne and record Airborne Time Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0014
Title	Crew/Aircraft induced spacing conflicts
Requirement	The probability per departure of Imminent infringement (WT or radar) on the Initial Common Departure path due to 1st or 2nd a/c deviation from expected behaviour while second a/c already airborne shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline).
Status	<deleted>
Rationale	There should be no increase of imminent infringement (WT or radar) on the Initial Common Departure path due to preceding or following aircraft deviation from expected behaviour while the follower aircraft is already airborne. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>, <Functional>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Monitor for aircraft becoming airborne and record Airborne Time Issue take-off clearance and Monitor and Record Roll Time Determine preceding aircraft earliest distance position taking into account any other separation Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0015
Title	ATC induced spacing conflicts
Requirement	The probability per departure of Imminent infringement (WT or radar) on the Initial Common Departure path induced by ATC while second a/c already airborne shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline).
Status	<deleted>
Rationale	There should be no increase of imminent infringement (WT or radar) on the Initial Common Departure path induced by ATC while the follower aircraft is already airborne. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine earliest take-off clearance time taking into account any other separation Determine preceding aircraft earliest distance position taking into account any other separation Monitor separation on initial departure path Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0016
Title	Runway conflicts
Requirement	The probability per departure of Runway conflict due to premature take-off shall be no greater in operations based on WT scheme under consideration than in current operations applying reference minima (e.g. ICAO or an established operational baseline).
Status	<deleted>
Rationale	There should be no increase of runway conflicts due to premature take-off. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Issue take-off clearance and Monitor and Record Roll Time Commence take-off roll

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0017
Title	Runway incursion
Requirement	The probability per departure of Runway incursion shall not increase in operations based on WT scheme under consideration (due to ATCO decreased situation awareness & overload in relation to RWY increased throughput enabled by the Concept) compared to current operations applying reference minima (e.g. ICAO or an established operational baseline).
Status	<deleted>
Rationale	There should be no increase of runway incursion due to ATCO decreased situation awareness & overload in relation to runway increased throughput enabled by the concept, affecting take-off management, runway entry management and runway monitoring. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine next aircraft to be given a line-up clearance Instruct aircraft to line-up

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0018
Title	SID information provision
Requirement	SID information shall be provided to the Tower Runway Controller.
Status	<validated>
Rationale	Part II SAR SR#D49 in relation to the SO#D03: Ensure no reduction in SID route spacing or any other non-wake constraints between successive departures when applying WDS or S-PWS and SO#D04: Ensure the application of WDS-D only when pre-defined SID/Route combinations are met and SO#D10: Ensure the application of the greatest applicable departure separation constraint. i.e. wake, SID and MRS separation requirement(s). To enable the Controller to formulate and execute an efficient departure plan taking into account the intended SID of each departure aircraft. To enable the controllers to apply the SID separations without OSD tool support. For the application of the WDS-D Xw reduced wake separation in order to facilitate the controller awareness of when a departure pair can apply a WDS-D Xw reduced wake separation, prior to the aircraft being given line-up clearance and moved to the runway bay, and so before the OSD tool calculates the wake separation time and NBAT. Note that the SID information should already be provided to support the application of SID separations as is the case of Heathrow where the planned SID is displayed on the FDE of each departure aircraft, so there is no change required to the current system. For other local environments there may be a need to supplement the provision of SID information.
Category	<Safety>, <Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Formulate optimised sequence order for departing aircraft Determine the most restrictive Wake Separation or SID Separation Distance Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0019
Title	Flight crew adherence to instruction
Requirement	Flight Crew shall follow Controller instructions.
Status	<deleted>
Rationale	If Flight Crew do not adhere to Controller instruction, it is not possible for him/her to provide right separation, whether WDS (departures) or standard separation rule is in use. It is already the case that the Flight Crew are required to adhere to ATC instructions while at the same time being responsible for the safety of the aircraft. The PJ02-01 Wake Turbulence Optimisation Concepts do not change this. As no change to current operations delete requirement.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Commence take-off roll Line up and hold

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0020
Title	Aircraft route display for distance-based separation
Requirement	The Tower Runway Controller shall be able to visualise the planned route of each aircraft when applying distance-based separation.
Status	<validated>
Rationale	Part II SAR SR#D36 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D). Part II SAR SR#D61 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). When applying distance-based wake separations the controller needs to apply visualisation of how far along the SID path the lead aircraft needs to progress before giving the take-off clearance to the follower aircraft. This is in order to deliver the required wake separation distance when the follower aircraft becomes airborne. This applies to the application of both standard distance-based wake separations (ICAO, RECAT-EU and RECAT-PWS-EU) and WDS-D reduced distance-based wake separations. This may already be provided for in some local environments. For other local environments there may be a need to supplement the provision of the visualisation of the planned route of each departure aircraft. Validated in ECTL RTS4a.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance

		position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Wake Separation or SID Separation Distance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0021
Title	Procedures for greater departure spacing/separation requirements
Requirement	Procedures shall be implemented such that greater departure spacing/separation requirements are not eroded by the introduction of more efficient wake turbulence separation standards.
Status	<validated>
Rationale	Part II SAR SR#D02 in relation to the Hazard: ATCO issues a premature take-off clearance with respect to SID separation. Greater departure spacing/separation requirements include SID separations, MDIs, ADIs and LVO separations. Validated in NATS RTS5.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine preceding aircraft earliest distance position taking into account any other separation Determine earliest take-off clearance time taking into account any other separation Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Time satisfying

		Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0022
Title	Alerted to the possibility of catch-up
Requirement	ATCOs shall be alerted to the possibility of catch-up by following aircraft, that may lead to an erosion of wake separation requirements.
Status	<in progress>
Rationale	Part II SAR SR#D03 in relation to the Hazard of Aircraft deviates from planned trajectory. Still in progress as the definition of catch-up and corresponding erosion in wake turbulence separation will need to be agreed at local level. This requirement requires further consideration in the local V4 maturity validation activities.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0023
Title	Stopping premature take-off roll
Requirement	ATCOs shall, when possible, instruct aircraft to stop a premature take-off roll (in the context of an aircraft has started the take-off roll and is able to safely stop subject to speed).
Status	<in progress>

Rationale	Part II SAR SR#D04 in relation to the Hazard of ATCO issues premature take-off clearance regarding wake separation. Also in relation to the Hazard of Aircraft deviates from planned trajectory in the particular case where the preceding departure aircraft deviates in the context of applying a WDS-D Xw reduced separation such that cross wind transport is no longer assured. This would also apply if the Flight Crew started a premature take-off roll before the take-off clearance from ATC. EGLL ATCOs suggest that this may not be a reasonable requirement as a take-off may only be cancelled if an aircraft is below 80kts IAS. This requirement requires further consideration in the local V4 maturity validation activities.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0024
Title	Training in the operation of new wake turbulence separation standards
Requirement	ATCOs shall be provided with sufficient training in the operation of new wake turbulence separation standards.
Status	<validated>
Rationale	Part II SAR SR#D05 in relation to the Hazard of ATCO issues premature take-off clearance regarding wake separation. Validated in NATS RTS5.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Monitor for aircraft becoming airborne and record Airborne Time Issue take-off clearance and Monitor and Record Roll Time Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0025
Title	Training in the operation of OSD tool
Requirement	ATCOs shall be provided with appropriate training in the operation of the OSD Tool.
Status	<validated>
Rationale	Part II SAR SR#D30 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D). Part II SAR SR#D58 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). Validated in NATS RTS5.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Monitor separation on initial departure path Instruct aircraft to line-up Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures Apply WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Formulate optimised sequence order for departing aircraft Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0026
Title	Training on inputting take-off time information

Requirement	ATCOs shall be trained to recognise the importance of inputting consistent and accurate take-off time information.
Status	<validated>
Rationale	Part II SAR SR#D31 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D). Part II SAR SR#D59 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path (for PWS-D or RECAT-EU with OSD alone). Validated in NATS RTS5.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0027
Title	Training on consistently applying SID route spacing and any other non-wake constraints
Requirement	ATCOs shall be trained to recognise and consistently apply SID route spacing and any other larger non-wake constraints when applying WDS-D or S-PWS-D.
Status	<validated>

Rationale	Part II SAR SR#D48 in relation to the SO#D03: Ensure no reduction in SID route spacing or any other non-wake constraints between successive departures when applying WDS-D or PWS-D and SO#D10: Ensure the application of the greatest applicable departure separation constraint. i.e. wake, SID and MRS separation requirement(s). Validated in NATS RTS5.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0028
Title	Ensuring runway entry point information
Requirement	ATCOs shall ensure that the runway entry point information on the electronic flight progress strip reflects the corresponding runway entry point issued to the departing aircraft.
Status	<validated>

Rationale	Part II SAR SR#D56 in relation to the SO#D07: Issue take-off instructions, such as to establish the applicable wake separation minima on the common initial departure path. This is used to determine when a departure aircraft is taking off from an intermediate position relative to the take-off position of the preceding departure aircraft, and thus whether 60 seconds needs to be added to the wake separation time. Validated in NATS RTS5.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0029
Title	Applying the applicable safe departure intervals
Requirement	ATCOs shall apply the applicable safe departure intervals fully taking into account all of the SID route separation, MRS and wake turbulence separation requirements.
Status	<validated>
Rationale	Part II SAR SR#D67 in relation to the SO#D10: Ensure the application of the greatest applicable departure separation constraint. i.e. wake, SID and MRS separation requirement(s). Validated in NATS RTS5.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine SID Separation Distance to each relevant preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine earliest take-off clearance time taking into account any other separation Determine SID Separation and earliest Time to each preceding aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0030
Title	Flight Crew training on the optimised wake separation standards
Requirement	All Flight Crew shall be briefed/trained on the optimised wake separation standards and informed of the wake separation standards being applied at each departing airport.
Status	<validated>

Rationale	Part II SAR SR#D68 in relation to the SO#D10: Not to negatively affect the ability of Crew/Aircraft, to be able to follow ATC instructions. In the ECTL validation activities Paris CDG and Vienna ATCOs indicated that they do not consider it necessary for the ATCOs to provide notification of the wake separation standards being applied to every flight as it would burden the R/T frequency and because it is the responsibility of pilots to follow ATC instructions. The applicability of reduced separation (whatever the procedures) shall be made available in the flight information documents as NOTAM and AIP (under weather conditions) with the notification that at the particular airport it is to be expected that in particular wind conditions reduced wake separation procedures apply. In the case that a pilot does not want to comply with the reduced wake separation, they can delay their take-off roll, and when this happens ATC can file a report, as it is expected that pilots should normally comply with the ATC take-off instruction.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0031
Title	Tower Runway Controller separation responsibilities

Requirement	The Tower Runway Controller shall apply the applicable time or distance separation until separation responsibility is transferred to the TMA Departure Radar Controller.
Status	<validated>
Rationale	Part II SAR SR#D63 in relation to the SO#D08: Provide correct wake turbulence spacing delivery, from the moment the following aircraft rotates/begins its take-off roll as applicable, until it is transferred to the next sector. Validated in NATS RTS5.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time taking into account any other separation Monitor for aircraft becoming airborne and record Airborne Time Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0032

Title	ATCO training on safe instructions to go-around/missed approach aircraft
Requirement	ATCOs shall be trained to issue safe instructions to aircraft on a go-around/missed approach that will minimise the possibility of a WTE (to be developed at local level).
Status	<validated>
Rationale	Part II SAR SR#D70 in relation to the SO#D12: Ensure wake turbulence separation between departing aircraft and an aircraft executing a go-around/missed approach. In conformance with good HF practices.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0033
Title	ATC checking of the SID
Requirement	Prior to push-back (or at the latest before line-up) ATC shall check with the Pilot that the SID in the ATC flight plan information matches the SID selected in the FMS.
Status	<validated>
Rationale	This was established as a preventative mitigation in the ECTL SAF & HP workshop. ATC must ensure the consistency of the SID in the ATC information when applying WDS-D Xw reduced separations. The consistency of the SID in the ATC information is also required with respect to the OSD tool determining the positioning of the DDI-D when support the application of distance-based separation.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Formulate optimised sequence order for departing aircraft Determine next aircraft to be given a line-up clearance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0034
Title	Informative MRS and SID separation support
Requirement	The display of the countdown time shall be differentiated between “informative” MRS and SID separation support that the ATCO has the discretion to interpret and WT “separation” support that the ATCO must apply.
Status	<validated>
Rationale	This requirement applies when the OSD tool is providing informative support for SID and MRS constraints that the ATCO has the discretion to interpret and issue an earlier take-off clearance. This is so as to clearly distinguish from the WT separation support that the ATCO is required to apply. This is so as to avoid ATCO confusion as to when they can apply discretion and interpret the countdown timer. This was established as a requirement in the ECTL SAF & HP workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying

		Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0035
Title	Training on informative MRS and SID separation support
Requirement	It shall be made clear to ATCOs (through training and differentiated display support) that the tool is just informative for MRS and SID separation constraints, while remaining a separation tool for WT constraints.
Status	<validated>
Rationale	This applies in case when the separation/ spacing tools are not fully refined to efficiently and accurately account for all constraints (MRS/ SID and WT). This was established as a requirement in the ECTL SAF & HP workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time

		taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0036
Title	Training for retention of skills
Requirement	Training of TWR ATCO's shall emphasize the need for retaining current skills in A/C WV category acknowledgement and the related spacing.
Status	<validated>
Rationale	Both the RTS5 and the Post RTS5 workshop confirmed the need for this requirement; although a new element of automation is proposed for the operation, controller training in the mental processing of A/C types and the associated wake category shall be retained.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine earliest take-off clearance time taking into account any other separation Determine SID Separation and earliest Time to each preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Wake Separation or SID Separation Distance Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine Wake Separation Distance to preceding aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0037
Title	Procedures for degraded mode operations
Requirement	Procedures shall be defined for degraded mode operations.
Status	<validated>
Rationale	In the case of technical failure that comprises the tool procedures are required for the degraded mode steps. In the case of WDS-D, in the event of a WDS-D tool support failure there will be a need to revert to applying PWS-D with the OSD tool support. In the case of an OSD tool support failure there will be a need to revert to manually applying the WT separation constraints; either RECAT-EU, UK 5-CAT or ICAO 4-CAT as per local procedures. This was established as a requirement at the Post RTS5 SAF & HP workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0038
Title	Training in roll time variations
Requirement	Training of ATC staff shall include roll time variations for different aircraft types, checking wind conditions, air temperature, surface runway conditions and take-off weight.
Status	<validated>
Rationale	This mitigation originated from the EGLL workshop held on March 28, 2019, as a preventative one against CF "ATCO mis-judges take-off roll-time", Hazard 1 ATCO issues a premature take-off clearance with respect to wake separation. When using the NBAT and the associated countdown time when applying "airborne time" procedures, if the ATCO applies a longer anticipated roll time than the actual roll time the "airborne time" will be earlier than anticipated which could result in under separating against the required wake turbulence separation.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Monitor for aircraft becoming airborne and record Airborne Time Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0039
Title	Training on the application of SID separation constraints
Requirement	Controller training shall emphasize that the OSD/Enhanced OSD tool support represents advice only and that the controller is still responsible for the application of any SID separation constraint.
Status	<validated>
Rationale	This requirement originated from the EGLL workshop held on March 28 as a preventative mitigation against a CF "ATCO ignores the tool" and "ATCO mis-judges take-off roll-time". This is in the context of the OSD tool providing no support for the SID separation constraints. In order to prevent the controller from applying the WV separation only and omitting to include consideration of the required SID separation constraints, SID information of an adequate prominence shall be available. SID information is included on the A/C FDE strip already. SID information prominence was identified as a preventative mitigation against CF "ATCO fails to take into account a SID separation constraint within the departure clearance (even though appropriate wake separation applied)", Hazard 2 ATCO issues a premature take-off clearance with respect to a SID separation constraint; held at EGLL on 28 March 2019.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0040
Title	Training on alerts/alarms and support information
Requirement	The training shall appropriately familiarize the ATCOs with the meaning of all alerts/ alarms and support information.
Status	<validated>
Rationale	This was established as a preventative mitigation in the ECTL SAF & HP workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0041
Title	Prominence of SID information
Requirement	SID information on the HMI shall be afforded adequate prominence.
Status	<validated>
Rationale	SID information prominence was identified as a preventative mitigation against CF "ATCO fails to take into account a SID separation constraint within the departure clearance (even though appropriate wake separation applied)", Hazard 2 ATCO issues a premature take-off clearance with respect to SID separation constraint; held at EGLL on 28 March 2019. SID information is included on the A/C FDE strip already. Note that the SID information should already be provided to support the application of SID separation constraints as in the case of Heathrow. RTS5 exercise revealed that due to the new HMI element (OSD tool) being "easy to follow", controllers might omit to include the SID separation constraints, when applicable, into the departure clearance. RTS5 confirmed an HP hazard when ATCO follows the WV separation provided by the tool and omits to consider an additional SID separation constraint, where applicable. Therefore, it is important for the SID information to be adequately prominent on the HMI and captured by the controller when scanning the sources of information.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance Determine SID Separation and earliest Time to

		each preceding aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0042
Title	Distinguishing an OSD tool failure
Requirement	All HMI elements of the OSD tool shall display the wake separation time or the non-wake pair informative information for each departure pair so as enable the ATCO to distinguish when there is an OSD tool failure.
Status	<validated>
Rationale	The reason for providing information for a non-wake pair is to give an indication that the tool is working correctly. If nothing is displayed, that means that the tool is unable to provide accurate information to the controller. When this occurs the controller will need to revert to manually applying the WT separation for the impacted departure pairs as per the degraded mode procedures. This was established as a requirements in the Post RTS5 SAF & HP workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0043
Title	Distinguishing non-wake pair
Requirement	HMI associated with the NBAT and the value displayed by the Countdown timer for a non-wake pair shall be unambiguous.
Status	<validated>
Rationale	"NONE" was displayed in the NBAT field on the FDE in RTS 5. This signified that there was no wake separation constraint to the preceding departure aircraft. This was instead of displaying "0000" which was considered as confusing. There were also issues associated with "NONE" being interpreted as also implying that there was no SID separation constraint and so the suggestion is that "----" is displayed instead. "0" was displayed in the Countdown timer for a non-wake pair which may have been confused as the countdown having counted down to 0s. There is a need to further address this issue in the local V4 maturity development and validation activities.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0044
Title	Controller training
Requirement	Controllers shall undergo briefing on the functionality of the tool, its use and sufficient simulation training.
Status	<validated>

Rationale	This was established as a requirements in the Post RTS5 SAF & HP workshop.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine next aircraft to be given a line-up clearance Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance Determine Wake Separation Time to preceding aircraft and associated Time Formulate optimised sequence order for departing aircraft Determine earliest take-off clearance time taking into account any other separation Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0045
Title	Distinguishing countdown timer status
Requirement	The display of the countdown timer should distinguish a passive status (ticking has not started yet) from an active status (ticking has started).
Status	<validated>
Rationale	This recommendation originates from NATS RTS5, where users reflected on the practical use of the tool HMI elements and identified areas where errors or mis-seeing or mis-judgement of the displayed information might occur.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0046
Title	Training on countdown timer format
Requirement	Training on the countdown timer format should emphasize that the value displayed is in seconds.
Status	<validated>

Rationale	Various formats were analysed (80s, 80, 1m20s). Eventually 80 was the preferred option, controllers familiarised themselves with the format and did not misunderstand the value any further.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.0047
Title	Countdown timer on FDE
Requirement	The OSD tool should include the countdown timer on the FDE.
Status	<validated>
Rationale	This was at the beginning the preferred option of the HMI prototype, however this was not able to be supported in RTS5 due to technical constraints. The countdown timer on the ADIS display increased heads-up time which was seen as a positive benefit of the prototyped option in RTS5.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.2001
Title	SID and other constraints
Requirement	The PWS-D/OSD tool should include SID constraints and aircraft type speed considerations in the NBAT/NBTOT calculations in order to work properly.
Status	<validated>
Rationale	The separation tool should take into consideration all of the constraints related to the separations rather than just the wake turbulence separation constraints. This was feedback from the ATCOs in the ENAIRE RTS6.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine earliest take-off clearance time taking into account any other separation Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation

		Determine the most restrictive Wake Separation or SID Separation Distance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.2002
Title	Support for traffic in the holding bay
Requirement	The PWS-D/OSD take-off clearance time indicator should be displayed for all the traffic in the holding bay (for segregated mode operations).
Status	<validated>
Rationale	The controllers participating in RTS6 suggested adding the countdown timer to the electronic flight progress strip of all the departure aircraft waiting at the holding point, not just waiting for the aircraft that has been given the line-up clearance, This would help the controller choose the best option from the departure aircraft at the holding point. This was feedback for the ATCOs in the ENAIRE RTS6. Note that this requirement shall only be applied to segregated mode operations. This does not apply to mixed mode and partially segregated mode operations where a requirement has been established that the departure aircraft shall be provided with a line-up clearance before providing the take-off time support information.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine next aircraft to be given a line-up clearance Determine Wake Separation Distance to preceding aircraft Formulate optimised sequence order for departing aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3001
Title	Future assessments
Requirement	Local implementation shall assess the operational feasibility of the tool in challenging and different wind conditions.
Status	<validated>
Rationale	To ensure the applicability of the concept in a wide array of conditions. This is a requirement from ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine earliest take-off clearance time taking into account any other separation Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance Determine Wake Separation Time to preceding aircraft and associated Time Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3002
Title	HF design principles
Requirement	In case there are more than just one tool supporting the ATCO with the departure clearances all displays shall present the same information in a synchronized way.
Status	<validated>
Rationale	In the validations performed by ECTL, both the DDI-D and the DDI-T were used, in conjunction with a simplified sequence list. In line with HF design principles, all displays shall be synchronised, ensuring the ATCO has the appropriate level of SA, without enhancing workload. Thus, the timers, if available, shall all display "minutes" or "seconds" and not both on different displays. This is a requirement validated in ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine preceding aircraft earliest distance position taking into account any other separation Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3003
Title	Alarms and alerts
Requirement	In case a departure clearance is issued too early (against the timer display) an alarm shall be available on the CWP.
Status	<validated>
Rationale	To represent a barrier against a possible runway incursion there is a means of protection and/ or warning (safety net) to indicate to the controller that the runway is engaged, and no departures or crossing are allowed until the arriving aircraft has vacated the runway. This is a requirement validated in ECTL RTS4a.
Category	

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine next aircraft to be given a line-up clearance Instruct aircraft to line-up

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3004
Title	Gap value updates
Requirement	The OSD gap spacing delivery information shall be stable and reliable in order to avoid the recalculation and constant updates of the gap values.
Status	<validated>
Rationale	One potential solution to achieve it could be to use the predicted touch down time based on the standard descent profiles in order to avoid the recalculation and constant updates of the gap values. This is a requirement from ECTL RTS4a and ECTL RTS4b.

Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine earliest take-off clearance time taking into account any other separation Determine preceding aircraft earliest distance position taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3005
Title	HF design principles II
Requirement	The OSD gap spacing delivery information shall be displayed in a coherent manner both for APP and TWR CWPs.
Status	<validated>
Rationale	HF design principles & design standards should be used to develop such requirements. This is a requirement validated in ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine earliest take-off clearance time taking into account any other separation Determine preceding aircraft earliest distance position taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3006
Title	Mixed mode
Requirement	If the OSD tool is to be applied in partially segregated/ mixed mode runway operations, the OSD tool (DDI-T) shall take into consideration the arrival flights and indicate to the controller when to line up a departure only when it is safe to do so.
Status	<validated>
Rationale	This could be done by integrating information on the arrivals such as from an arrival management tool into the OSD tool. When an arrival is imminent the OSD tool should indicate that no departures are allowed to be cleared for line-up. This is a requirement validated in ECTL RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine next aircraft to be given a line-up clearance Instruct aircraft to line-up

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3007
Title	Mixed mode II
Requirement	If the OSD tool is to be applied in partially segregated/ mixed mode runway operations, an additional HMI support shall be provided to visualise the planned arrivals and departures sequence on the runway in partially segregated / mixed mode.
Status	<validated>
Rationale	This could be done using electronic flight strips, or with an AMAN/DMAN or with a bespoke sequencing tool. This is a requirement validated in ECTL RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3008
Title	Separation Infringements
Requirement	In order to prevent any separation infringement, the OSD tool shall integrate the adequate buffers to accommodate for variability related to aircraft performance on the climb profiles.
Status	<validated>
Rationale	The size of the buffer should be based on the analysis of the aircraft performance data derived from operational data collected from the local airport where the OSD is to be implemented. This should be done as part of the local safety case conducted prior to implementation. This is a requirement validated in ECTL RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3009
Title	Required time elapsed
Requirement	The OSD tool should indicate to the controller that the required time has elapsed to enable a subsequent departure even though an arriving aircraft is imminent, and no departures are allowed on the runway until the arriving aircraft has landed and exited the runway.
Status	<validated>
Rationale	In order to increase efficiency and enhance situation awareness. This is a recommendation from ECTL RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine next aircraft to be given a line-up clearance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3010
Title	Taking into account the 1,000ft vertical separation
Requirement	If applicable, the DDI-T and DDI-D values for the MRS separation minima should take into account the 1000ft vertical separation as well as the 3NM lateral separation constraint between the departing aircraft under the condition that the separation is also achieved on hand-over to the next sector.
Status	<validated>
Rationale	To ensure an appropriate separation are maintained during the departure phase, lowering the potential of human error. This is validated in ECTL RTS4a and RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine preceding aircraft earliest distance position taking into account any other separation Determine earliest take-off clearance time taking into account any other separation Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3011
Title	Automatic detection of take-off
Requirement	In case the controller forgets to input the take-off instruction in the EFS system, the DDI-T and DDI-D should automatically detect the aircraft take-off based on the aircraft rolling speed. The DDI for the next aircraft should adapt accordingly to the actual take-off time.
Status	<validated>
Rationale	To ensure efficiency as well as to ensure appropriate separations are maintained during the departure phase, lowering the potential of human error. This is a recommendation validated in ECTL RTS4a and RTS4b.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor for aircraft becoming airborne and record Airborne Time Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3012
Title	Timestamping of instructions
Requirement	The OSD tool/ CWP HMI should timestamp the time of the instructions given/inputted by the controllers.
Status	<validated>
Rationale	In current operations, the TWR ATCO usually writes down time of instruction, or in case the electronic flight strips the time of the instruction is marked automatically on the strip. This is a recommendation validated in ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Instruct aircraft to line-up Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3013
Title	Alert of abnormal departure aircraft performance
Requirement	An alert of a departing aircraft performance that is outside its normal performance envelope should be provided to the controller to avoid the separation infringement due to the aircraft not conforming to the speed. One potential solution could be to display of a ruler indicating distance to the leader aircraft to make controllers aware of possible decrease of separation to the leader aircraft.
Status	<validated>
Rationale	To ensure speed conformance or timely correction if needed. This is a recommendation from ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3015
Title	Regular refresher training
Requirement	Regular refresher training should be conducted to ensure that the controllers maintain their skills with no controller support tool in case of OSD tool degradation.
Status	<validated>
Rationale	Potentially ATCOs should have the opportunity to work without the use of the OSD tool, to maintain their skills. This is a recommendation from ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Monitor for aircraft becoming airborne and record Airborne Time Issue take-off clearance and Monitor and Record Roll Time Determine Wake Separation Distance to preceding aircraft Determine the most restrictive Wake Separation or SID Separation Distance Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine earliest take-off clearance time

		taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3016
Title	Warning message for mixed mode
Requirement	For mixed mode operations, a warning message should be made available to show whether sequence changes are possible. (e.g. Highlighted in red in case the proposal is not accurate).
Status	<validated>
Rationale	To ensure the ATCO has an appropriate view with regard to both arrivals and departures, lowering the potential for human error. This is a recommendation from ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3017
Title	Distinguishing wake separations
Requirement	The HMI should allow the ATCOs to easily distinguish the wake separations.
Status	<validated>
Rationale	In order for them to quickly distinguish which separations are based on wake minima compared to separations based on MRS or SID constraints. This is a recommendation from ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3018
Title	Support for complex environments
Requirement	The OSD tool should be developed to ensure it can be used for aircraft departing from different runway entry points, and also developed to take into consideration any regulations related to the TMA exit point.
Status	<validated>
Rationale	To be applicable in complex environments. This is a recommendation from ECTL RTS4b, the different entry runway points feature has been validated.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3019
Title	AMAN/DMAN integration
Requirement	The integration the ORD and OSD (including the DDI-T, DDI-D and gap spacing management tool) should be merged with the AMAN / DMAN.
Status	<validated>
Rationale	To synchronize all data and ensure the ATCO does not have redundant information or different displays. This is a recommendation from ECTL RTS4a.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine preceding aircraft earliest distance position taking into account any other separation Determine earliest take-off clearance time taking into account any other separation Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3020
Title	OSD in mixed mode
Requirement	If used in mixed mode or partially segregated operations, the OSD tool shall not display the departure separation to be applied to the preceding departure aircraft when the immediately preceding aircraft in the sequence is an arrival aircraft, unless the Tower Runway Controller gives the departure aircraft a line-up clearance behind the arrival aircraft.
Status	<validated>
Rationale	Part II SAR SR#D55 in relation to the SO#D06: Ensure that the runway is free from obstruction before issuing a take-off clearance. If the OSD tool is not taking into account the arrivals in mixed mode, when the DDI-T starts counting down or if the DDI-D is shown, it might suggest to the controller that the follower a/c to use the runway could be a departure. This requirement could be achieved via a procedure, by not starting the countdown timer unless the next a/c has been given line-up clearance so separation will be displayed always for a departure pair, or via the system by making the OSD tool take into account the arrival sequence. The exact solution is to be determined at local level.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine next aircraft to be given a line-up clearance Line up and hold

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3021
Title	OSD tool buffers
Requirement	If the OSD tool takes into account aircraft performance, it shall integrate the adequate buffers to accommodate for aircraft performance variability on the runway and airborne.
Status	<validated>
Rationale	Part II SAR SR#D66 in relation to the SO#D08: Provide correct wake turbulence spacing delivery, from the moment the following aircraft rotates/begins its take-off roll as applicable, until it is transferred to the next sector. The size of the buffer should be based on the analysis of the aircraft performance data derived from operational data collected from the local airport where the OSD is to be implemented. This should be done as part of the local safety case conducted prior to implementation. Aircraft performance could be speed and climb profile per aircraft type or for example in the form of speed group additional spacing rules. This requirement has been validated in RTS4a and RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation and earliest Time to each preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Time satisfying

		Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3022
Title	A/C outside the climb envelope considered by the tool
Requirement	If the local airport departure route structure permits catch-up situations, prior to giving a take-off clearance, the TWR controller shall be warned when an a/c is outside the climb profile envelope used by the OSD tool such that the controller takes the appropriate action to manage the possible catch-up between that pair of a/c.
Status	<validated>
Rationale	Part II SAR SR#D66 in relation to the SO#D08: Provide correct wake turbulence spacing delivery, from the moment the following aircraft rotates/begins its take-off roll as applicable, until it is transferred to the next sector. This is in order to avoid catch-up situations between two consecutive departures. Note this information is only useful when the follower is not yet airborne. This is dependent on the local environment.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP0.3023
Title	Apply separation between multiple aircraft
Requirement	If the OSD tool calculates SID, MRS and Wake separations, it shall take into account the separation not only between the first pair of aircraft but also between the leader and other aircraft in the sequence (e.g. 1st and 3rd, etc.).
Status	<validated>
Rationale	Part II SAR SR#D66 in relation to the SO#D08: Provide correct wake turbulence spacing delivery, from the moment the following aircraft rotates/begins its take-off roll as applicable, until it is transferred to the next sector. This is to mitigate the case when there is still some separation/spacing to be applied between e.g. the first and the third departure, after the separation/spacing between the second the third departure has been achieved. I.e. if given take-off clearance, the third departure will be separated with the second departure but it will not be separated compared with the first departure (e.g. MRS constraint between 1st and 2nd a/c and between 2nd and 3rd aircraft but at the same time there is a SID constraint between the 1st and 3rd a/c). This requirement has been validated in RTS4a and RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine SID Separation and earliest Time to each preceding aircraft Determine the most restrictive Time satisfying

		Wake Separation or SID Separation Determine the most restrictive Wake Separation or SID Separation Distance Determine Wake Separation Time to preceding aircraft and associated Time Determine earliest take-off clearance time taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0001
Title	PWS-D wake separation minima
Requirement	The Tower Runway Controller shall be informed of the PWS-D wake separation minima to apply.
Status	<validated>
Rationale	The Tower Runway Controller shall be informed of the PWS-D wake separation minima to apply. NATS RTS5 validated the "airborne time" wake separation procedures. ECTL RTS4a validated the "start of take-off roll time" wake separation procedures. ECTL RTS4a validated the distance-based wake separation procedures.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine Wake Separation Time to preceding aircraft and associated Time Determine earliest take-off clearance time

		taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0002
Title	WTE risk for PWS minima
Requirement	For an aircraft type pair at RECAT-PWS minima on Initial Common Departure path, the pair-wise wake turbulence encounter severity shall not be higher than the severity of reference aircraft type pair (selected as acceptable baseline with proven extensive operations) at ICAO minima and in reasonable worst-case conditions.
Status	<deleted>
Rationale	There should be no increase in the risk of wake turbulence encounter severity on the Initial Common Departure path related to the correct application of the WT scheme under consideration compared to the severity of the reference aircraft type pairs that have been selected as the acceptable baseline with proven extensive operations employment. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0003
Title	PWS-D capacity requirements
Requirement	The application of PWS-D optimised wake separations shall increase runway throughput compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme.
Status	<deleted>
Rationale	The application of PWS-D optimised wake separations shall increase runway throughput compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 for the "airborne time" separation procedures when applying the draft 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a PWS-D capacity requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0004
Title	PWS-D predictability requirements
Requirement	The application of PWS-D optimised wake separations shall decrease departure ground delay compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme.
Status	<deleted>
Rationale	The application of PWS-D optimised wake separations shall decrease departure ground delay compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 for the "airborne time" separation procedures when applying the draft 96x96 aircraft type pairwise and 20-CAT wake category time-based wake separation rules. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a PWS-D predictability requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0005
Title	PWS-D wake separation rules
Requirement	PWS-D wake separation rules shall be provided to the Optimised Separation Delivery tool and shall be based on the pairwise aircraft type rules and the pairwise refined wake category rules.
Status	<deleted>
Rationale	PWS-D wake separation rules shall be provided to the Optimised Separation Delivery tool. These shall and based on the pairwise aircraft type rules and the pairwise refined wake category rules. For the distance-based wake separation rules these are the RECAT-EU-PWS distance-based 96x96 aircraft type pairwise wake separation rules and the distance-based 20-CAT wake separation rules. For the wake separation time rules, draft rules are defined in SPR-INTEROP/OSED derived from the distance-based rules. The full development of these rules has been deferred to SESAR 2020 Wave 2. Validated in NATS RTS5 for the wake separation time rules. Validated in ECTL RTS4a and RTS4b for both the wake separation time rules and the distance-based wake separation rules. This is a system requirement and so should also be in the TS/IRS. Deleted from the OSED as covered by REQ-02.01-SPRINTEROP-DEP1.0007 as an operational requirement.
Category	<Operational>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0006
Title	PWS-D fuel efficiency requirements
Requirement	The application of PWS-D optimised wake separations shall decrease ground departure fuel burn compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme.
Status	<deleted>
Rationale	The application of PWS-D optimised wake separations shall decrease ground departure fuel burn compared to the application of RECAT-EU wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 for the "airborne time" separation procedures when applying the draft 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a PWS-D fuel efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0007
Title	PWS-D concept
Requirement	The PWS-D concept shall apply wake turbulence separation rules defined between aircraft type pairs and defined between refined wake categories on the straight-out initial common departure path.
Status	<validated>
Rationale	The PWS-D optimised wake separation rules are to be applied over the straight-out initial common departure path to the position of the first SID turn. Soon after the first SID turn separation responsibility becomes the responsibility of the TMA Departure Controller and the follower departure aircraft either turns on to a wake independent path or the distance-based TMA wake separation rules apply and also a SID separation. Validated in NATS RTS5 for the "airborne time" separation procedures. ECTL RTS4a validated the "start of take-off roll time" wake separation procedures. ECTL RTS4a validated the distance-based wake separation procedures.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time

		Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0008
Title	PWS-D no negative impact on human performance
Requirement	PWS-D application shall not have negative impact on human performance.
Status	<deleted>
Rationale	PWS-D application shall not have negative impact on human performance. This is a performance requirement to facilitate traceability to the associated HP validation objectives. However this is an HP objective rather than a requirement, and there are several HP requirements to facilitate traceability to the HP validation objectives, so this requirement is deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time Determine Wake Separation Distance to preceding aircraft Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0009
Title	PWS-D cost efficiency requirement
Requirement	PWS-D application shall have a positive return on investments.
Status	<deleted>
Rationale	PWS-D application shall have a positive return on investments. To be validated in the CBA. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a PWS-D cost efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP1.0010
Title	PWS-D no negative impact on safety
Requirement	PWS-D application shall not have a negative impact on safety.
Status	<deleted>
Rationale	PWS-D application shall not have a negative impact on safety. This is a performance requirement to facilitate traceability to the associated safety validation objectives. However this is a safety objective rather than a requirement, and there are several safety requirements to facilitate traceability to the safety validation objectives, so this requirement is deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Monitor separation on initial departure path Monitor for aircraft becoming airborne and record Airborne Time Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0001
Title	WDS-D Xw concept traffic situation picture
Requirement	For the WDS-D Xw concept the Runway Controller shall be provided with the traffic situation picture covering the departure phase of aircraft and that includes the identification, position and optionally the horizontal and vertical speed for all departing flights during their initial climb phase.
Status	<validated>
Rationale	The runway controller requires the traffic situation picture to support the application and monitoring of the WDS-D Xw concept reduced wake separations; particularly for the application of distance-based separation. A traffic situation picture is already provided in current operations at Heathrow through the A-SMGCS display and the ATM display. It is not clear that there is a mandatory requirement for the traffic situation picture to include the horizontal and vertical speeds when applying "airborne time" procedures as these do not appear necessary for Heathrow. NATS RTS5 validated the "airborne time" wake separation procedures. The WDS-D concept was not validated with respect to distance-based procedures.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor for aircraft becoming airborne and record Airborne Time Monitor separation on initial departure path Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0002
Title	WDS-D Xw concept undetected error in wind forecast
Requirement	For the WDS-D Xw concept the probability of an undetected error in the wind forecast, leading to an erroneous Go/No-Go indication shall be no greater than 2×10-9 per take-off.
Status	<in progress>
Rationale	An undetected error can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-01. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0003
Title	WDS-D Xw concept capacity requirements
Requirement	The application of WDS-D Xw concept reduced wake separations shall increase runway throughput compared to the application of PWS-D wake separations or locally deployed static wake separation scheme.
Status	<deleted>
Rationale	The application of WDS-D Xw concept reduced wake separations shall increase runway throughput compared to the application of PWS-D wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 for the "airborne time" separation procedures when applying the draft WDS-D Xw concept reduced wake separations in the context of draft PWS-D 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a WDS-D Xw concept capacity requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding

		aircraft and associated Time Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0004
Title	WDS-D Xw concept wind information
Requirement	The Tower Runway Controller and the Tower Supervisor shall be provided with an adequate meteorological situation picture covering the area encompassing the initial climb phase of departing flights with respect to the direction of the runway intended for the application of WDS-D Xw concept reduced wake separations.
Status	<validated>
Rationale	Tower Controllers and Supervisors need a clear visual indicator of the wind conditions; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-D Xw concept reduced wake separations and secondly to help ensure overall compliance with the WDS-D Xw concept procedures. The WDS-D tool support requires the complete picture of the wind conditions (nowcast and forecast). It is not necessary for the complete picture of the wind conditions to be displayed to the Tower Runway Controller and Tower Supervisor. From the Heathrow User Groups and RTS5 the Tower Runway Controller feedback was that the runway surface crosswind speed, together with the implied Controller GO status is required to be displayed for employing the WDS-D reduced separation. This is on the basis that there is justifiable confidence in the surface wind speed and implied GO status displayed to the controllers. The complete wind aloft profile is taken into consideration in the WDS-D tool processing when determining the GO status. Only the latest measurements representing the nowcast provision have so far been considered. It is unclear whether there is a suitable forecast service. The Tower Supervisor requirements have still to be addressed taking into account the Supervisor workload and other task commitments with the recommendation that as much as possible should be automated. These requirements will need to be

	addressed in the local V4 maturity development and validation activities.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Inform operational actors that WDS-D is no longer to be applied Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0005
Title	WDS-D Xw concept undetected error in wind now-cast
Requirement	For the WDS-D Xw concept the probability of an undetected error in the wind now-cast, leading to an erroneous Go/No-Go indication shall be no greater than 2×10-9 per take-off.
Status	<in progress>
Rationale	An undetected error can result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-02. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0006
Title	WDS-D Xw concept predictability requirements
Requirement	The application of WDS-D Xw concept reduced wake separations shall decrease departure ground delay compared to the application of PWS-D wake separations or locally deployed static wake separation scheme.
Status	<deleted>
Rationale	The application of WDS-D Xw concept reduced wake separations shall decrease departure ground delay compared to the application of PWS-D wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 for "airborne time" separation procedures when applying the draft WDS-D Xw concept reduced wake separations in the context of draft PWS-D 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a WDS-D Xw concept predictability requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0007
Title	WDS-D Xw concept wake turbulence advisory
Requirement	The Runway Controller, Tower Supervisor and Ground Controller shall be provided with wake turbulence advisory information that relates to the applicability of WDS-D Xw concept reduced wake separations for a period of time (based on aircraft wake turbulence categories and pre-defined departure profiles).
Status	<deleted>
Rationale	To support notifying the flight crew of the application of WDS-D reduced wake separations. Obsolete as the CREDOS concept has now evolved to having Enhanced OSD tool support. This is now covered by new SESAR 2020 requirements and so the requirement has been deleted.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0008
Title	WDS-D Xw concept undetected error in departure planning
Requirement	For the WDS-D Xw concept the probability of an undetected error in the departure planning, leading to an erroneous Go/No-Go indication shall be no greater than 2×10-9 per take-off.
Status	<deleted>
Rationale	An undetected error can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-03. This requirement is deleted as the Go/No-Go indication is not applied directly to each departure pair as it was in CREDOS.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0009
Title	WDS-D Xw concept fuel efficiency requirements
Requirement	The application of WDS-D Xw concept reduced wake separations shall decrease ground departure fuel burn compared to the application of PWS-D wake separations or locally deployed static wake separation scheme.
Status	<deleted>
Rationale	The application of WDS-D Xw concept reduced wake separations shall decrease ground departure fuel burn compared to the application of PWS-D wake separations or locally deployed static wake separation scheme in order to support justifying investing in the operational improvement. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 for "airborne time" separation procedures when applying the draft WDS-D Xw concept reduced wake separations in the context of draft PWS-D 96x96 aircraft type pairwise and 20-CAT wake category wake separation time rules. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a WDS-D Xw concept fuel efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures

		Determine Wake Separation Distance to preceding aircraft Determine next aircraft to be given a line-up clearance Determine Wake Separation Time to preceding aircraft and associated Time Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0010
Title	WDS-D Xw concept departure planning
Requirement	The Runway Controller shall be provided with the departure flight information required to support the departure planning.
Status	<validated>
Rationale	To support the consistent application of WDS-D Xw concept reduced wake separations. This includes the aircraft type and wake turbulence category, the designated runway and SID and possibly the first cleared flight level of each departure aircraft. This is information that is already provided to the Tower Runway Controller in the local Heathrow environment. The first cleared flight level is not required in the local Heathrow environment. This was validated in NATS RTS5 for the "airborne time" separation procedures. This information is also already provided in the local Paris Charles de Gaulle and Vienna environments. The provision of this information may need to be supplemented in other local environments.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding

		aircraft and associated Time Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0011
Title	WDS-D Xw concept undetected failure of the WTA module
Requirement	The probability of an undetected failure of the Wake Turbulence Advisory (WTA) module, leading to an erroneous Go/No-Go indication shall be no greater than 2×10-9 per take-off.
Status	<deleted>
Rationale	An undetected error can result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-04. The SESAR 2020 WDS-D Xw concept does not have an explicit Go/No-Go indication for each departure pair so delete requirement.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0012
Title	WDS-D Xw concept Flight Crew notification
Requirement	Flight Crew shall be notified about the employment of WDS-D Xw concept reduced wake separations at an aerodrome.
Status	<validated>
Rationale	Part II SAR SR#D69 in relation to the SO#D10: Not to negatively affect the ability of Crew/Aircraft, to be able to follow ATC instructions. The Flight Crew are required to be informed of the application of the WDS-D Xw concept reduced wake separation at an aerodrome so that they are fully aware of the reduced separation so that they can consistently apply the associated procedures. It has been established through Airspace User and ATCO discussions that the Flight Crew should be prepared for the WDS-D Xw reduced separation to be applied at all times without the need for specific notification of when it is being applied. To support this the notification can be through the AIP and through the Flight Crew briefing material for the aerodrome. Specific notification of when the WDS-D Xw reduced wake separation is being applied is not seen as necessary and so is optional. In NATS RTS5 the NBAT was highlighted when a WDS-D Xw reduced wake separation was being applied. The runway surface crosswind speed was also provided on the ADIS display so as to support the Tower Runway Controller in providing the runway surface crosswind speed to the Flight Crew in the take-off clearance instruction.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0013
Title	WDS-D Xw concept advisory trigger line displayed wrongly
Requirement	For the WDS-D Xw concept the probability that the advisory trigger line is displayed wrongly on the radar display shall be no greater than 9×10-6 per take-off.
Status	<in progress>
Rationale	The advisory trigger line being displayed wrongly can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-05. This applies to the application of distance-based separation for departures where the advisory trigger line is the Dynamic Departure Indicator - Distance (DDI-D). The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.1013

Title	WDS-D Xw concept time separation displayed wrongly
Requirement	For the WDS-D Xw concept the probability that the advisory time separation is displayed wrongly shall be no greater than 9×10-6 per take-off.
Status	<in progress>
Rationale	The advisory time separation being displayed wrongly can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is the time separation equivalent to the CREDOS Safety Requirement SR-05 on the wrong display of the advisory trigger line for distance-based separation. This applies to the application of time separation for departures where the advisory time separation is the NBAT/NBTOT and the associated Countdown Timer. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0014
Title	WDS-D Xw concept no negative impact on human performance
Requirement	WDS-D Xw concept application shall not have a negative impact on human performance.
Status	<deleted>
Rationale	WDS-D Xw concept application shall not have a negative impact on human performance. This is a performance requirement to facilitate traceability to the associated HP validation objectives. However this is an HP objective rather than a requirement, and there are several HP requirements to facilitate traceability to the HP validation objectives, so this requirement is deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time taking into account any other separation Formulate optimised sequence order for departing aircraft Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Inform operational actors that WDS-D is no

		longer to be applied Monitor separation on initial departure path Apply WDS-D to Departures Monitor for aircraft becoming airborne and record Airborne Time Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0015
Title	WDS-D Xw concept runway controller misreading Go/No-Go indication
Requirement	For the WDS-D Xw concept the probability that that the runway controller misreads the Go/No-Go indication shall be no greater than 5×10-5 per take-off.
Status	<deleted>
Rationale	The runway controller misreading the Go/No-Go indication may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-06. The SESAR 2020 WDS-D Xw concept does not have an explicit Go/No-Go indication for each departure pair. There is now a Supervisor Go/No-Go indication about the suitability of the prevailing crosswind conditions over the straight-out initial common departure path and a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. This requirement is now out-of-date, so this requirement is deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Time to preceding aircraft and associated Time Determine Wake Separation Distance to preceding aircraft Stop Applying WDS-D to Departures Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0016
Title	WDS-D Xw concept cost efficiency requirement
Requirement	WDS-D Xw concept application shall have a positive return on investments.
Status	<deleted>
Rationale	WDS-D Xw concept application shall have a positive return on investments. To be validated in the CBA. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for a WDS-D Xw concept cost efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0017
Title	WDS-D Xw concept runway controller failure to check the actual wind
Requirement	For the WDS-D Xw concept the probability that the runway controller fails to check the actual wind shall be no greater than 1×10-2 per take-off.
Status	<deleted>
Rationale	The runway controller failure to check the actual wind may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-07. The basic HMI in CREDOS just had a Go/No-Go indication for each departure pair, no advisory trigger line or countdown timer. This was seen as an important engagement issue in this context with respect to reducing the potential for Controller error of wrongly suspending the application of the wake separation minimum between the departure pair. The SESAR 2020 WDS-D Xw concept now has an explicit Supervisor Go/No-Go indication of the suitability of the prevailing crosswind conditions together with a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. The Supervisor and Controller Go/No-Go indications are automatically switched to No-Go when the crosswind conditions are no longer suitable. The Enhanced OSD tool only applies the WDS-Xw reduced wake separation to eligible pairs when there is a Controller Go indication. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation. There is now no longer a need for the runway controller to check the actual wind before issuing the clearance to take-off, so this requirement is deleted.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0018
Title	WDS-D Xw concept wake separation minima
Requirement	The Tower Runway Controller shall be informed of the WDS-D Xw concept wake separation minima to apply.
Status	<validated>
Rationale	Currently controllers are responsible for judging which separation minima should be the primary determinant of the take-off time of the next succeeding aircraft. With the addition of PWS-D and the WDS-D Xw concept this task will need to be reallocated to a technical system component and controllers informed. When WDS-D Xw concept reduced separations are being applied in the context of PWS-D or local static wake separation rules the Tower Runway Controller will need to be informed of when the WDS-D Xw reduced separation can be applied between departure aircraft and the associated reduced wake separation that can be applied. The Enhanced OSD tool only applies the WDS-D Xw reduced wake separation to eligible pairs when there is a Controller Go indication. The eligibility of pairs includes ensuring the SID route of the follower departure aircraft is upwind of the SID route of the preceding departure aircraft after the first SID route turn for to avoid encountering the wake turbulence generated by the preceding departure aircraft. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the

	application of the reduced wake separation. For all other pairs the PWS-D wake separations or the locally deployed static wake separation scheme is applied. Validated in NATS RTS5 for WDS-D Xw reduced wake separations in the context of PWS-D wake separations for the "airborne time" procedures.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0019
Title	WDS-D Xw concept runway controller failure to see the advisory trigger line is not displayed
Requirement	For the WDS-D Xw concept the probability that the runway controller fails to see that the advisory trigger line is not displayed shall be no greater than 1×10-2 per take-off.
Status	<in progress>
Rationale	The runway controller failure to see that an advisory trigger line is not displayed may result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-08. This applies to the application of distance-based separation for departures where the trigger line is the Dynamic Departure Indicator - Distance (DDI-D). The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine SID Separation Distance to each relevant preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine the most restrictive Wake Separation or SID Separation Distance

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.1019
Title	WDS-D Xw concept runway controller failure to see the time separation is not displayed
Requirement	For the WDS-D Xw concept the probability that the runway controller fails to see that the advisory time separation is not displayed shall be no greater than 1×10-2 per take-off.
Status	<in progress>
Rationale	The runway controller failure to see that an advisory time separation is not displayed may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is the time-based equivalent to the CREDOS Safety Requirement SR-05 on the failure to see the advisory trigger line is not displayed for distance-based separation. This is failure to see that the NBAT/NBTOT is not displayed (i.e. nothing displayed in the NBAT/NBTOT field of the FDE), or failure to see that there is no displayed countdown time for the follower aircraft (no follower callsign and associated countdown in the Countdown timer). Error has to be mitigated, however HP cannot commit to the probability numbers given. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine SID Separation and earliest Time to each preceding aircraft Determine earliest take-off clearance time taking into account any other separation Determine the most restrictive Wake Separation or SID Separation Distance

		Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0020
Title	WDS-D Xw concept provision of crosswind information
Requirement	The Tower ATC Roles may be provided with the WDS-D Xw concept crosswind information to inform their situation awareness.
Status	<deleted>
Rationale	To safely and effectively apply the WDS-D Xw concept, there has to be adequately strong crosswinds for a suitable period of time. To minimise the risk that controllers incorrectly apply this reduction in separation time, it is important that they are given crosswind information. Provision of crosswind information is already addressed in REQ-02.01-SPRINTEROP-DEP2.0004. This is a duplicate requirement, so delete requirement.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0021
Title	WDS-D Xw concept runway controller failure to inspect the Go/No-Go indication

Requirement	For the WDS-D Xw concept the probability that that the runway controller fails to inspect the Go/No-Go indication shall be no greater than 1×10-9 per take-off.
Status	<deleted>
Rationale	The runway controller failure to inspect the Go/No-Go indication can result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. The basic HMI in CREDOS just had a Go/No-Go indication for each departure pair, no advisory trigger line or countdown timer. This was seen as an important engagement issue in this context with respect to reducing the potential for Controller error of wrongly suspending the application of the wake separation minimum between the departure pair. The SESAR 2020 WDS-D Xw concept now has an explicit Supervisor Go/No-Go indication of the suitability of the prevailing crosswind conditions together with a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. The Supervisor and Controller Go/No-Go indications are automatically switched to No-Go when the crosswind conditions are no longer suitable. The Enhanced OSD tool only applies the WDS-Xw reduced wake separation to eligible pairs when there is a Controller Go indication. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation. The SESAR 2020 WDS-D Xw concept does not have an explicit Go/No-Go indication for each departure pair. The requirement is out-of-date, so the requirement has been deleted.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied

		Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0022
Title	Informing controllers of WDS-D Xw concept reduced wake separation application
Requirement	The Tower Runway Controller shall be informed of when WDS-D Xw concept reduced wake separation is being applied.
Status	<validated>
Rationale	Part II SAR SR#D43 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met. Controllers need a clear visual indicator of when the WDS-D Xw concept reduced wake separation is being applied, first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the reduced wake separation and secondly to help ensure overall compliance with the associated procedures. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation. Validated in NATS RTS5 for the "airborne time" procedures.
Category	<Human Performance>, <Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0023
Title	Applying WDS-D Xw concept to an unsuitable aircraft pair
Requirement	For the WDS-D Xw concept the probability that the runway controller applies WDS-D Xw concept reduced wake separation to an unsuitable aircraft pair shall be no greater than 1×10-9 per take-off.
Status	<in progress>
Rationale	The runway controller application of the WDS-D Xw concept to an unsuitable aircraft pair, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation. Note that this is CREDOS Safety Requirement SR-10. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0024
Title	WDS-D Xw concept runway controller applying insufficient wake turbulence separation
Requirement	For the WDS-D Xw concept the probability that the runway controller applies insufficient wake turbulence separation shall be no greater than 1×10-9 per take-off.
Status	<deleted>
Rationale	The runway controller applying insufficient wake turbulence separation, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-11. This requirement applies to both the application of distance-based wake separations and wake separation times. For a HP perspective this is to be addressed through applying the User Centred Design (UCD) process and as such does not mitigate anything and so is just a form of argument. This is addressed through practical HMI or procedural requirements and so is not needed and so is deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no

		longer to be applied Monitor separation on initial departure path Issue take-off clearance and Monitor and Record Roll Time Monitor for aircraft becoming airborne and record Airborne Time Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0025
Title	Provision to controllers of the WDS-D Xw concept reduction factors
Requirement	The Tower Runway Controller shall be provided with the specific WDS-D Xw concept wake separation minima reduction factors such as the crosswind speed, each aircraft line-up position and each aircraft planned SID.
Status	<validated>
Rationale	Trust in a system can be facilitated if controllers are given the opportunity to check that the system is functioning as expected. To this end, a request to make available to controllers the specific details of the WDS-D Xw concept reduction factors such as the crosswind speed, each aircraft line-up position and each aircraft planned SID. The aircraft SID information that is already provided to the Tower Runway Controller in the local Heathrow environment. Each aircraft planned SID is already available on the FDEs. Each aircraft line-up entry taxiway is added on to the FDE. The runway surface wind speed and wind direction are displayed on the ADIS display. The runway surface crosswind speed was added when WDS-D Xw reduced wake separations were being applied. This was validated in NATS RTS5 for the "airborne time" separation procedures. The provision of this information may need to be supplemented in other local environments.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0026
Title	WDS-D Xw concept runway controller confusing a non-WDS-D runway with a WDS-D runway
Requirement	For the WDS-D Xw concept the probability that the runway controller confuses a non-WDS-D runway with a WDS-D runway shall be no greater than 1×10-9 per take-off.
Status	<deleted>
Rationale	The runway controller confusing a non-WDS-D runway with a WDS-D runway can result in the WDS-D X-Wind concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-12. This may be applicable in multiple runway environments where more than one runway is being used to support departure operations at the same time. This is not a runway mode being validated in SESAR 2020 Wave 1, and is not foreseen to be validated, so this requirement has been deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0027
Title	WDS-Xw concept wind forecast input
Requirement	The wind forecast provided to the users shall include standard meteorological information and WDS-D Xw concept specific information with respect to wind nowcast and forecast, wind speed, direction and trends, in particular the crosswind component with respect to each runway direction.
Status	<deleted>

Rationale	Controllers need a clear visual indicator of the wind conditions; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-D Xw concept reduced wake separations and secondly to help ensure overall compliance with the procedure. Provision of meteorological information is already addressed in REQ-02.01-SPRINTEROP-DEP2.0004. This is a duplicate requirement, so delete requirement.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine SID Separation Distance to each relevant preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine Wake Separation Distance to preceding aircraft Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0028
Title	Using WDS-D Xw concept differently than specified
Requirement	For the WDS-D Xw concept the probability that the runway controller uses WDS-D Xw concept differently than specified in the operational concept shall be no greater than 1×10-9 per take-off.
Status	<deleted>

Rationale	The runway controller using WDS-D Xw concept differently than specified can result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-13. It is considered that "differently than specified" is equivalent to ignoring the tool. Preventative mitigation is the training on the use of the advice from the tool. Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0029
Title	WDS-D Xw concept departure planning system support
Requirement	Departure planning system support shall be provided to the users to plan or execute WDS-D Xw concept operations.
Status	<validated>

Rationale	The system support is envisaged to include standard departure information and WDS-D Xw concept specific information: 1. The departing flights, their allocated runway, SIDs and first cleared flight level 2. The aircraft types and wake turbulence categories and changes to these categories depending on WDS-D Xw concept reduced wake separation application or suspension 3. The set of available SIDs and advise on their use for WDS-D Xw concept reduced wake separations (upwind, downwind). The level of support which is currently given would need to be enhanced in the new operating environment (i.e. the allocation of the task between human actors and technical systems would shift to placing the onus on the technical system). This should help to mitigate any risks associated with reduced or lost information processing capacity. In SESAR 2020 WDS-D Xw concept the departure planning system support includes the A-CDM/DMAN support to formulate and optimise a departure sequence order and departure rate for coordinating the TOBTs and TSATs and for managing the taxi-out flow of the departure aircraft to the runway holding points (see REQ-02.01-SPRINTEROP-DEP0.001). This system support may also be extended to formulating an optimised sequence plan for line-up and take-off, taking into account departure aircraft readiness constraints at the runway holding points (see REQ-02.01-SPRINTEROP-DEP0.002). In the local Heathrow environment the specific information on each departure flight is provided on the Flight Data Entry (FDE) of the EFPS. There are no dynamic changes to wake turbulence categories or need for advice on the available SIDs or on their use. This has been validated in NATS RTS5 for the "airborne time" separation procedures. The provision of this system support may need to be supplemented in other local environments. This is a system requirement and so there should be associated requirements in the TS/IRS.
Category	<Operational>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine next aircraft to be given a line-up clearance Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0030
Title	WDS-D Xw concept runway controller issuing distance-based take-off clearance early
Requirement	For the WDS-D Xw concept the probability that the runway controller issues a take-off clearance before the predecessor has crossed the advisory trigger line shall be no greater than 3×10-5 per take-off.
Status	<deleted>
Rationale	The runway controller issuing the take-off clearance early, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-14. This applies to the application of distance-based separation for departures where the advisory trigger line is the Dynamic Departure Indicator - Distance (DDI) in the SESAR 2020 OSD concept. Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft

		Determine preceding aircraft earliest distance position taking into account any other separation Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Wake Separation or SID Separation Distance Issue take-off clearance and Monitor and Record Roll Time Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.1030
Title	WDS-D Xw concept runway controller issuing time-based take-off clearance early
Requirement	For the WDS-D Xw concept the probability that the runway controller issues a take-off clearance too early with respect to the NBAT/NBTOT or displayed countdown time for the required wake separation shall be no greater than 3×10-5 per take-off.
Status	<deleted>
Rationale	The runway controller issuing the take-off clearance early, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-14 in the context of time separation procedures. Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0031
Title	WDS-Xw concept wake turbulence advisory system support
Requirement	Wake turbulence advisory system support shall be provided to the users to plan or execute WDS-D Xw concept operations. The system support shall include an indication of whether wind conditions allow the application of WDS-D Xw concept reduced wake separation or require its suspension.
Status	<validated>
Rationale	Controllers need a clear visual indicator of the WDS-D Xw concept Go/No Go status; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-D Xw concept reduced wake separations and secondly to help ensure overall compliance with the procedure. The SESAR 2020 WDS-D Xw concept has an explicit Supervisor Go/No-Go indication of the suitability of the prevailing crosswind conditions together with a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. The Supervisor and Controller Go/No-Go indications are automatically switched to No-Go when the crosswind conditions are no longer suitable. The Enhanced OSD tool only applies the WDS-Xw reduced wake separation to eligible pairs when there is a Controller Go indication. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation. The above was validated in NATS RTS5 for the "airborne time" separation procedures. This is a system requirement and so there should be associated requirements in the TS/IRS.
Category	<Operational>, <System>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0032
Title	WDS-D Xw concept Flight Crew misinterprets an instruction as a take-off clearance
Requirement	For the WDS-D Xw concept the probability that the Flight Crew misinterprets a communication as a take-off clearance for a WDS-D operation and subsequently starts the take-off roll shall be no greater than 1×10-8 per take-off.
Status	<deleted>
Rationale	The Flight Crew misinterpreting a communication as a take-off clearance for a WDS-D operation, is a case of the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-15. Flight Crew and Airline Operator representatives need to be consulted on this requirement. Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Issue take-off clearance and Monitor and Record Roll Time Commence take-off roll

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0033
Title	WDS-D Xw concept wake turbulence advisory system support
Requirement	Wake turbulence advisory system support shall be provided to the users to plan or execute WDS-D Xw concept operations. The system support shall include an indication of whether wind conditions allow the application of WDS-D Xw concept reduced wake separation or require its suspension.
Status	<deleted>
Rationale	Controllers need a clear visual indicator of the WDS-D Xw concept Go/No Go status; first to reduce the mental effort and human error risk associated with the controller making the decision about whether or not it is appropriate to apply the WDS-D Xw concept reduced wake separations and secondly to help ensure overall compliance with the procedure. The SESAR 2020 WDS-D Xw concept has an explicit Supervisor Go/No-Go indication of the suitability of the prevailing crosswind conditions together with a Controller Go/No-Go indication for when there is authorisation to apply the WDS-D Xw concept reduced wake separation to eligible departure pairs. The Supervisor and Controller Go/No-Go indications are automatically switched to No-Go when the crosswind conditions are no longer suitable. The Enhanced OSD tool only applies the WDS-Xw reduced wake separation to eligible pairs when there is a Controller Go indication. When the WDS-D Xw reduced wake separation is applied it is proposed that the displayed NBAT and Countdown Time is highlighted to inform/alert the Tower Runway Controller to the application of the reduced wake separation. Duplicate requirement with REQ-02.01-SPRINTEROP-DEP2.0031 so delete.
Category	<System>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0034
Title	WDS-D Xw concept Flight Crew selects wrong SID
Requirement	For the WDS-D Xw concept the probability that the flight crew selects the wrong SID shall be no greater than 3×10-5 per take-off.
Status	<deleted>
Rationale	The Flight crew selecting the wrong SID may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-16. Flight Crew and Airline Operator representatives need to be consulted on this requirement. Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0035
Title	WDS-D Xw concept system support users
Requirement	The users of the wind information, departure planning and wake turbulence advisory system support shall be the Tower Runway Controller, the Tower Supervisor, the Tower Clearance Delivery Manager and the Tower Ground Controller.
Status	<validated>
Rationale	The users of the system support for the WDS-D Xw concept are the Tower ATC Roles responsible for the application of the WDS-D Xw concept reduced wake separations. The wind information system support is used by the Tower Supervisor and the Tower Runway Controller (see REQ-02.01-SPRINTEROP-DEP2.0004). The departure planning system support for pushback and taxi-out is used by the Tower Clearance Delivery Manager and the Tower Ground Movement Controllers (see REQ-02.01-SPRINTEROP-DEP0.0001). The departure planning system support for line-up and take-off is used by the Tower Runway Controller (see REQ-02.01-SPRINTEROP-DEP0.0002). The wake turbulence advisory system support is used by the Tower Supervisor and Tower Runway Controller (see REQ-02.01-SPRINTEROP-DEP2.0031). Validated in NATS RTS5 for the "airborne time" separation procedures.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine preceding aircraft earliest distance position taking into account any other separation Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time taking into account any other separation Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0036
Title	WDS-D Xw concept Flight Crew deviating from SID due to engine failure
Requirement	For the WDS-D Xw concept the probability of the crew deviating from the SID due to engine failure shall be no greater than 1×10-6 per take-off.
Status	<deleted>
Rationale	The flight crew deviating from the SID due to engine failure may result in an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-17. There is a need to clarify this requirement as the Flight Crew will not necessarily have control over the deviation from the SID when there is an engine failure. Flight Crew and Airline Operator representatives need to be consulted on this requirement. Relevant requirements have been generated in the SAF & HP workshop and added to the Part II SAR, so this requirement is deleted.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0037
Title	Authorisation of the application of WDS-D Xw concept reduced separations
Requirement	The responsibility to authorise the application of WDS-D Xw concept reduced wake separations for a significant period of time or on a case by case basis shall be clearly defined as part of Tower ATC operational procedures.
Status	<in progress>
Rationale	Part II SAR SR#D44 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met. There is a need for clearly defined Tower ATC Roles who are responsible for authorising the application of the WDS-D Xw concept reduced wake separations. The approval process is subject to local considerations. As a result of NATS RTS5 it is suggested that for Heathrow the authorisation process is based on pre-authorisation by the Tower Supervisor, who takes all operational factors into consideration, and then supported automatically on a departure pair case by case basis with respect to the sufficiency of the crosswind conditions when the follower aircraft is given clearance to line-up. The Tower Supervisor requirements have still to be addressed taking into account the Supervisor workload and other task commitments with the recommendation that as much as possible should be automated. This is to be further investigated in the local V4 maturity development and validation activities.
Category	<Safety>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied

		Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0038
Title	WDS-D Xw concept Flight Crew deviating from SID in nominal operations
Requirement	For the WDS-D Xw concept the probability of the crew deviating from the SID to avoid clouds (Cb), other traffic, or expected wake turbulence shall be no greater than 4×10-6 per take-off.
Status	<in progress>
Rationale	The flight crew deviating from the SID may result in an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-18. Questions have been raised about the scenario examples for deviating from the SID and whether these constitute nominal operations. Weather avoidance conditions constitutes non-nominal operations and it would be expected that the employment of the WDS-D Xw concept reduced separations would be suspended. Similarly deviating from the SID due to conflict scenarios with other traffic is a non-nominal scenario and deviating from the SID due to expected wake turbulence encounter is a non-nominal scenario. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0039
Title	Responsibility for applying the WDS-D Xw concept reduced separations
Requirement	The Tower Runway Controller shall be responsible for applying the WDS-D Xw concept reduced wake separation to any applicable departure aircraft pair.
Status	<validated>
Rationale	The Tower Runway Controller is responsible for applying the WDS-D Xw concept reduced wake separations to any applicable departure aircraft pair as advised by the wake turbulence advisory system support of the Enhanced OSD tool. Validated in NATS RTS5 for the "airborne time" separation procedures.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no

		longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0040
Title	WDS-D Xw concept unjust Go/No-Go indication
Requirement	For the WDS-D Xw concept the probability of an unjust Go/No-Go indication due to an unreliable wind forecast shall be no greater than 2×10-9 per take-off.
Status	<deleted>
Rationale	An unjust Go indication may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-19. The basic HMI in CREDOS just had a Go/No-Go indication for each departure pair, no advisory trigger line or countdown timer. In CREDOS an unjust Go indication could result in wrongly suspending the application of the standard wake separation minimum between the departure pair. In the SESAR 2020 WDS-D Xw concept the equivalent is an unjust reduced separation being reflected in the NBAT/NBTOT and/or countdown time for the take-off clearance when applying a time separation or being reflected in the Dynamic Departure Indicator - Distance (DDI-D) when applying a distance-based separation. This requirement is deleted as it is not relevant to the SESAR 2020 WDS-D Xw concept.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0041
Title	WDS-D Xw concept monitoring of reduced separation for distance-based separation
Requirement	When a WDS-D Xw concept reduced wake separation is applied, the Runway Controller shall monitor the aircraft during the initial climb phase.
Status	<validated>
Rationale	Part II SAR SR#D52 in relation to the SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path. The Tower Runway Controller is responsible for ensuring the continued correct application of a WDS-D Xw concept reduced wake separation when applying distance-based separation. This is so as to ensure that the WDS-D Xw concept reduced wake separation remains applicable, based on the information provided by the wind information and wake turbulence advisory system support. This is also to ensure the effective application of WDS-D Xw concept reduced wake separation through verifying departing aircraft progress, through the provision of a traffic situation picture. When the follower aircraft is not yet airborne, if the first SID turn takes place fairly quickly after take-off the ATCO may be able to stop the follower aircraft on the ground when the lead aircraft is monitored as turning the wrong way. When the follower aircraft is rolling and cannot be stopped from becoming airborne, or is airborne, the opportunity for intervention action is reduced to an extent that all the controller may be able to do is issue a cautionary wake advisory.
Category	<Human Performance>, <Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0042
Title	WDS-D Xw concept aircraft catches up due to speed differences
Requirement	For the WDS-D Xw concept the probability that an aircraft catches up on its predecessor due to speed differences shall be no greater than 3×10-5 per take-off.
Status	<in progress>
Rationale	A follower aircraft catching up to the preceding aircraft due to speed differences, when WDS-D Xw concept reduced wake separation is being applied, may result in insufficient time for the wake vortices to be transported out of the path of the follower aircraft, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-20. This requirement is not relevant to the application of time separation for departures where departure pairs applying a wake separation diverge onto wake independent SIDs after the first SID turn when the straight-out initial common departure paths are short with limited opportunity for time separation catch-up before the first SID turn. This requirement possibly applies when the straight-out initial common departure paths are sufficiently long for there to be significant opportunity for time separation catch-up before the first SID turn for departure pairs that diverge onto wake independent SIDs after the first SID turn. This requirement possibly applies when the leader and follower are employing the same SID or employing wake dependent SID paths after the first SID turn. There is a need to consider whether there are any cases where the wake separation is larger than the SID separation when the leader and follower are employing the same SID or are employing non wake independent SID paths after the first SID turn, and where the follower aircraft type has a significantly faster airspeed profile

	than the lead aircraft type. Normally the follower aircraft types of wake pairs employ a similar or slower airspeed profile compared to the larger leader aircraft types. This requirement is also relevant to the application of distance-based separation for departures. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0043
Title	WDS-D Xw concept notification to Flight Crews
Requirement	The Flight Crew shall be notified of the application of WDS-D Xw concept reduced wake separations: 1. In terms of operational rules and procedures (through the Aeronautical Information Publication) 2. During tactical phase, when WDS-D Xw concept reduced wake separation is applied or likely to be applied during the day of operation (maybe part of the local air traffic information service such as ATIS) 3. When their own flight is subject to reduced wake separation from the preceding departure and when reduced wake separation is suspended, in a timely manner
Status	<deleted>
Rationale	The Flight Crew are required to be informed of the application of the WDS-D Xw reduced wake separations so that they are fully aware of the reduced wake separations so that they can consistently apply the associated procedures. It has been established through Airspace User and ATCO

	discussions that the Flight Crew should be prepared for the WDS-D Xw reduced separation to be applied at all times without the need for specific notification of when it is being applied. To support this the notification can be through the AIP and through the Flight Crew briefing material for the aerodrome. Specific notification of when the WDS-D Xw reduced wake separation is being applied is not seen as necessary and so is optional. In NATS RTS5 the NBAT was highlighted when a WDS-D Xw reduced wake separation was being applied. The runway surface crosswind speed was also provided on the ATIS display so as to support the Tower Runway Controller in providing the runway surface crosswind speed to the Flight Crew in the take-off clearance instruction. This is already covered by REQ-02.01-SPRINTEROP-DEP2.0012 so delete requirement.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0044
Title	WDS-D Xw concept aircraft deviates laterally on SID
Requirement	For the WDS-D Xw concept the probability that the aircraft deviates laterally outside the boundaries of the Wake Turbulence Separations Suspension Airspace Volume (WTSSAV) shall be no greater than 1×10-6 per take-off.
Status	<in progress>
Rationale	The preceding or the follower aircraft deviating laterally on the straight-out initial SID, beyond the normally contained lateral navigation performance, may result in insufficient time for the wake vortices to be transported out of the path of the follower

	aircraft, causing an unacceptable increase in the probability of a severe wake turbulence encounter with the WDS-D Xw concept. Note that this is CREDOS Safety Requirement SR-21. In SESAR 2020 we have not retained the concept of a WTSSAV as the WDS-D Xw concept reduced wake separations is only proposed to be applied to departure pairs applying wake independent SIDs after the first SID turn where the follower SID is upwind of the lead SID. It should be noted that CREDOS was also proposing to apply the WDS-D Xw concept reduced separations to departure pairs employing the same SID provided the standard radar wake separation is achieved before the follower aircraft exits the WTSSAV. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0045
Title	WDS-D Xw concept delegation of responsibility
Requirement	The Runway Controller shall have a delegated responsibility for issuing radar vectoring instructions to aircraft subject to WDS-D Xw concept reduced wake separation up to the agreed flight level for the handover to the TMA Departure Controller.
Status	<validated>
Rationale	Part II SAR SR#D53 in relation to the SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common

	departure path. The Tower Runway Controller is responsible for applying the WDS-D Xw concept reduced wake separations. When the follower aircraft is not yet airborne, if the first SID turn takes place fairly quickly after take-off the ATCO may be able to stop the follower aircraft on the ground when the lead aircraft is monitored as turning the wrong way. When the follower aircraft rolling and cannot be stopped from becoming airborne or is airborne the opportunity for intervention action is reduced to an extent that all the controller may be able to do is issue a cautionary wake advisory. This will be dependent on local factors such as the extent of the straight-out initial common departure path, when the follower aircraft will attain a stable flight profile such that the Flight Crew are able to respond to intervention action, and when separation responsibility is transferred to the TMA Departure Controller.
Category	<Operational>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Determine Wake Separation Time to preceding aircraft and associated Time Determine Wake Separation Distance to preceding aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0046
Title	WDS-D Xw concept aircraft employs different SID to WDS-D planning
Requirement	For the WDS-D Xw concept the probability that the SID used by an aircraft is not the SID used in WDS-D planning shall be no greater than 4×10-6 per take-off.
Status	<in progress>

Rationale	The preceding or the follower aircraft employing a different SID than WDS-D may result in the WDS-D Xw concept reduced wake separation being wrongly applied, causing an unacceptable increase in the probability of a severe wake turbulence encounter. Note that this is CREDOS Safety Requirement SR-22. The Part II SAR has recommended that the requirements realised as a result of the work carried out in CREDOS are further investigated in the local V4 maturity development and validation activities.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0047
Title	WDS-D Xw concept Tower to TMA coordination
Requirement	When the application of WDS-D Xw concept reduced wake separations are likely to have an impact on the work of the TMA Departure Controller, the Tower Supervisor or Tower Runway Controller shall coordinate with the TMA Departure Controller prior to employing the WDS-D Xw concept reduced wake separations.
Status	<validated>
Rationale	There is a need to ensure the TMA Departure Controller is aware of and able to support the WDS-D Xw concept reduced wake separations. Validated in NATS RTS5 where the TMA Departure Controller indicated that there was no need for any coordination for the "airborne time" separation procedures.

Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0048
Title	WDS-D Xw concept deviation alert
Requirement	The Tower Runway Controller shall be alerted, through audio and / or visual signal, when an aircraft deviates from its planned SID trajectory when applying a WDS-D Xw concept reduced wake separation.
Status	<validated>
Rationale	Part II SAR SR#D54 in relation to the SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path. The Controller should need to know when an aircraft is deviating from the planned SID, for any reason, since when applying the WDS-D Xw concept reduced wake separation the conditions to ensure the crosswind transport of the wake vortices out of the path of the follower may no longer be guaranteed and as a consequence this could lead to a risk of a wake encounter with significantly stronger wake vortices compared with standard separation (RECAT-EU or RECAT-EU-PWS) in reasonable worst case conditions. In the Heathrow local case where the first SID turn is less than 1.5NM from the end of the runway the Tower Runway Controller have indicated that there is no opportunity for any intervention action and so question the necessity of a deviation alert. This is a local issue to be investigated in the local V4 maturity development and validation activities.

Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0049
Title	WDS-D Xw concept wind forecast
Requirement	The users shall be provided with the wind forecast in order to plan or execute the departure operations.
Status	<deleted>
Rationale	To allow the Controller to have the needed information to execute the departure plan with or without WT separation. The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0050
Title	WDS-D Xw concept activation HMI
Requirement	The Tower Supervisor shall be able to activate and monitor the application of the WDS-D Xw concept reduced wake separation procedure through the HMI.
Status	<deleted>
Rationale	Tower Supervisor shall have on the HMI the possibility to activate the application of the WDS-D Xw concept reduced wake separations. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Stop Applying WDS-D to Departures Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0051
Title	WDS-D Xw concept meteorological information
Requirement	Standard meteorological information and specific information with respect to wind nowcast and forecast, wind speed and direction shall be provided to support the WDS-D Xw concept.

Status	<deleted>
Rationale	To allow Tower ATC to have all information to take the decision about WT separation reduction (w.r.t WDS-D Xw concept). Additional information (crosswind component at the runway surface at the rotation positions) is required beyond that currently provided. The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0052
Title	WDS-D Xw concept de-activation HMI
Requirement	The Tower Supervisor shall be able to de-activate the application of the WDS-D Xw concept reduced wake separation procedure through the HMI.
Status	<deleted>
Rationale	Tower Supervisor shall have on the HMI the possibility to de-activate the application of the WDS-D Xw concept reduced wake separations. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0053
Title	WDS-D Xw concept wind condition changes notification
Requirement	The Tower Runway Controller shall be notified when the WDS-D Xw concept wind conditions changes.
Status	<deleted>
Rationale	The Controller shall be aware of wind conditions changes, because this could imply that WDS Xw concept applicability conditions are met/not met. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0054
Title	WDS-D Xw concept wind conditions suitability indication
Requirement	An indication shall be provided to Tower ATC of whether the wind conditions allow the application of WDS-D Xw concept wake separation reduction.
Status	<deleted>
Rationale	To allow Tower ATC to be sure of when the WDS-D Xw concept wake separation reduction can be applied. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0055
Title	WDS-D Xw concept status monitoring

Requirement	The Tower Runway Controller shall be able to check the WDS-D Xw concept activation status.
Status	<deleted>
Rationale	The Controller needs to have a clear indication of whether WDS-D Xw concept wake separation reduction is active or not. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0056
Title	WDS-D Xw concept wind forecast for runway
Requirement	Tower ATC shall be provided with current and forecast wind speed and direction for each runway when applying the WDS-D Xw concept.
Status	<deleted>
Rationale	To allow Tower ATC to be able to determine whether the WDS-D Xw concept reduced wake separation can be applied to each of the runways supporting departure operations. From the NATS controller workshop discussions the feedback has been that the wind profile provided to the Tower Runway Controller should be just the current runway surface crosswind speed and only when the WDS-D Xw concept reduced wake separation is authorised to be applied. This was validated in NATS RTS5. The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0057
Title	WDS-D Xw concept authorisation notification to controller
Requirement	The Tower Runway Controller should be notified when WDS Xw concept wake separation reduction is authorised to be applied.
Status	<deleted>
Rationale	The Controller should have a clear indication of whether the WDS-D Xw concept wake separation reduction is authorised to be applied or not. As a result of the Heathrow RTS5 it is proposed that it should optional as whether the Tower Runway Controller is proactively notified of when the WDS-D Xw concept status changes from No-Go to Go or from Go to No-Go. As a result this is changed to "should" rather than "shall". The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0058
Title	WDS-D Xw concept wind on different altitudes
Requirement	Tower ATC shall be provided with the current and forecast wind speed and direction on different altitudes encompassing the initial climb phase on the straight-out initial common departure path when applying the WDS-D Xw concept.
Status	<deleted>
Rationale	To allow Tower ATC and the associated Enhanced OSD tool support to be able to determine whether the WDS-D Xw concept reduced wake separation can be authorised to be applied. From the NATS controller workshop discussions the feedback has been that the wind profile provided to the Tower Runway Controller should be just the current runway surface crosswind speed and only when the WDS-D Xw concept reduced wake separation is authorised to be applied. This was validated in NATS RTS5. The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0059
Title	WDS-D Xw concept de-activation notification to Controller
Requirement	The Tower Runway Controller may need to be notified of when the WDS-D Xw concept application of reduced wake separations is de-activated.
Status	<deleted>
Rationale	The Controller may need to have a clear notification of when the WDS-D Xw concept application of wake separation reduction has been de-activated. As a result of the Heathrow RTS5 it is proposed that it should be optional as to whether the Tower Runway Controller is notified of when the WDS-D Xw concept status changes from No-Go to Go or from Go to No-Go. As a result this is changed to "may" rather than "shall". The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.1059
Title	WDS-D Xw concept reduced separation notification to Controller
Requirement	The Tower Runway Controller shall be notified when a WDS-D Xw concept reduced wake separation is being applied to a departure pair.
Status	<deleted>
Rationale	The Tower Runway Controller needs to be informed when a WDS-D Xw reduced wake separation is being applied to a departure pair. As a result of the Heathrow RTS5 It is proposed that the Tower Runway Controller is informed of when a WDS-D Xw concept reduced wake separation is being applied through highlighting the NBAT and also possibly highlighting the countdown time. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Inform operational actors that WDS-D is to be applied or changed Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0060
Title	WDS-D Xw concept controller situation awareness
Requirement	The Controller situation awareness shall not be reduced when the WDS-D Xw concept reduced wake separation is applied.
Status	<deleted>
Rationale	The WDS-D Xw concept operation shall improve and/or not change the Controller situation awareness. This is an HP argument statement against which evidence needs to be provided, rather than a requirement. Deleted as a requirement.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path Monitor for aircraft becoming airborne and record Airborne Time Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0061
Title	WDS-D Xw concept activation notification to the Flight Crew
Requirement	The Flight Crew shall be notified when the WDS-D Xw concept is activated.
Status	<deleted>
Rationale	The Flight Crew needs to be informed when the WDS-D Xw concept reduced wake separation may be applied. From the feedback from the Heathrow Tower Controllers involved in the preparation and execution of the RTS5 validation exercise and from feedback from the Airspace User representatives at the RTS5 visitor day there is no requirement for notification from the Tower ATC to the Flight Crew. There is just a need for the Flight Crew to be aware that the WDS-D Xw reduced wake separation may be applied through the AIP and the Flight Crew briefing material for the Aerodrome. This is already covered by REQ-02.01-SPRINTEROP-DEP2.0012 so deleted requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.1061
Title	WDS-D Xw concept briefing of the Flight Crew
Requirement	The Flight Crew shall be made aware of the potential application of the WDS-D Xw concept reduced separation at an aerodrome through the Flight Crew briefing material and the AIP for the aerodrome.
Status	<deleted>
Rationale	The Flight Crew shall be informed of when the WDS-D Xw concept reduced wake separations may be applied at an aerodrome. From the feedback from the Heathrow Tower Controllers involved in the preparation and execution of the RTS5 validation exercise and from feedback from the Airspace User representatives at the RTS5 visitor day there is no requirement for notification from the Tower ATC to the Flight Crew. There is just a need for the Flight Crew to be aware that the WDS-D Xw reduced wake separation may be applied through the AIP and the Flight Crew briefing material for the Aerodrome. This is already covered by REQ-02.01-SPRINTEROP-DEP2.0012 so deleted requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0062
Title	WDS-D Xw concept controller workload
Requirement	The workload changes caused by the WDS-D Xw concept operation shall not negatively impact Controllers' performances.
Status	<deleted>
Rationale	The WDS-D Xw concept operation shall improve and/or not change the Controller performance. This is an HP argument statement against which evidence needs to be provided, rather than a requirement. Deleted as a requirement.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Monitor separation on initial departure path Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0063
Title	WDS-D Xw concept de-activation notification to the Flight Crew
Requirement	The Flight Crew shall be notified when the WDS-D Xw concept application of the wake separation reduction is de-activated.
Status	<deleted>
Rationale	The Flight Crew has to be informed by Tower ATC when the WDS-D Xw concept application of the wake separation reduction is de-activated. From the feedback from the Heathrow Tower Controllers involved in the preparation and execution of the RTS5 validation exercise and from feedback from the Airspace User representatives at the RTS5 visitor day there is no requirement for notification from the Tower ATC to the Flight Crew. There is just a need for the Flight Crew to be aware that the WDS-D Xw reduced wake separation may be applied through the AIP and the Flight Crew briefing material for the Aerodrome. This is already covered by REQ-02.01-SPRINTEROP-DEP2.0012 so deleted this requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is no longer to be applied

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0064
Title	WDS-D Xw concept tower runway controller monitoring
Requirement	The Tower Runway Controller shall be able to monitor the lead aircraft speed and receive alerting messages in case of deviation of the lead aircraft from the anticipated initial climb airspeed profile.
Status	<deleted>
Rationale	To give the Controller awareness of any deviation of the lead aircraft airspeed profile when applying the distance-based WDS-D Xw concept. More generally this also applies to the distance-based separation deliver for standard wake separation rules such as ICAO, RECAT-EU and RECAT-EU-PWS. Controller feedback in the ECTL validation exercises indicated that from their perspective this requirement is not feasible. As a result this requirement is deleted.
Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0065
Title	WDS-D Tw concept applicability
Requirement	The Tower Runway Controller shall have the possibility to apply WDS-D Tw concept wake separation reductions only if the total wind (wind speed no matter the direction) at the aerodrome runway surface is equal or greater than a defined wind speed threshold.
Status	<deleted>
Rationale	The Controller shall be presented with the possibility to apply WDS-D Tw concept wake separation reductions only when wind speed conditions are met. No work has been conducted in PJ02-01 to develop the WDS-Tw concept and to validate this requirement. As a consequence this requirement is deleted.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0066
Title	WDS-D Xw concept wake separation reduction application
Requirement	The Tower Runway Controller shall be advised when to apply the WDS-D Xw concept reduced wake separation.
Status	<deleted>
Rationale	To give the Controller awareness of when to apply the WDS-D Xw reduced wake separation. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Delete this requirement.

Category	<Operational>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0067
Title	WDS-D Xw concept wind threshold
Requirement	The WDS-D Xw concept wind threshold shall be based on locally considering specificities of local traffic aircraft performance in the local weather conditions over the local straight-out common initial departure paths.
Status	<validated>

Rationale	Part II SAR SR#D45 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met and SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path. The wind threshold for the WDS-D Xw concept needs to be based on consideration of the local traffic aircraft performance in the local weather conditions over the local straight-out initial common departure paths. Local variation on the extent of the straight-out common initial departure paths and the aircraft performance over the straight-out initial departure paths will be dependent on local procedures and the variations in the stability of the crosswind conditions due to the local influences on the wind conditions. This is a local V4 maturity development and validation activity.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Apply WDS-D to Departures Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0068
Title	WDS-D Xw concept runway controller responsibilities
Requirement	The Tower Runway Controller shall be able to: - confirm the WT separation suspension remains applicable between the departure aircraft - ensure the effective application of the WDS-D Xw concept reduced wake separation - verify the departing aircraft sequence
Status	<deleted>

Rationale	To enable consistent and accurate delivery and monitoring of the WDS-D Xw concept reduced wake separation. For the SESAR 2020 WDS-D Xw concept there is no longer a need to confirm the separation suspension remains applicable as this is automatically managed by the WDS-D tool support. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. The effective application of the WDS-D Xw concept reduced separation is achieved though the consistent use of the NBAT and Countdown Timer for the "airborne time" separation procedures. This is already addressed by the associated safety requirements. The assurance of the integrity of the departure sequence order provided to the Enhanced OSD tool is addressed by requirement REQ-02.01-SPRINTEROP-DEP3.0008. This requirement is covered by other requirements so deleted this requirement.
Category	<Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0069
Title	WDS-D Xw concept application of standard separation
Requirement	The Tower Runway Controller shall apply standard separation when WDS-D Xw concept wind conditions criteria are not satisfied.
Status	<deleted>
Rationale	When the wind conditions do not satisfy the WDS-D Xw concept wind conditions criteria threshold standard separation has to be applied. Standard separation is anticipated to be RECAT-EU-PWS but may be RECAT-EU or ICAO if RECAT-EU-PWS has not yet been deployed. This requirement is already covered or implied by REQ-02.01-SPRINTEROP-DEP2.0018, so deleted this requirement.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Apply WDS-D to Departures Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied Determine whether and how the application of WDS-D is to be changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0070
Title	WDS-D Xw concept to standard separation transition

Requirement	The Tower Runway Controller shall have the possibility to invoke the transition from applying WDS-D Xw concept wake separation reductions to applying standard wake separations.
Status	<validated>
Rationale	Part II SAR SR#D46 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met. There are situations where the Tower Runway Controller may need to invoke the switch from applying WDS-D Xw concept wake separation reductions to applying standard wake separations, for example in periods of weather avoidance or intruder traffic which impact on the straight-out initial common departure path. In such situations the Tower Runway Controller requires the possibility to invoke the transition to applying standard wake separations either in coordination with the Tower Supervisor or directly without coordination depending on local procedures. It is not envisaged that the Tower Runway Controller requires the possibility to independently invoke the transition from applying standard wake separations to applying WDS-D Xw concept wake separation reductions without coordination with the Tower Supervisor.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0071
Title	WDS-D Xw concept system interface

Requirement	The users of the WDS-D system shall access it through a human-machine interface integrated into their working environment. The interface will be developed on purpose for WDS-D or will result from an upgrade of the current interfaces. The WDS-D system interface shall display information about: 1. Wind forecast 2. Applicability of WDS-D Xw concept reduced wake separation 3. Departure planning These items will be displayed together or separately.
Status	<deleted>
Rationale	To satisfy the associated operational requirements and user requirements. From NATS RTS5 it appears that the Tower Runway Controller requires the display of the runway surface crosswind speed with the implied Controller Go authorisation status when the WDS-D Xw reduced wake separations have been authorised to be employed. It is a local issue to determine the responsibilities for the Controller Go/No-Go status authorisation of the employment of the WDS-D Xw reduced separations and the associated system support with respect to the displaying of the current and possibly forecast crosswind conditions and the associated Supervisor Go/No-Go status of whether the wind conditions are suitable. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<System>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0072
Title	WDS-D Xw concept wind forecast
Requirement	The WDS-D system shall display the following information: 1. Current and forecast wind speed and direction 2. Current and forecast crosswind conditions for each runway direction 3. At different positions and altitudes encompassing the initial climb phase area
Status	<deleted>
Rationale	To satisfy the associated operational requirements and user requirements. It is a local issue to establish the current and forecast wind conditions display requirements. The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement.
Category	<Operational>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0073
Title	WTE risk for WDS-D Tw concept minima
Requirement	The probability per departure of wake turbulence encounter of a given severity for a given traffic pair spaced at WDS Total wind minima on Initial Common Departure path or any applicable total wind conditions shall not increase compared to the same traffic pair spaced at reference minima in reasonable worst case conditions.

Status	<deleted>
Rationale	There should be no increase in the risk of wake turbulence encounter on the Initial Common Departure path related to the correct application of the WT scheme under consideration. This is a SAC and so is to be deleted and replaced by the associated safety requirements. Note that the WDS-D Tw concept has not been developed and validated in PJ02-01 so delete this requirement.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0074
Title	WDS-D Xw concept wake turbulence advisory
Requirement	The WDS-D system shall indicate for each runway direction whether wind conditions allow the application of WDS-D Xw concept reduced wake separations, in the form of a Go/No-Go information, taking into account standard aircraft wake turbulence categories and pre-defined departure profiles.

Status	<deleted>
Rationale	To satisfy the associated operational requirements and user requirements. It is a local issue to establish the Supervisor Go/No-Go status and Controller Go/No-Go status display requirements. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<System>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Inform operational actors that WDS-D is to be applied or changed Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0075
Title	WTE risk for WDS-D Xw concept minima
Requirement	The probability per departure of wake turbulence encounter of a given severity for a given traffic pair spaced at a WDS-D Xw reduced wake separation on the straight-out initial common departure path for any applicable cross wind conditions shall not increase compared to the same traffic pair spaced at reference minima in reasonable worst case conditions.

Status	<deleted>
Rationale	There should be no increase in the risk of wake turbulence encounter on the Initial Common Departure path related to the correct application of the WT scheme under consideration. This is a SAC and so is to be deleted and replaced by the associated safety requirements.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time Monitor for aircraft becoming airborne and record Airborne Time Monitor separation on initial departure path Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Stop Applying WDS-D to Departures Inform operational actors that WDS-D is to be applied or changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0076
Title	WDS-D Xw concept definition

Requirement	The WDS-D Xw concept shall apply weather dependent wake turbulence separation rules for departures, over the straight-out initial common departure path until aircraft diverge on to wake independent paths after the first SID turn, defined as minimum crosswind condition with an associated time separation minimum and associated SID pair constraints to be defined locally.
Status	<validated>
Rationale	Part II SAR SR#D47 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met. The WDS-D Xw concept shall apply weather dependent wake turbulence separation rules for departures, over the straight-out initial common departure path until aircraft diverge onto wake independent paths after the first SID turn, defined as minimum crosswind condition with an associated time separation minimum and associated SID pair constraints to be defined locally. Validated in NATS RTS5 for the "airborne time" separation procedures.
Category	<Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Monitor for aircraft becoming airborne and record Airborne Time Monitor separation on initial departure path Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0077
Title	WDS-D Xw concept applicability
Requirement	The Tower Supervisor shall be notified when the WDS-D Xw concept wake separation reduction is applicable.
Status	<deleted>
Rationale	The Tower Supervisor shall be able to recognize when the WDS-D Xw concept wake separation reduction conditions are met. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0078
Title	WDS-D Xw concept wake separation rules
Requirement	WDS-D Xw concept wake separation rules shall be provided to the Enhanced OSD tool.

Status	<validated>
Rationale	Part II SAR SR#D38 in relation to the SO#D01: Ensure delivery of consistent and accurate wake turbulence separation delivery on the common initial departure path (for WDS-D in the context of PWS-D). WDS-D Xw concept wake separation rules shall be provided to the Enhanced OSD tool. This was validated in NATS RTS5. This is a system requirement and so an associated requirement should be in the TS/IRS.
Category	<Operational>, <System>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0079
Title	WDS-D Xw concept not applicable
Requirement	The Tower Supervisor shall be notified when the WDS-D Xw concept wake separation reduction is not applicable.
Status	<deleted>

Rationale	The Tower Supervisor shall be able to recognize when the WDS-D Xw concept wake separation reduction conditions are not met. De-authorisation responsibility supported by automatic transition when busy with other activities. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0080
Title	WDS-D Xw concept wind condition monitoring
Requirement	Tower ATC shall be able to monitor the wind conditions applicable to the WDS-D Xw concept.
Status	<deleted>
Rationale	Tower ATC shall be provided with wind speed and direction information applicable to the WDS-D Xw concept. The authorisation process is addressed in REQ-02.01-SPRINTEROP-DEP2.0037 and the associated system support is addressed in REQ-02.01-SPRINTEROP-DEP2.0031. Deleted this requirement.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0081
Title	WDS-D Xw concept no negative impact on safety
Requirement	WDS-D Xw concept application shall not have a negative impact on safety.
Status	<deleted>
Rationale	WDS-D Xw concept application shall not have a negative impact on safety. This is a performance requirement to facilitate traceability to the associated safety validation objectives. However this is a safety objective rather than a requirement, and there are several safety requirements to facilitate traceability to the safety validation objectives, so this requirement is deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures Determine Wake Separation Distance to preceding aircraft Determine Wake Separation Time to preceding

		aircraft and associated Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0082
Title	WDS-D Xw concept wind forecast information to the end user
Requirement	Wind forecast information shall be provided to the users so as to support the planning and execution of the WDS-D Xw concept operations.
Status	<deleted>
Rationale	Wind forecast information shall be provided to the users so as to support the planning and execution of the WDS-D Xw concept operations. The WDS-D Xw concept wind conditions information requirement has already been addressed in REQ-02.01-SPRINTEROP-DEP2.0004 so deleted this requirement.
Category	<System>, <Human Performance>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0083
Title	WDS-D Xw concept departure planning system support
Requirement	The WDS-D system shall maintain up-to-date and display to the users using an appropriate HMI: - for each departing aircraft: - aircraft type and wake turbulence category - designated runway, SID and the initial cleared flight level - ICAO Flight Plan information - for each planned set of departing aircraft - available upwind - downwind SIDs - advisory on optimum take-off sequence
Status	<deleted>
Rationale	To satisfy the associated operational requirements and user requirements. Departure planning is now supported by the A-CDM/D-MAN system support for managing optimising the departure sequence and managing the TOBT and TSAT for each departure aircraft. Flight plan information is now displayed on the departure aircraft FDE (flight data entry) in the electronic environment of the controller. WDS-D Xw concept planning system support is covered by REQ-02.01-SPRINTEROP-DEP2.0029 so deleted this requirement.
Category	<System>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine next aircraft to be given a line-up clearance Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0084
Title	Flight Crew training on awareness for accurate track keeping after departure for WDS-D Xw concept
Requirement	Flight Crew shall be provided with adequate training to enable awareness for accurate track keeping after departure.
Status	<validated>
Rationale	Part II SAR SR#D06 in relation to the Hazard: Aircraft deviates from planned trajectory. This is in the context of the WDS-D Xw concept and SO#D11: Not to increase the possibility of wake encounter on departure due to lateral deviation from the common initial departure path. (Only applicable to WDS-D Xw). Validated in HP-SAF workshop.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Aircraft rotates and becomes airborne Monitor separation on initial departure path

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0085
Title	Ensuring the application of the WDS-D pre-defined parameters
Requirement	Tower controllers shall only apply WDS-D reduced wake separations when the pre-defined weather parameters are met.
Status	<validated>
Rationale	Part II SAR SR#D39 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met. Validated in NATS RTS5.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0086
Title	Informing Tower ATC when WDS-D parameters are met
Requirement	The WDS-D Tool shall inform Tower ATC when the defined weather parameters are met.
Status	<validated>
Rationale	Part II SAR SR#D40 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met. Validated in NATS RTS5.
Category	<Safety>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0087
Title	Supporting authorisation of the application of WDS-D reduced wake separations
Requirement	The WDS-D Tool shall support the procedures for authorising the application of the WDS-D reduced wake separations.
Status	<validated>
Rationale	Part II SAR SR#D41 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met. Validated in NATS RTS5.
Category	<Safety>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is no longer to be applied Inform operational actors that WDS-D is to be applied or changed Stop Applying WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0088
Title	Supporting automatic de-authorisation of the application of WDS-D reduced wake separations
Requirement	The WDS-D Tool shall support automatic de-authorisation of the application of the WDS-D reduced wake separation when the wind conditions change such that the pre-defined weather parameters are no longer met.
Status	<validated>
Rationale	Part II SAR SR#D42 in relation to the SO#D02: Ensure the application of WDS minima only when the predefined wind parameter(s) are met. Validated in NATS RTS5.
Category	<Safety>. , <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0089
Title	Applying SID constraints for WDS-D Xw concept
Requirement	ATCOs shall only apply WDS-D Xw reduced wake separation when the follower aircraft departure SID is upwind of all applicable preceding aircraft departure SIDs (e.g. this may be also to the second preceding departure aircraft in the case of an A380 – Light – Light departure sequence).
Status	<validated>
Rationale	Part II SAR SR#D50 in relation to the SO#D04: Ensure the application of WDS-D only when pre-defined SID/Route combinations are met. Validated in NATS RTS5.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0090
Title	Monitoring the conformance of the flight path of the departure aircraft when applying a WDS-D reduced wake separation
Requirement	ATCOs shall monitor the conformance of the flight path of the departing aircraft along the initial common departure path (when WDS-D Xw reduced separation is being applied).
Status	<validated>
Rationale	Part II SAR SR#D51 in relation to the SO#D05: Ensure the basis of WDS-D are continued to be fulfilled along the initial common departure path and SO#D011: Not to increase the possibility of wake encounter on departure due to lateral deviation from the common initial departure path. (Only applicable to WDS-D Xw) and SO#D15: Provision of wake vortex warning(s) when crosswind transport is not assured due to divergence of either the preceding, or follower, aircraft from the straight-out initial common departure path. Validated in SAF & HP workshop.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0091
Title	ATCO training on safe intervention instructions to the departure aircraft with WDS-D Xw concept
Requirement	ATCOs shall be trained to issue safe intervention instructions to departure aircraft that will minimise the possibility of the follower departure aircraft encountering the wake generated by the preceding departure aircraft when a WDS-D Xw reduced wake separation is being applied.
Status	<validated>
Rationale	Part II SAR SR#D71 in relation to the SO#D12: Ensure wake turbulence separation between departing aircraft and an aircraft executing a go-around/missed approach. Validated in SAF & HP workshop.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Apply WDS-D to Departures

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0092
Title	System support for monitoring for departure aircraft lateral navigation divergence with WDS-D Xw concept
Requirement	System support shall be provided to monitor and provide a warning when there is divergence of either the preceding, or follower, aircraft from the straight-out initial common departure path when a WDS-D Xw reduced separation is being applied.
Status	<validated>
Rationale	Part II SAR SR#D72 in relation to the SO#D15: Provision of wake vortex warning(s) when crosswind transport is not assured due to divergence of either the preceding, or follower, aircraft from the straight-out initial common departure path. Validated in SAF & HP workshop.
Category	<System>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Role>	Tower Runway Controller (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0093
Title	Positioning of the displayed crosswind speed
Requirement	The crosswind speed shall be positioned in the centre of/within the regular scanning pattern of the controller.
Status	<validated>
Rationale	In RTS5, the runway surface crosswind speed was displayed on the ADIS screen and perceived as on the periphery of controller scanning. It was recommended that the displayed crosswind speed should be positioned closer to the centre of controller view and closer to the countdown timer.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine whether and how the application of WDS-D is to be changed Inform operational actors that WDS-D is to be applied or changed Inform operational actors that WDS-D is no longer to be applied

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP2.0094
Title	Phraseology for WDS-D
Requirement	Phraseology that accommodates the use of WDS-D shall be designed.
Status	<validated>
Rationale	RTS5 employed phraseology in the WDS-D validation exercise for informing the flight crew of when a WDS-D Xw reduced wake separation was being applied to the preceding departure aircraft. The take-off clearance phraseology incorporated the addition of the runway surface cross wind speed so as to inform the flight crew. The feedback from the controllers is that they would expect the flight crew to be prepared and aware of when a WDS-D Xw reduced wake separation could be applied without the need for informing of the runway surface crosswind speed.
Category	<Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Role>	Tower Runway Controller (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0001
Title	OSD capacity requirements
Requirement	The use of OSD shall increase runway throughput with respect to RECAT-EU or locally deployed static wake separation scheme without tool support.
Status	<deleted>
Rationale	The use of OSD shall increase runway throughput with respect to RECAT-EU or locally deployed static wake separation scheme without tool support. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 with respect to RECAT-EU and the time-based "airborne time" separation procedures. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for an OSD capacity requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0002
Title	Integrity assurance of the input data provided to the OSD (aircraft type and wake category)
Requirement	ATCOs shall be trained to ensure the integrity of the aircraft type and wake category information.
Status	<validated>
Rationale	Part II SAR SR#D10 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This is with respect to the procedures for checking and if needed correcting the aircraft type of the aircraft in the flight plan data (on the FDE) at the start-up of the flight. The aircraft type and wake category may be checked and amended by any of the Tower ATC roles. This will need to be supported by the associated system propagation of any corrections to the OSD tool. This is to ensure that high integrity aircraft type and wake category information is provided to the OSD tool.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Role>	Tower Runway Controller (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0003
Title	Provision of Aircraft Type and RECAT-EU Wake Turbulence Category to the OSD tool.
Requirement	The tool shall be provided with the Aircraft Type and RECAT-EU Wake Turbulence Category of each departure aircraft.

Status	<validated>
Rationale	Part II SAR SR#D09 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This includes subsequent updates to this information for new aircraft types. This is with respect to the maintenance of the tool to accommodate new aircraft types. This is a system requirement and so should be in the TS/IRS. Validated in NATS RTS5 with respect to inputs to the industry prototype OSD tool provided by Indra for the "airborne time" separation procedures.
Category	<Operational>, <Safety>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0004
Title	OSD predictability requirements
Requirement	The use of OSD shall decrease departure ground delay with respect to RECAT-EU or locally deployed static wake separation scheme without tool support.
Status	<deleted>

Rationale	The use of OSD shall decrease departure ground delay with respect to RECAT-EU or locally deployed static wake separation scheme without tool support. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 with respect to RECAT-EU and the "airborne time" separation procedures. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for an OSD predictability requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Distance to preceding aircraft Determine next aircraft to be given a line-up clearance Determine preceding aircraft earliest distance position taking into account any other separation Determine the most restrictive Time satisfying Wake Separation or SID Separation Determine Wake Separation Time to preceding aircraft and associated Time Determine the most restrictive Wake Separation or SID Separation Distance Determine earliest take-off clearance time taking into account any other separation Formulate optimised sequence order for departing aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0005
Title	Integrity assurance of the input data to OSD (aircraft SID)

Requirement	The Tower ATCOs shall be trained to ensure the integrity of the aircraft SID information.
Status	<validated>
Rationale	Part II SAR SR#D14 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This is with respect to the procedures for changing the aircraft SID of the aircraft in the flight plan data (on the FDE). The SID information may be updated by any of the Tower ATC roles. A study of STAR reports for individual airfields is recommended to inform whether there are any gaps in the robustness of the SID information within transmissions. I.e. whether Human error or any other type of error is leading to pilots misunderstanding the SID or to an incorrect SID being issued by ATC. Frequency of these errors will likely not increase in WDS-D, however consequences might be more serious due to reduced separation. This will need to be supported by the associated system propagation of any corrections to the OSD tool. This is to ensure that high integrity aircraft SID information is provided to the OSD tool.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Role>	Tower Runway Controller (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0006
Title	OSD fuel efficiency requirements
Requirement	The use of OSD shall decrease ground departure fuel burn with respect to RECAT-EU or locally deployed static wake separation scheme without tool support.

Status	<deleted>
Rationale	The use of OSD shall decrease ground departure fuel burn with respect to RECAT-EU or locally deployed static wake separation scheme without tool support. This is a performance requirement to facilitate traceability to the associated validation objectives. Validated in NATS RTS5 with respect to RECAT-EU and the "airborne time" separation procedures. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for an OSD fuel efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0007
Title	Integrity assurance of the input data to OSD (entry taxiway line-up position)
Requirement	The Tower Runway Controller shall be trained to ensure the integrity of the entry taxiway line-up position information of each departure aircraft.
Status	<validated>

Rationale	Part II SAR SR#D12 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircrafts and SO#D18: Provision of reliable tool-based information regarding departure intervals. This is with respect to ensuring that the ATCO adds the entry taxiway position to the FDE by the time they give the line-up clearance and the FDE is moved to the runway bay. This will need to be supported by the associated system propagation to the OSD tool. This is to ensure that high integrity entry taxiway line-up position information is provided to the OSD tool.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Role>	Tower Runway Controller (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0008
Title	Integrity & stability assurance of departure sequence provided to the OSD
Requirement	The Tower Runway Controller shall be trained to ensure the integrity and stability of the departure sequence information.
Status	<validated>

Rationale	Part II SAR SR#D08 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This is with respect to ensuring that the ATCO always reflects the intended departure sequence take-off order in the electronic environment. With EFPS this is the order of the FDEs in the runway bay. This will need to be supported by the associated system propagation to the OSD tool. This is to ensure that high integrity intended departure sequence take-off order information is provided to the OSD tool. In NATS RTS5 there were limitations in the EFPS support which exposed the safety consequences of not providing the intended departure sequence take-off order to the OSD tool. The EFPS support was not able to inform the OSD tool of when an FDE was moved to the runway bay ahead of a departure aircraft already in the runway bay or to inform the OSD tool when the FDE order in the runway bay was changed.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Role>	Tower Runway Controller (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0009
Title	Consistency assurance of airborne time provided to OSD
Requirement	The Tower Runway Controller shall be trained to ensure the consistency of the airborne time information.
Status	<validated>

Rationale	Part II SAR SR#D16 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This is with respect to ensuring the Tower Runway Controller consistently observes and invokes the actions to record the airborne time that is provided to the OSD tool when no automatic means of identifying and recording this time is supported (REQ-02.01-SPRINTEROP-DEP0.0009). Consistency is recording the airborne time of when the back wheels lift from the ground (rather than when the aircraft starts to rotate when the front wheels begin to lift from the ground), or just after the back wheels have lifted from the ground, so as to ensure that the OSD tool calculates an NBAT for the next departure aircraft that will result in the required wake separation time being delivered. It is accepted that the Tower Runway Controller may be busy with other tasks and may occasionally be late in invoking the actions to record the airborne time. In these instances the OSD tool will calculate a NBAT for the next departure aircraft with the additional time from being late in invoking the recording of the airborne time. If the Tower Runway Controller then takes this into account when using the NBAT and associated countdown timer by providing an earlier clearance to take-off to the next departure aircraft than would normally be the case against the countdown time this could then have an impact on the system support for monitoring the delivered time separation ((REQ-02.01-SPRINTEROP-DEP0.1002). This could also induce a risk of under-separation delivery if the controller over-estimates how late they were in invoking the actions to record the airborne time.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Role>	Tower Runway Controller (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0010
Title	OSD usage no negative impact on human performance
Requirement	OSD usage shall not have negative impact on human performance.
Status	<deleted>
Rationale	OSD usage shall not have negative impact on human performance This is a performance requirement to facilitate traceability to the associated HP validation objectives. However this is an HP objective rather than a requirement, and there are several HP requirements to facilitate traceability to the HP validation objectives, so this requirement is deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0011
Title	Integrity & consistency assurance of start of take-off roll time used by the OSD
Requirement	The Tower Runway Controller shall be trained to ensure the integrity and consistency of the start of take-off roll time information.
Status	<validated>

Rationale	Part II SAR SR#D25 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This is with respect to ensuring the Tower Runway Controller consistently observes and invokes the actions to record the start of take-off roll time that is provided to the OSD tool when no automatic means of identifying and recording this time is supported (REQ-02.01-SPRINTEROP-DEP0.1009). Consistency is recording the start of take-off roll time when the departure aircraft is beyond the line-up position and just meets the minimum roll ground speed criteria so as to ensure that the OSD tool calculates an NBTOT for the next departure aircraft that will result in required wake separation time being delivered. It is accepted that the Tower Runway Controller may be busy with other tasks and may occasionally be late in invoking the actions to record the start of take-off roll time. In these instances the OSD tool will calculate a NBTOT for the next departure aircraft with the additional time from being late in invoking the recording of the start of take-off roll time. If the Tower Runway Controller then takes this into account when using the NBTOT and associated countdown timer by providing an earlier clearance to take-off to the next departure aircraft than would normally be the case against the countdown time this could then have an impact on the system support for monitoring the delivered time separation ((REQ-02.01-SPRINTEROP-DEP0.1002). This could also induce a risk of under-separation delivery if the controller over-estimates how late they were in invoking the actions to record the start of take-off roll time.
Category	<Safety>, <Human Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Role>	Tower Runway Controller (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0012

Title	OSD cost efficiency requirement
Requirement	OSD usage shall have a positive return on investments.
Status	<deleted>
Rationale	OSD usage shall have a positive return on investments. To be validated in the CBA. ECTL have advised that this is a validation objective, not a requirement, and that there is no need for an OSD cost efficiency requirement to provide traceability to the validation objective, so the requirement has been deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0013
Title	Provision of wind profile information to the OSD tool for supporting distance-based separation
Requirement	When required to support distance-based separation the OSD tool shall be provided with wind profile information over the departure SID routes out to the maximum distance-based separation that is required to be supported.
Status	<validated>

Rationale	To calculate the position of the Dynamic Departure Indicator - Distance (DDI-D) the OSD tool needs to take into account the airspeed profile and climb profile and the associated ground speed impact of the prevailing wind profile over the departure SID route of the lead aircraft out to the required distance-based separation from the anticipated initial airborne position of the follower aircraft. This is so as to calculate the distance the lead aircraft is anticipated to fly over the time the follower aircraft is anticipated to take to become airborne after being given the clearance to take-off. This distance is subtracted from the required wake separation distance to establish the position of where to display the DDI-D. The DDI-D is the position the lead aircraft needs to reach before the Tower Runway Controller should issue the clearance to take-off in order to satisfy the required separation when the follower aircraft becomes airborne. Validated in ECTL RTS4b.
Category	<Operational>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0014
Title	OSD usage no negative impact on safety
Requirement	OSD usage shall not have a negative impact on safety.
Status	<deleted>
Rationale	OSD usage shall not have a negative impact on safety. This is a performance requirement to facilitate traceability to the associated safety validation objectives. However this is a safety objective rather than a requirement, and there are several safety requirements to facilitate traceability to the safety validation objectives, so this requirement is deleted.
Category	<Performance>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0015
Title	Provision of airspeed profile and climb profile information to the OSD tool for supporting distance-based separation
Requirement	The OSD Tool shall be configured with the accurate airspeed and climb profiles of each aircraft type over the SID routes from each departure runway out to the maximum wake separation distance from the rotation positions of the follower aircraft types (to determine the DDI-D position for distance-based separation procedures).
Status	<validated>
Rationale	Part II SAR SR#D26 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. To calculate the position of the Dynamic Departure Indicator - Distance (DDI-D) the OSD tool needs to take into account the airspeed profile and climb profile and associated ground speed impact of the prevailing wind profile over the departure SID route of the lead aircraft out to the required distance-based separation from the anticipated initial airborne position of the follower aircraft. This is so as to calculate the distance the lead aircraft is anticipated to fly over the time the follower aircraft is anticipated to take to become airborne after being given the clearance to take-off. This distance is subtracted from the required wake separation distance to establish the position of where to display the DDI-D. The DDI-D is the position the lead aircraft needs to reach before the Tower Runway Controller should issue the clearance to take-off in order to satisfy the required separation when the follower aircraft becomes airborne. Validated in ECTL RTS4b.
Category	<Operational>, <Safety>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine SID Separation Distance to each relevant preceding aircraft Determine the most restrictive Wake Separation or SID Separation Distance Determine preceding aircraft earliest distance position taking into account any other separation

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0016
Title	Provision of take-off roll time and rotation position information to the OSD tool for supporting distance-based separation
Requirement	The OSD Tool shall be configured with the accurate roll time and rotation position of each aircraft type for each departure runway and line-up position (to determine the DDI-D position for distance-based separation procedures).
Status	<validated>

Rationale	Part II SAR SR#D22 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. To calculate the position of the Dynamic Departure Indicator - Distance (DDI-D) the OSD tool needs to take into account the roll time and rotation position of the follower departure aircraft to be issued with the take-off clearance. This is so as to calculate the distance the lead aircraft is anticipated to fly over the time the follower aircraft is anticipated to take to become airborne after being given the clearance to take-off. This distance is subtracted from the required wake separation distance from the anticipated rotation position (initial airborne position) of the follower departure aircraft to establish the position of where to display the DDI-D. The DDI-D is the position the lead aircraft needs to reach before the Tower Runway Controller should issue the clearance to take-off in order to satisfy the required separation when the follower aircraft becomes airborne. Validated in ECTL RTS4b.
Category	<Operational>, <Safety>, <System>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0017
Title	OSD tool assurance/integrity
Requirement	OSD tool assurance/integrity shall be set to a level, as appropriate for total ATCO dependence, to ensure, all applicable separations on departure (e.g. as required for the assurance of radar equipment).
Status	<validated>

Rationale	Part II SAR SR#D01 in relation to the Hazard: ATCO issues premature take-off clearance regarding wake separation. In the Post RTS5 workshop it was established that when the OSD tool is in use, controllers will rely on it to a high extent, therefore the safety assurance of the OSD tool is necessary. Through stakeholder engagement airspace users can be informed of the assurance of the separation service provided with the OSD tool support.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0018
Title	Provision of intended take-off order of the departure aircraft to the OSD tool
Requirement	The tool shall be provided with the intended take-off order of the departure aircraft.
Status	<validated>
Rationale	Part II SAR SR#D07 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. Validated in NATS RTS5.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0019
Title	Provision of line-up position to the OSD tool
Requirement	The tool shall be provided with the accurate line-up position of each departure aircraft (to allow for automatically adding the 60s for intermediate position line-up).
Status	<validated>
Rationale	Part II SAR SR#D11 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. Validated in NATS RTS5.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0020
Title	Provision of SID to the OSD tool
Requirement	The tool shall be provided with the SID for each departure aircraft (for WDS-D and distance-based).
Status	<validated>
Rationale	Part II SAR SR#D13 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. Validated in NATS RTS5.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0021
Title	Provision of airborne time to the OSD tool
Requirement	The tool shall be provided with the accurate airborne time of each departing aircraft (for airborne time procedures).
Status	<validated>
Rationale	Part II SAR SR#D15 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. Validated in NATS RTS5.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0022
Title	Provision of wind profile information to the WDS-D tool
Requirement	The tool shall be provided with accurate and reliable wind measurements at the rotation positions on the runway surface and aloft along the common straight-out initial departure path (for WDS-D).
Status	<validated>
Rationale	Part II SAR SR#D17 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. Validated in NATS RTS5.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0023
Title	Consideration of staleness criteria for the wind profile information by the WDS-D tool
Requirement	The tool shall take into account staleness criteria with respect to the wind information and the timely suspension of applying associated reduced wake separations (for WDS-D).
Status	<validated>
Rationale	Part II SAR SR#D18 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0024
Title	Software assurance level for the OSD tool
Requirement	The software assurance level of the tool shall be such that ATCOs may justifiably be reliant on the wake separation information provided by the tool facilitating the provision of the wake turbulence separation between each successive departure.
Status	<validated>
Rationale	Part II SAR SR#D19 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. Airline representatives need to be included in the future assurance activities. Airline representative familiarity of the assurance level of the tool, that ATCOs will use to make wake separation delivery decisions, will improve trust and might also highlight further risks to be addressed.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0025
Title	Accurate display of the wake separation time
Requirement	In the case of wake separation time procedures, the wake separation time shall be accurately displayed with respect to indicating the applicable wake separation time interval between each successive departures.
Status	<validated>
Rationale	Part II SAR SR#D20 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. Validated in NATS RTS5.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine Wake Separation Time to preceding aircraft and associated Time Issue take-off clearance and Monitor and Record Roll Time

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0026
Title	Accurate display of the wake separation distance
Requirement	In the case of wake separation distance-based procedures, the wake separation distance shall be accurately displayed with respect to indicating the applicable wake separation distance between each successive departure.
Status	<validated>
Rationale	Part II SAR SR#D21 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. The ECTL RTSs applied wake time based separation procedures (more common in European airports) however the OSD tool validated in RTS4a and RTS4b provided for distance-based separation procedures capability.
Category	<Human Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Determine preceding aircraft earliest distance position taking into account any other separation Determine Wake Separation Distance to preceding aircraft

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0027
Title	Provision of start of take-off roll time to the OSD tool
Requirement	The tool shall be provided with the accurate start of take-off roll time of each departing aircraft (for start of take-off roll time procedures).
Status	<validated>

Rationale	Part II SAR SR#D24 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This requirement has been validated in RTS4a and RTS4b.
Category	<System>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0028
Title	Provision of wind profile to the OSD tool
Requirement	The tool shall be provided with accurate and reliable wind measurements along the SID route of each departure runway out to the maximum wake separation distance from the rotation positions of the follower aircraft types (to determine the DDI-D position for distance-based separation procedures).
Status	<validated>
Rationale	Part II SAR SR#D27 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This requirement has been validated in RTS4a and RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0029
Title	Consideration of staleness criteria for the wind profile information by the OSD-D tool
Requirement	The tool shall take into account staleness criteria with respect to determining the DDI-D position for distance-based separation procedures.
Status	<validated>
Rationale	Part II SAR SR#D28 in relation to the SO#D17: Provision of accurate tool-based information regarding wake separation intervals between successive departing aircraft and SO#D18: Provision of reliable tool-based information regarding departure intervals. This requirement has been validated in RTS4a and RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0030
Title	Informing the OSD tool of late/tactical changes to the departure sequence
Requirement	The OSD Tool shall be informed of late/tactical changes to the departure sequence.
Status	<validated>
Rationale	Part II SAR SR#D74 in relation to the SO#D16: Maintain the ability of ATCOs to tactically rearrange the departure sequence. This requirement has been validated in RTS4a and RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

[REQ]

Identifier	REQ-02.01-SPRINTEROP-DEP3.0031
Title	OSD tool ensuring the correctness of the information presented to the controller
Requirement	The OSD Tool shall ensure the correctness of the wake turbulence separation information presented to the controller when there is a late/tactical change to the departure sequence.
Status	<validated>
Rationale	Part II SAR SR#D75 in relation to the SO#D16: Maintain the ability of ATCOs to tactically rearrange the departure sequence. There is a need to ensure the removal of the stale wake separation information for the old sequence order that no longer applies and the generation and presentation of the wake separation information for the new sequence order. This requirement has been validated in RTS4a and RTS4b.
Category	<Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Functional Block>	Departure Separation Management (PJ.02-01)

4.3 Wake Risk Monitoring Concept Solution

The latest consolidated list of requirements for the Wake Risk Monitoring Concept Solution has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

Identifier	REQ-02.01-SPRINTEROP-WRM0.0001
Title	Wake Risk Monitoring – Detection of wake encounters
Requirement	The Wake Risk Monitoring analysis shall be able to detect at least 80% of wake encounters occurring in operational data available to it.
Status	<in progress>
Rationale	To be useful and to provide an improvement over current operating methods, the analysis needs to reliably capture a large part of actually occurring wake encounters.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Transmit Data Collect Data Analyse Data Establish Wake Risk Baseline Collect Data Analyse Data

[REQ]

Identifier	REQ-02.01-SPRINTEROP-WRM0.0002
Title	Wake Risk Monitoring – Ratio of spurious detections
Requirement	The Wake Risk Monitoring analysis shall not produce more than 20% of spurious detections with respect to the total number of wake encounters reported, i.e. not more than 2 out of 10 detections shall be detections where no actual wake encounter is occurring.
Status	<in progress>
Rationale	To produce meaningful data and to provide an improvement over current operating methods, the number of wrongly identified wake turbulence encounters needs to be limited.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Transmit Data Collect Data Analyse Data Establish Wake Risk Baseline Collect Data Analyse Data

[REQ]

Identifier	REQ-02.01-SPRINTEROP-WRM0.0003
Title	Wake Risk Monitoring – Automation and Reporting
Requirement	The Wake Risk Monitoring analysis shall be designed such that it can automatically assemble data relevant to detected wake encounters, for example in the form of a report.
Status	<in progress>
Rationale	To support later analysis of events and to facilitate collection of wake turbulence related information by flight crews and controllers.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Create Wake Risk Report Evaluate Wake Risk Report

[REQ]

Identifier	REQ-02.01-SPRINTEROP-WRM0.0004
Title	Wake Risk Monitoring - Analysis Demand
Requirement	The way to demand a Wake Risk Monitoring analysis shall be formalized to facilitate the processing of the demand by the operator.
Status	<in progress>
Rationale	The analysis may be operated based on an "on-demand" model, i.e. a Stakeholder may request an analysis covering a defined scope. The way to perform the demand has to be formalized.
Category	<Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Analyse Data Create Wake Risk Report Evaluate Wake Risk Report

4.4 Wake Decay Enhancing Concept Solution

The latest consolidated list of requirements for the Wake Decay Enhancing Concept Solution has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

Identifier	REQ-02.01-SPRINTEROP-WDE0.0001
Title	Specification of accelerated wake vortex decay
Requirement	The installation of plate lines shall demonstrate a minimum wake vortex lifetime reduction of 20%
Status	<validated>
Rationale	It has to be demonstrated to which extent the lifetime of the longest lived and thus potentially most hazardous wake vortices remaining within the approach corridor can be reduced. This defines the achievable safety gains and the capacity gains that can be obtained in combination with systems and regulations for the optimization of aircraft separations.
Category	<Performance>, <Safety>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Quantify Accelerated Wake Vortex Decay Install Permanent Plate Lines Measure Wake Vortex Install Temporary Plate Lines

[REQ]

Identifier	REQ-02.01-SPRINTEROP-WDE0.0002
Title	Compliance with ICAO requirements
Requirement	The plate line design and installation shall comply with ICAO requirements.
Status	<validated>
Rationale	The decay enhancing devices shall comply with the requirements set forth by ICAO regarding obstacle clearance, stability, frangibility, electromagnetic compatibility with localizer, and guidance lighting visibility.
Category	<Safety>, <Operational>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01
<ALLOCATED_TO>	<Activity>	Install Permanent Plate Lines Install Temporary Plate Lines

4.5 Security Requirements

High level security requirements have been provided by the security experts for PJ02-01.

These have been mapped to the PJ02-01 Solutions through the following application of the requirements identifier fields:

- XXXZ is
    - ALL4 when the security requirement applies to all Concepts Solutions (Arrivals, Departures, Wake Risk Monitoring and Wake Decay Enhancing)
    - SYS3 when the security requirement applies to the three system/software based Concepts Solutions only (Arrivals, Departures and Wake Risk Monitoring)

The latest consolidated list of high level security requirements has been generated via the SE-DMF publishing engine report and is included below.

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0001
Title	Security Policy (C2.1)
Requirement	The Responsible Organisation shall produce, approve, and adopt a security policy which complies with the Reference ATM Security Policy; this security policy shall be communicated to all relevant parties. Note: it is recommended that this be based upon the principles set out in ISO-270001:2013, or later.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0002
Title	Reviewing Security Policy (C2.2)
Requirement	The Responsible Organisation shall regularly review the security policy and ensure that it remains effective.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0003
Title	Resourcing & Assigning Security Policy Roles (C3.1)
Requirement	The Responsible Organisation shall provide the resources needed for information and ATM services security and assign roles and responsibilities for all security management functions.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0004
Title	Coordinating Security Controls (C3.2)
Requirement	The Responsible Organisation shall ensure that the implementation of information and ATM services security controls is co-ordinated across the organisation.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0005
Title	Information Storage and Exchange Means (C3.3)
Requirement	Information storage and exchange means shall be defined in accordance with the security value of such information.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0006
Title	Background Security Verification Checks (C4.1)
Requirement	Background verification checks on all staff shall be carried out in accordance with relevant laws, regulation, and ethics. The checks shall be proportional to the roles and responsibilities, in particular in respect to the business requirements (e.g. safety-critical function, developments), the protective marking or classification of information to be accessed, and the perceived risks.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0007
Title	Staff Application of Security (C4.2)
Requirement	Staff shall apply security in accordance with the established policies and procedures.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0008
Title	Security Awareness Training (C4.3)
Requirement	Staff shall receive appropriate awareness training and regular updates in organisational policies and procedures, as relevant for their job function.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0009
Title	Staff Security Procedures (C4.4)
Requirement	Staff shall undergo a formal rotation, change, and leaving procedure.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0010
Title	Inventory of Assets (C5.1)
Requirement	All assets shall be clearly identified, and an inventory of all important assets drawn up and maintained.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0011
Title	Designated Responsibility (C5.2)
Requirement	All information and ATM services associated with information processing facilities shall be ‘owned’ by a designated responsible individual or role.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0012
Title	Acceptable Use of Asset Policy (C5.3)
Requirement	Rules for the acceptable use of assets shall be identified, documented, and implemented.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0013
Title	Security Classification (C5.4)
Requirement	All Information and ATM services shall be classified in terms of its value, legal requirements, sensitivity and criticality to ATM, ATM organisations and stakeholders.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0014
Title	Labelling and Handling Procedures (C5.5)
Requirement	An appropriate set of procedures for information and ATM services labelling and handling shall be developed and implemented in accordance with the protective marking or classification scheme adopted.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0001
Title	Removable Media Procedures (C5.6)
Requirement	There shall be procedures in place for the management of removable media.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0002
Title	Media Disposal Procedures (C5.7)
Requirement	Media shall be disposed of securely and safely when no longer required, using formal procedures.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0003
Title	Procedures for Handling and Storage of ATM Information (C5.8)
Requirement	Procedures for the handling and storage of ATM information shall be established to protect ATM services and information from unauthorised disclosure or misuse.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0015
Title	Protection of ATM System Documentation (C5.9)
Requirement	ATM system documentation shall be protected against unauthorised access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0016
Title	Access Control Policy (C6.1)
Requirement	An access control policy shall be established, documented, and reviewed based on business and security requirements for access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0017
Title	Access Control Procedure (C6.2)
Requirement	There shall be an access control procedure in place for granting and revoking access to all information systems and services.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0018
Title	Allocation of Access Privileges (C6.3)
Requirement	The allocation of access privileges shall be restricted to users who have been specifically authorised to use ATM facilities, and such privileges should be controlled by a formal management process.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0004
Title	Access Control Policy for Shared ATM Networks (C6.4)
Requirement	For shared ATM networks, especially those extending across the Responsible Organisation's boundaries, the capability of users to connect to the network shall be restricted, in accordance with the access control policy and requirements of the operational applications.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0005
Title	Utility Programs Policy (C6.5)
Requirement	The use of utility programs that might be capable of overriding system and application controls shall be restricted and tightly controlled.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0006
Title	Sensitive Systems Policy (C6.6)
Requirement	Sensitive systems shall have a dedicated (protected) computing environment.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0007
Title	External Access Policy (C6.7)
Requirement	The Responsible Organisation shall review the security requirements and risks of every external access to information or ATM Services before granting access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0008
Title	User Security Practices (C6.8)
Requirement	User shall be required to follow good security practices in the protection of authentication information or devices.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0009
Title	Unattended Equipment Procedure (C6.9)
Requirement	Users shall ensure that unattended equipment has appropriate protection.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0010
Title	Papers, Media and Information Processing Facilities Policy (C6.10)
Requirement	A security policy for papers and removable storage media and information processing facilities shall be adopted.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0019
Title	Security Perimeter Policy (C7.1)
Requirement	Security perimeters shall be used to protect ATM sensitive areas and ATM processing facilities.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0020
Title	Entry Control Policy (C7.2)
Requirement	ATM secure areas shall be protected by appropriate entry controls which allow access only to authorised personnel and which detect unauthorised access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0011
Title	Auxiliary Means Policy (C7.3)
Requirement	ATM equipment shall be provided with auxiliary means to compensate for deliberate compromising of power supply, overheating and fire.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0012
Title	ATM Cabling Policy (C7.4)
Requirement	ATM cabling shall be protected from deliberate damage, eavesdropping or interference.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0021
Title	Maintenance and Servicing Policy (C7.5)
Requirement	ATM equipment shall be maintained and serviced to ensure their availability and integrity.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0022
Title	Operating ATM Procedures Policy (C8.1)
Requirement	Operating ATM procedures shall be documented, maintained, and made available to all users who need to know them.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0023
Title	Change Control Procedures Policy (C8.2)
Requirement	Changes to ATM information processing facilities, ATM services and systems shall be controlled.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0013
Title	ATM Software Controls Policy (C8.3)
Requirement	Detection, prevention, and recovery controls to protect ATM software against malicious code and appropriate user awareness procedures shall be implemented.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0014
Title	Back-up Policy (C8.4)
Requirement	Backup copies of ATM information and software shall be taken and tested regularly in accordance with an agreed backup policy.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0015
Title	Monitoring Procedures (C8.5)
Requirement	Procedures for monitoring the use of ATM services and information processing facilities shall be established and the results of the monitoring activities reviewed regularly.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0024
Title	ATM Logging Protection Procedures (C8.6)
Requirement	ATM logging facilities and log information shall be protected against tampering and unauthorised access.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0025
Title	Fault Logging and Resolution Procedures (C8.7)
Requirement	Faults shall be logged, analysed, and appropriate action taken.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0016
Title	ATM Networks Policy (C9.1)
Requirement	ATM Networks shall be adequately managed and controlled, in order to be protected from threats, and to maintain security for the ATM systems and applications using the network, including information in transit.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0017
Title	Formal Exchange Policies (C9.2)
Requirement	Formal exchange policies, procedures, and controls shall be in place to protect the exchange of ATM services and information through the use of all types of communication facilities. Agreements shall be established for the exchange of ATM services and information and software between the Responsible Organisation and external parties.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0018
Title	Electronic Messaging Protection Policy (C9.3)
Requirement	Information conveyed by electronic messaging shall be appropriately protected.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0026
Title	Security Requirements Policy (C10.1)
Requirement	Every specification for new or updated facilities shall include security requirements.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0027
Title	Change Control Approval Policy (C10.2)
Requirement	An operational process and plan which controls how system changes are approved and implemented, and how security considerations are incorporated in the change process shall be enacted.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0028
Title	Security Testing Policy (C10.3)
Requirement	Security testing shall be performed whenever a system is updated.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier

<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0029
Title	Security Acceptance Criteria Policy (C10.4)
Requirement	Security acceptance criteria for new ATM information systems or services, upgrades, and new versions shall be established, and suitable security tests of the ATM system(s) carried out during development and prior to acceptance. This shall include individual development activities such as specification, design, development and qualification which may have corresponding acceptance criteria.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0030
Title	Reporting of Security Events Policy (C11.1)
Requirement	ATM service and Information security events shall be reported through appropriate management channels as quickly as possible.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0031
Title	Reporting of Suspected Security Weaknesses or Malfunctions Policy (C11.2)
Requirement	All employees, contractors and third party users of information systems and services shall be required to note and report any observed or suspected security weaknesses or malfunctions in ATM systems or services.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0032
Title	Responding to Security Incidents Policy (C11.3)
Requirement	Management responsibilities and procedures shall be established to ensure an effective and orderly response to ATM service and information security incidents.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0033
Title	Security Incident Evidence Management Policy (C11.4)
Requirement	Where a follow-up action against a person or organisation after an ATM service or information security incident involves legal action (either civil or criminal), pieces of evidence shall be collected, retained, and presented to the relevant jurisdiction(s).
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0034
Title	Security Incident External Authorities Involvement Policy (C11.5)
Requirement	The Responsible Organisation shall have procedures in place that specify when and by whom external authorities (e.g. law enforcement, fire department, supervisory authorities) shall be contacted in the event of a security incident.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0035
Title	ATM Business Continuity Security Requirements Policy (C12.1)
Requirement	A managed process shall be developed and maintained that addresses the ATM service and information security requirements needed for ATM business continuity.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0036
Title	Disruptive Events Identification and Risk Assessment Policy (C12.2)
Requirement	Events that can cause interruptions to ATM business processes shall be identified, along with the likelihood and impact of such interruptions and their consequences for ATM information security.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0037
Title	Planning Policy for Restoration from Disruptive Events (C12.3)
Requirement	Plans shall be developed and implemented to maintain or restore operations and to ensure the availability, integrity and confidentiality of information at the required level and in the required time scales following interruption to critical ATM business processes.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0038
Title	Policy for Testing and Updating Business Continuity Plans (C12.4)
Requirement	ATM business continuity plans shall be tested and updated regularly to ensure that they are up to date and effective.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0039
Title	Compliance Policy (C13.1)
Requirement	Compliance to statutory, regulatory and contractual requirements shall be checked, and the correct and authorised use of facilities and assets shall be defined.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-ALL4.0040
Title	Compliance to National and European Requirements (C13.2)
Requirement	Any personal or protectively classified information shall be protected in accordance with National and European requirements.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0019
Title	Malicious Software Policy (C8.3 PR1)
Requirement	The software development and production process shall detect and remove malicious software.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0020
Title	Malicious Software Removal on Detection Policy (C8.3 PR2)
Requirement	The software management process shall ensure that all detected malicious software is removed on detection.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0021
Title	Malicious Software User Policy (C8.3 PR3)
Requirement	Once detected users shall be immediately informed of the event and as soon as possible provided with detailed of any effects.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0022
Title	Software Installation Media Policy (C8.3 PR4)
Requirement	Software shall only be installed from verified media.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0023
Title	Software Validation and Verification Testing Policy (C8.3 PR5)
Requirement	Only software which has been the subject of documented validation and verification testing shall be installed.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0024
Title	Related Systems Malicious Software Policy (C8.3 PR6)
Requirement	The software management process shall ensure that related systems are informed of any infection or repulsed malicious software.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0025
Title	Malicious Software Staff Training Policy (C8.3 PR7)
Requirement	Software development, operations, maintenance and management staff shall be proved with periodic training on type of malicious software.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0026
Title	Malicious Software Operational System Fall-Back Policy (C8.3 PR8)
Requirement	The operational system shall retain the most recent (-1) version of software to provide an immediate fall-back if the detected malicious software requires cessation of operations.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0027
Title	Scanning Policy (C8.3 TR1)
Requirement	The detection and removal system shall scan all software before installation, all data items that are input to the system, all data and software on access and scan all system software in every 7 day period.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0028
Title	Operational Systems Malicious Software Protection Policy (C8.3 TR2)
Requirement	For operational systems, protection against detected malicious software shall be achieved within 10 minutes of detection. If cessation of operations is necessary, this shall be done as soon as operationally safe to do so.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0029
Title	New Form of Malicious Software Protection Policy (C8.3 TR3)
Requirement	In response to information about a new form of malicious software development and operation software shall be reviewed for presence. The detection software shall utilise signature databases from a reputable security source; systems connected to the Internet shall update their detection databases within 12 hours of the availability of new signatures, or within 72 hours if the system has no Internet connection.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0030
Title	Malicious Software User Notification Policy (C8.3 TR4)
Requirement	The system and its management processes must ensure that users are notified of the detection of malicious software or any other security event that may cause perceptible loss of performance or a safety risk; such notification shall be within 1 hour of the identification of the risk.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0031
Title	Malicious Software Alerting Policy (C8.3 TR5)
Requirement	The System shall alert the Security and Software Management processes within 5 minutes of detecting malicious software.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0032
Title	Verified Media Definition Policy (C8.3 TR6)
Requirement	Verified media shall be defined within the Software Management process.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0033
Title	Validation and Verification Processes Policy (C8.3 TR7)
Requirement	Validation and verification processes to be used shall be based on industry standards e.g. ISO or Def Standards and industry best practices.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0034
Title	Malicious Software Staff Training Policy (C8.3 TR8)
Requirement	Training to staff shall ensure that all users understand and practice processes for handling media, are aware of the risks resulting from malicious software and the mechanisms by which such software may be inadvertently introduced into the system, and understand general security requirements and good practice for the protection of security tokens such as passwords and access controls. Users shall demonstrate current knowledge of these issues at intervals of no less than 1 year.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0035
Title	Operational Software Access Restriction Policy (C8.3 TR9)
Requirement	The Security and Software management processes shall maintain an up to date listing of those who have been trained and shall restrict access to operational software to those who have been trained and are current.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

[REQ]

Identifier	REQ-02.01-SPRINTEROP-SYS3.0036
Title	Virus Protection Policy (C8.3 TR10)
Requirement	To achieve the highest protection against virus introduction White Listing (or an acceptable industry standard equivalent) shall be used.
Status	<in progress>
Rationale	The requirement is proposed as a high-level security requirement, appropriate for the current phase, i.e. in absence, currently, of detailed design. This requirement is to be reviewed, updated, and refined, in future phases.
Category	<Security>

[REQ Trace]

Relationship	Linked Element Type	Identifier
<ALLOCATED_TO>	<SESAR Solution>	PJ.02-01

5 References and Applicable Documents

5.1 Applicable Documents

Content Integration

[1] PJ19: EATMA Guidance Material and Report (2019)

[2] EATMA Community pages

[3] SESAR ATM Lexicon

Concept Development

[4] Operational Concept Document (OCD) 2018

[5] SESAR 2020 Concept of Operations Edition 2019

System and Service Development

[6] 08.01.01 D52: SWIM Foundation v2

[7] 08.01.01 D49: SWIM Compliance Criteria

[8] 08.01.03 D47: AIRM v4.1.0

[9] 08.03.10 D45: ISRM Foundation v00.08.00

[10]B.04.03 D102 SESAR Working Method on Services

[11]B.04.03 D128 ADD SESAR1

[12]B.04.05 Common Service Foundation Method

Performance Management

[13]B.04.01 D108 SESAR 2020 Transition Performance Framework

[14]B.04.01 D42 SESAR2020 Transition Validation

[15]B.05 D86 Guidance on KPIs and Data Collection support to SESAR 2020 transition.

[16]16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model

[17]16.06.06-D51-SESAR_1 Business Case Consolidated_Deliverable-00.01.00 and CBA

[18]Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014)

[19]ATM Cost Breakdown Structure_ed02_2014

[20]Standard Inputs for EUROCONTROL Cost Benefit Analyses

[21]16.06.06_D26-08 ATM CBA Quality Checklist

[22]16.06.06_D26_04_Guidelines_for_Producing_Benefit_and_Impact_Mechanisms

Validation

[23]03.00 D16 WP3 Engineering methodology

[24]Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects

[25]European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

[26]PJ19 Validation Targets (2018), Edition 01.00.00, 26 February 2018

System Engineering

[27]SESAR 2020 Requirements and Validation Guidelines

Safety

[28]SESAR, Safety Reference Material, Edition 4.0, April 2016

[29]SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

[30]SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[31]SESAR, Resilience Engineering Guidance, May 2016

Human Performance

[32]16.06.05 D 27 HP Reference Material D27

[33]16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[34]SESAR, Environment Reference Material, alias, “Environmental impact assessment as part of the global SESAR validation”, Project 16.06.03, Deliverable D26, 2014.

[35]ICAO CAEP – “Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes” document, Doc 10031.

Security

[36]16.06.02 D103 SESAR Security Ref Material Level

[37]16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[38]16.06.02 D131 Security Database Application (CTRL_S)

5.2 Reference Documents

[39]ED-78A GUIDELINES FOR APPROVAL OF THE PROVISION AND USE OF AIR TRAFFIC SERVICES SUPPORTED BY DATA COMMUNICATIONS.

[40]P06.08.01, Wake Turbulence Re-Categorisation and Pair-Wise Separation Minima on Approach and Departure (RECAT-PWS-EU) Safety Case, v1.2, D38, 4th February 2016.

[41]P06.08.01, OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED, D30, 00.00.01, 31st May 2016.

[42]ICAO Doc 8168, Aircraft Operations.

[43]ICAO Document 4444 - ICAO Procedures for Air Navigation Services - Air Traffic Management (PANS-ATM), Doc 4444, Fifteenth Edition, 2007.

[44]ICAO DOC 8643 – ICAO, Aircraft Type Designators

[45]ICAO State Letter on update guidance for wake turbulence aspects of Airbus A380-800 aircraft, July 2008.

[46]P08.03.10, D64, European ATM Service Description for AirportMETObservation Service, Edition 00.01.01

[47]P08.03.10, D64, European ATM Service Description for AirportMETForecast Service, Edition 00.01.01

[48]P06.08.01, Operational Service and Environment Definition (OSED) for Time Based Separation for Arrivals (TBS), 00.01.02, D05, 3rd June 2013.

[49]P06.08.01, TBS, ORD, S-PWS and WDS for Arrivals OSED, 00.00.04, 16th October 2015.

[50]F. Holzäpfel, A. Stephan, T. Heel, S. Körner, "Enhanced Wake Vortex Decay in Ground Proximity Triggered by Plate Lines", Aircraft Engineering and Aerospace Technology, Vol. 88, Issue 2, 2016, pp. 206-214, http://dx.doi.org/10.1108/AEAT-02-2015-0045

[51]A. Stephan, F. Holzäpfel, T. Misaka, Hybrid simulation of wake-vortex evolution during landing on flat terrain and with plate line, Int. J. Heat Fluid Flow, Vol. 49, 2014, pp. 18-27, http://dx.doi.org/10.1016/j.ijheatfluidflow.2014.05.004.

[52]A. Stephan, F. Holzäpfel, T. Misaka, R. Geisler, R. Konrath, Enhancement of aircraft wake vortex decay in ground proximity - Experiment versus Simulation, CEAS Aeron. J., Vol. 5, 2014, pp. 109-125, http://dx.doi.org/10.1007/s13272-013-0094-8.

[53]Anton Stephan, Jürgen Schrall, Frank Holzäpfel "Numerical Optimization of Plate-Line Design for Enhanced Wake-Vortex Decay", J. Aircraft, 2016, http://dx.doi.org/10.2514/1.C033973

[54]"Collection of information on wake vortex encounters", ICAO note AN 13/4-07/67, 26 Oct. 2007.

[55]"Minimum Operational Performance Standards for 1090 MHz Extended Squitter Automatic Dependent Surveillance – Broadcast (ADS-B) and Traffic Information Services – Broadcast (TIS-B)", RTCA DO-260B, 02 Dec. 2009.

[56]OFA 01.03.01 Enhanced Runway Throughput Consolidated Final Step 1 OSED, P06.08.01 D30, Edition 00.01.00, 31st May 2016

[57]OFA 01.03.01 Enhanced Runway Throughput Consolidated SPR, P06.08.01 D32, Edition 00.00.01, 31st May 2016

[58]OFA 01.03.01 Enhanced Runway Throughput Consolidate Final Step 1 Interop, P06.08.01 D34, Edition 00.01.01, 25th May 2016

[59]Initial Departure Concept for Wake Turbulence Separation Optimisation for SESAR 2020, P05.03, Edition 00.01.00, 30th November 2011

[60]SESAR P06.08.01, WDS-D OSED, Edition 00.00.05, June 2015

[61]CREDOS Final Concept of Operations Description D4-11, Version 1.0, 10/11/2009

[62]CREDOS Preliminary Safety Case D4-12, Version 1.0, 10/11/2009

[63]CREDOS Human Factors Case Report D4-10, Version 1.0, June 2009

[64]CREDOS Real Time Simulation Conduct Report D4-15, Version 1.0, 14/09/2009

[65]CREDOS WP4 Final Report D4-16, Version 1.0, 30/11/2009

[66]SESAR P05.03 Initial Departure Concept for Wake Turbulence Separation Optimisation for SESAR 2020, Edition 00.01.00, 30/11/2016

[67]CREDOS Operational and System Requirements D4-1, Version 1.0, 31/03/2008

[68]D1.1.04 – PJ02-01 VALR (Final) – 01.00.00

[69]D1.1.01 – PJ02-01 OSED-SPR-INTEROP (Final) Part II – 01.00.00

[70]D1.1.01 – PJ02-01 OSED-SPR-INTEROP (Final) Part IV – 01.00.00

[71]D1.1.01 – PJ02-01 OSED-SPR-INTEROP (Final) Part V – 01.00.00

[72]D1.1.02 – PJ02-01 TS/IRS (Final) – 01.00.00

[73]D1.1.03 – PJ02-01 VALP (Final) Part I – 00.01.00

[74]D1.1.03 – PJ02-01 VALP (Final) Part II – 00.01.00

[75]D1.1.03 – PJ02-01 VALP (Final) Part IV – 00.01.00

[76]D1.1.05 – PJ02-01 CBA – 01.00.00

Appendix A Cost and Benefit Mechanisms

A.1 Stakeholders identification and Expectations

A.1.1 Arrivals Concepts Solutions

Stakeholder	Involvement	Why it matters to stakeholder
Flight Crew	Are subjected to new wake turbulence separation rules applied by ATC.	Flight crews need to be aware of updated wake separation rules. Flight crews need to trust the safety of the applied rules.
Flight Crew	Are aware of concepts deployment and impact on reduced separations	They are responsible for the safety of aircrew and passengers on-board. It is important that they respond to the ATCO instructions promptly.
Airport Operator	They cope with the arrivals traffic pressure	Arrivals concepts deployment can provide capacity, resilience and predictability benefits to the arrival flow
ANSP	They deploy the arrivals concepts	They manage the air traffic control operations
Regulator	They need to approve the use of the concepts	They regulate the standards for air traffic control
ATCO	They provide ATC services and apply separations based on the concepts	The use of the tool and arrivals concept shall not impact their workload altering safety of operations
Airline Operator	They schedule the flights	Improved capacity, predictability and resilience can reduce disruptions and provide financial benefits.

Table 54: Stakeholder's expectations for Arrivals Concepts Solutions

A.1.2 Departures Concepts Solutions

Stakeholder	Involvement	Why it matters to stakeholder
Flight Crew	Are subjected to new wake turbulence separation rules applied by ATC.	Flight crews need to be aware of updated wake separation rules. Flight crews need to trust the safety of the applied rules.
Flight Crew	Are aware of concepts deployment and impact on reduced separations	They are responsible for the safety of aircrew and passengers on-board. It is important that they respond to the ATCO instructions promptly.
Airport Operator	They cope with the departures traffic pressure	Departures concepts deployment can provide capacity, resilience and predictability benefits to the departures traffic flow
ANSP	They deploy the departures concepts	They manage the air traffic control operations
Regulator	They need to approve the use of the concepts	They regulate the standards for air traffic control
ATCO	They provide ATC services and apply separations based on the concepts	The use of the tool and departures concepts shall not impact their workload such as to adversely impact safety of operations
Airline Operator	They schedule the flights	Improved capacity, predictability and resilience can reduce disruptions and provide financial benefits.

Table 55: Stakeholder's expectations for Departures Concepts Solutions

A.1.3 Wake Risk Monitoring Concept Solution

Stakeholder	Involvement	Why it matters to stakeholder
Flight Crew	Are subjected to new wake turbulence separation rules applied by ATC.	Flight crews need to be aware of updated wake separation rules. Flight crews need to trust the safety of the applied rules.
Flight Crew	Provide wake encounter reporting form in case of a significant wake turbulence encounter.	The wake risk monitoring concept solution facilitates the task of reporting a wake encounter and reduces workload of the flight crew.
ATCO	May receive wake turbulence encounter report from flight crew via R/C and fill out a corresponding reporting form.	The wake risk monitoring concept solution facilitates the task of reporting a wake encounter and reduces workload of the ATCO.
Regulator	Has to ensure continued safety of air traffic procedures.	The wake risk monitoring concept solution provides an objective and reliable means to monitor safety with respect to wake turbulence encounters.
ANSP	Has to ensure continued acceptability of wake risk.	The wake risk monitoring concept solution provides an objective and reliable means to monitor safety with respect to wake turbulence encounters.
Airport Operator	Has to ensure continued safety of runway operations.	The wake risk monitoring concept solution provides an objective and reliable means to monitor safety with respect to wake turbulence encounters.
Airline Operator	Has to ensure continued safety of aircraft operations.	The wake risk monitoring concept solution provides an objective and reliable means to monitor safety with respect to wake turbulence encounters.
Aircraft Manufacturer	Has an interest in identifying increased wake risk related to particular aircraft models.	The wake risk monitoring concept solution provides an objective and reliable means to monitor safety with respect to wake turbulence encounters.

Table 56: Stakeholder's expectations for Wake Risk Monitoring Concept Solution

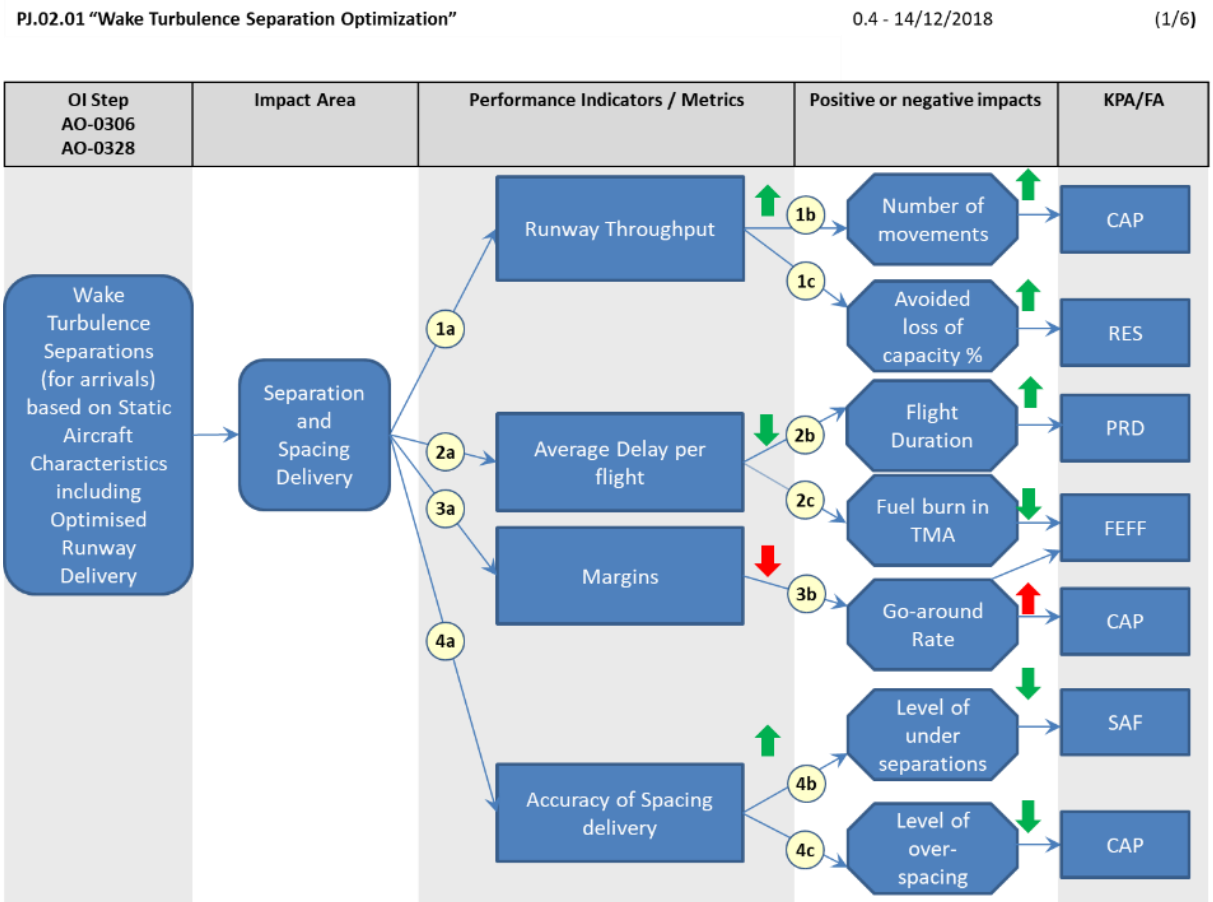
A.1.4 Wake Decay Enhancing Concept Solution

Stakeholder	Involvement	Why it matters to stakeholder
ANSP	Responsible for safe separations at the airports. Check the integrity of the plate line structure, fold the plates down in stormy conditions	Expect to increase safety level and thus experience fewer go-arounds. Further expect potential capacity gains via synergies with other measures for the optimization of aircraft separations.
Airport Operator	Provides the infrastructure for the plate lines (installation site, electricity)	Expect an enhanced safety level and a potential capacity gain. Further expect that the plates do not interfere with the airport instrumentation.
Flight Crew	See the plate lines on approach, need to be aware of plate frangibility	Expect an enhanced safety level on approach. Also expect that the plates are frangible in case of runway excursion
Authorities	Need to approve the installation of the plate lines	

Table 57: Stakeholder's expectations for Wake Decay Enhancing Concept Solution

A.2 Benefits mechanisms

A.2.1 Arrivals Concepts Solutions



(1a) The use of PWS-A is expected to reduce wake separation between arrivals. The use of ORD impacts the separation and spacing delivery between arrivals. The resulting optimised separation and spacing delivery increases the runway throughput.

(1b) The higher the throughput, the higher the number of movements, leading to a positive impact on Capacity.

(1c) Reduction of separations and spacing will result in higher Resilience and avoid loss of capacity.

(2a) Reduction of separations and spacing will reduce the average delay per flight.

(2b) Reduction of average delay per flight will reduce the variance between the flight duration and its planned duration (without delays). This has a positive impact on Predictability.

(2c) As airborne delay uses more fuel (e.g. in case of holding), a reduction in this delay will result in reduced fuel burn in the TMA. This has a positive impact on Fuel Efficiency.

(3a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will reduce the margins delivered.

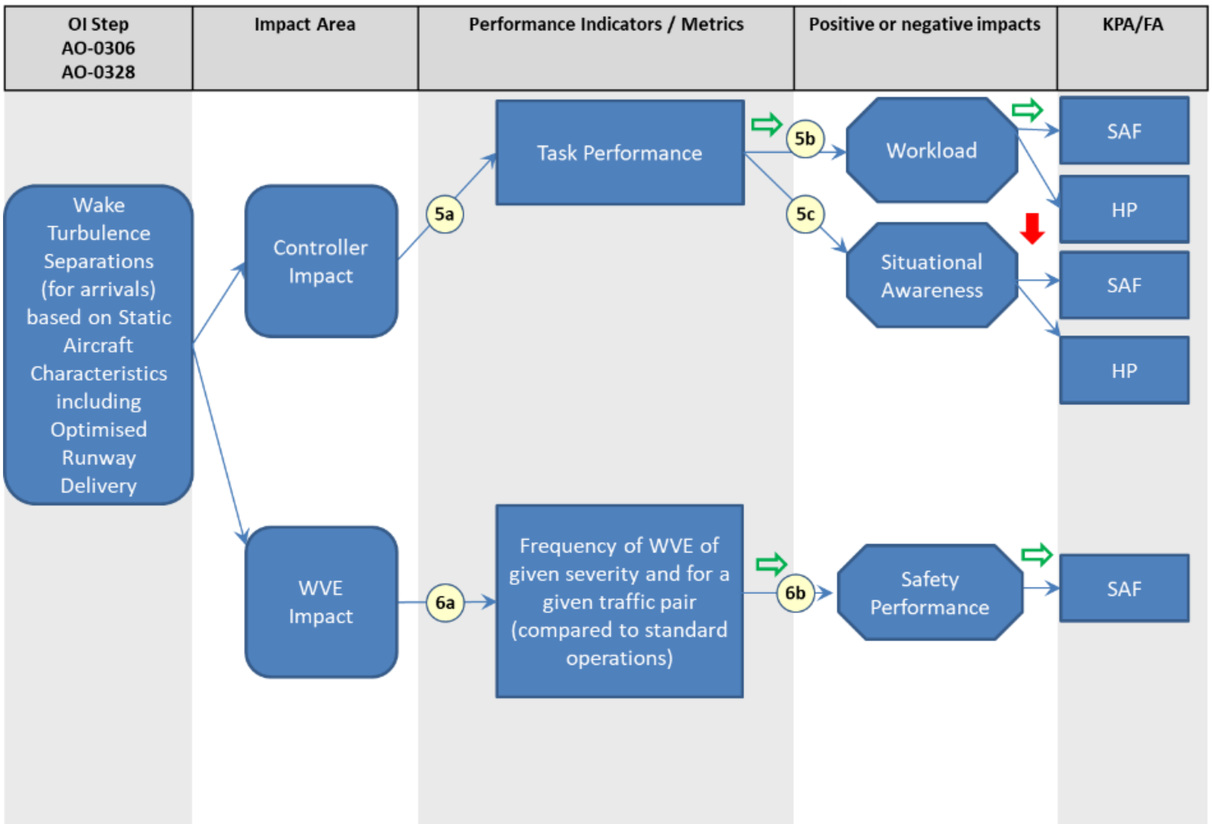
(3b) This may increase the go-around rate and will affect Capacity and Fuel Efficiency.

(4a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will allow controllers to deliver aircraft with greater accuracy than today.

(4b) Improving spacing accuracy will reduce the number of aircraft that are under-separated which links to Safety.

(4c) Improving spacing accuracy will enable more aircraft to be sequenced with reduced spacing which links to Capacity.

PJ.02.01 "Wake Turbulence Separation Optimization" 0.4 - 14/12/2018 (2/6)



(5a) Controller reliance on target indicators may impact Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

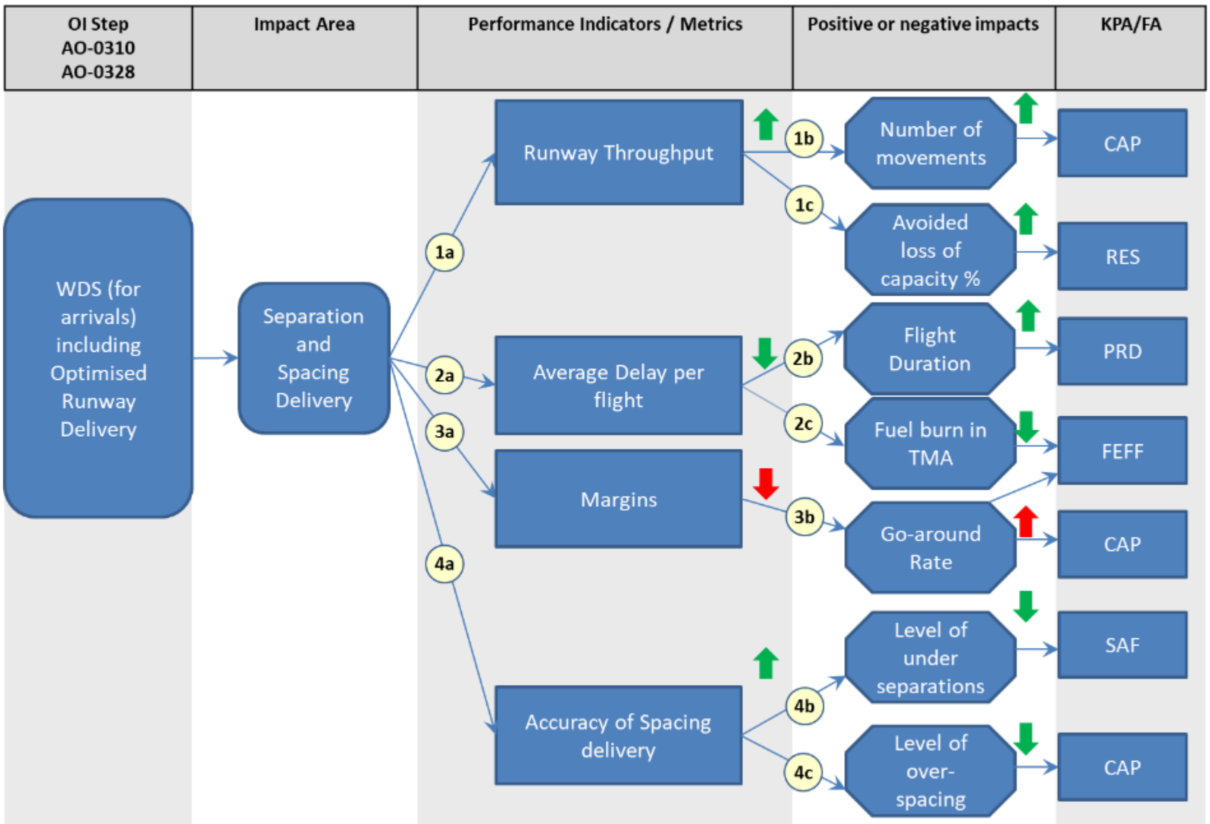
(5b) Overall workload will not increase. It is expected that workload will increase for some tasks such as using the new Sequencing tool HMI. However the benefits of tool support (i.e. the target distance indicators) will reduce workload in other areas so no changes are expected to Safety and Human Performance.

(5c) Reduced Situational Awareness (less aware of aircraft type), if below acceptable levels, could result in a decreased Safety and Human Performance.

(6a) Using PWS-A will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions

(6b) No increase in potential WVEs, will not impact safety performance – links to Safety.

PJ.02.01 “Wake Turbulence Separation Optimization” 0.4 - 14/12/2018 (3/6)



(1a) The use of WDS-A (e.g. for WDS based on crosswind when crosswind is above the activation threshold) is expected to reduce the separation between arrivals. The use of ORD impacts the separation and spacing delivered between arrivals. The resulting optimised separation and spacing delivery increases the runway throughput.

(1b) Increased average runway throughput will result in an increase Capacity.

(1c) Reduction of separations and spacing will result in higher Resilience and avoid loss of capacity.

(2a) Reduction of separations and spacing will reduce the average delay per flight.

(2b) Reduction of average delay per flight will reduce the variance between the flight duration and its planned duration (without delays). This has a positive impact on Predictability.

(2c) As airborne delay uses more fuel (e.g. in case of holding), a reduction in this delay will result in reduced fuel burn in the TMA. This has a positive impact on Fuel Efficiency.

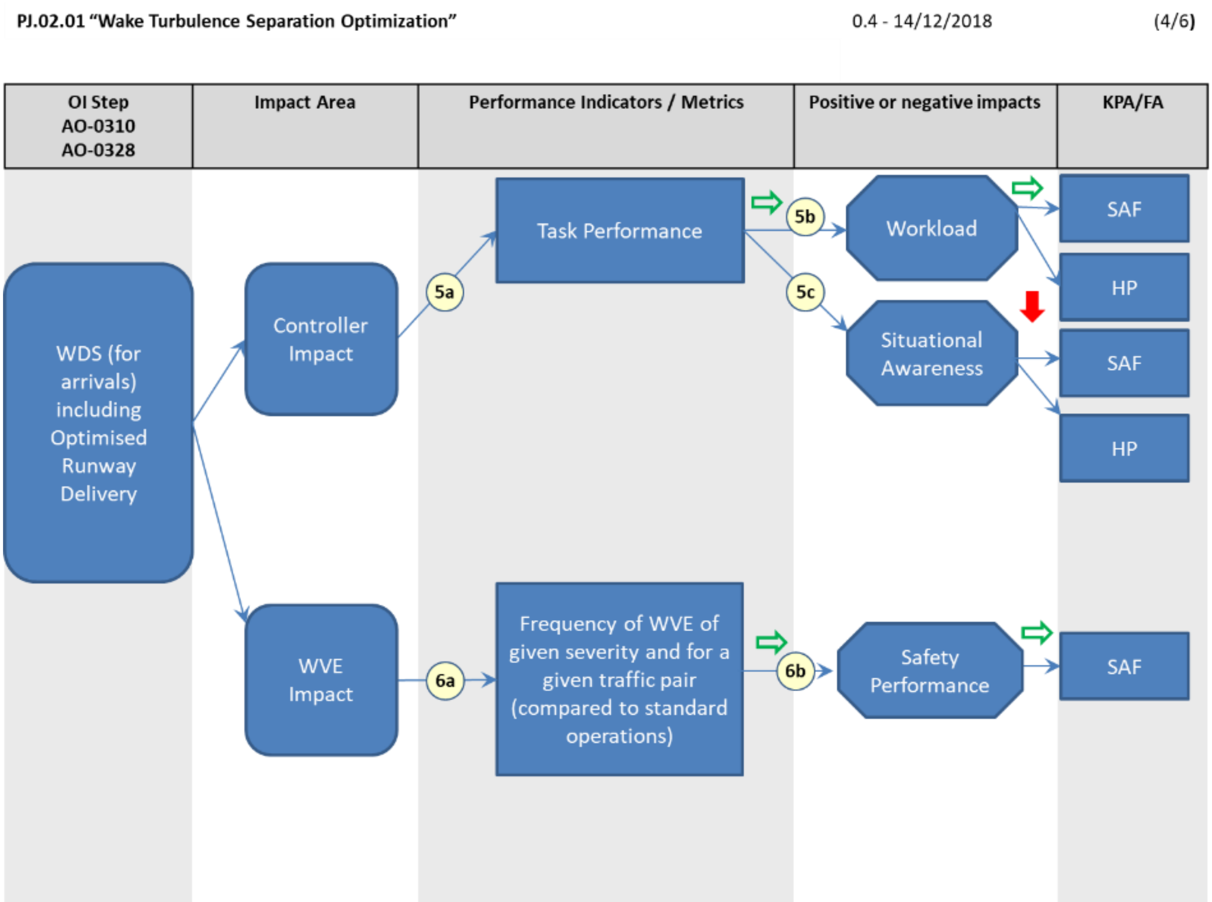
(3a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will reduce the margins delivered.

(3b) This may increase the go-around rate and will affect Capacity and Fuel Efficiency.

(4a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will allow controllers to deliver aircraft with greater accuracy than today.

(4b) Improving spacing accuracy will reduce the number of aircraft that are under-separated which links to Safety.

(4c) Improving spacing accuracy will enable more aircraft to be sequenced with reduced spacing which links to Capacity.



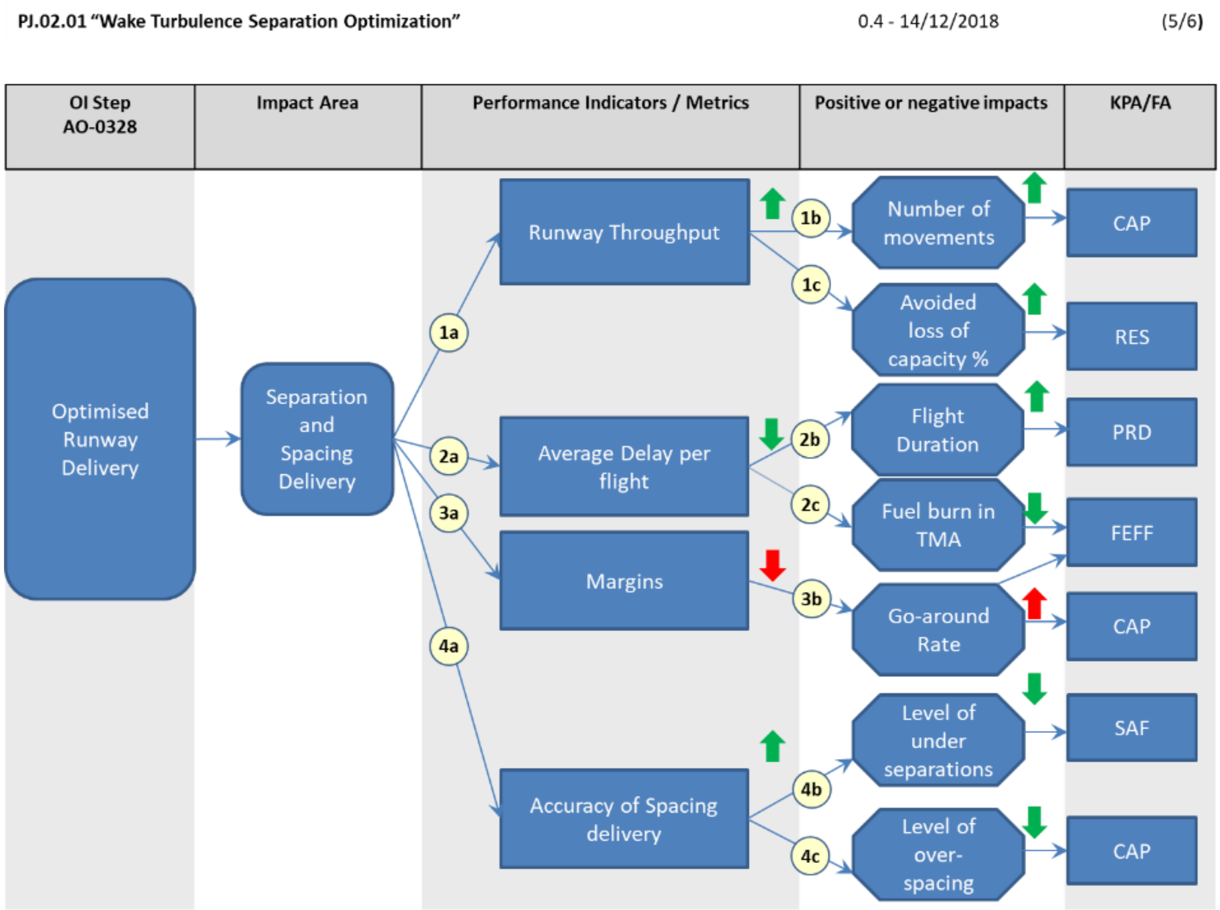
(5a) Controller reliance on target indicators may impact Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

(5b) Overall workload will not increase. It is expected that workload will increase for some tasks such as using the new Sequencing tool HMI. However the benefits of tool support (i.e. the target distance indicators) will reduce workload in other areas so no changes are expected to Safety and Human Performance.

(5c) Reduced Situational Awareness (less aware of aircraft type), if below acceptable levels, could result in a decreased Safety and Human Performance.

(6a) Using WDS-A will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions

(6b) No increase in potential WVEs, will not impact safety performance – links to Safety.



(1a) The use of ORD impacts the separation and spacing delivery between arrivals. The resulting optimised separation and spacing delivery increases the runway throughput.

(1b) The higher the throughput, the higher the number of movements, leading to a positive impact on Capacity.

(1c) Optimised separations and spacing delivery will result in higher Resilience and avoid loss of capacity.

(2a) Optimised separations and spacing delivery will reduce the average delay per flight.

(2b) Reduction of average delay per flight will reduce the variance between the flight duration and its planned duration (without delays). This has a positive impact on Predictability.

(2c) As airborne delay uses more fuel (e.g. in case of holding), a reduction in this delay will result in reduced fuel burn in the TMA. This has a positive impact on Fuel Efficiency.

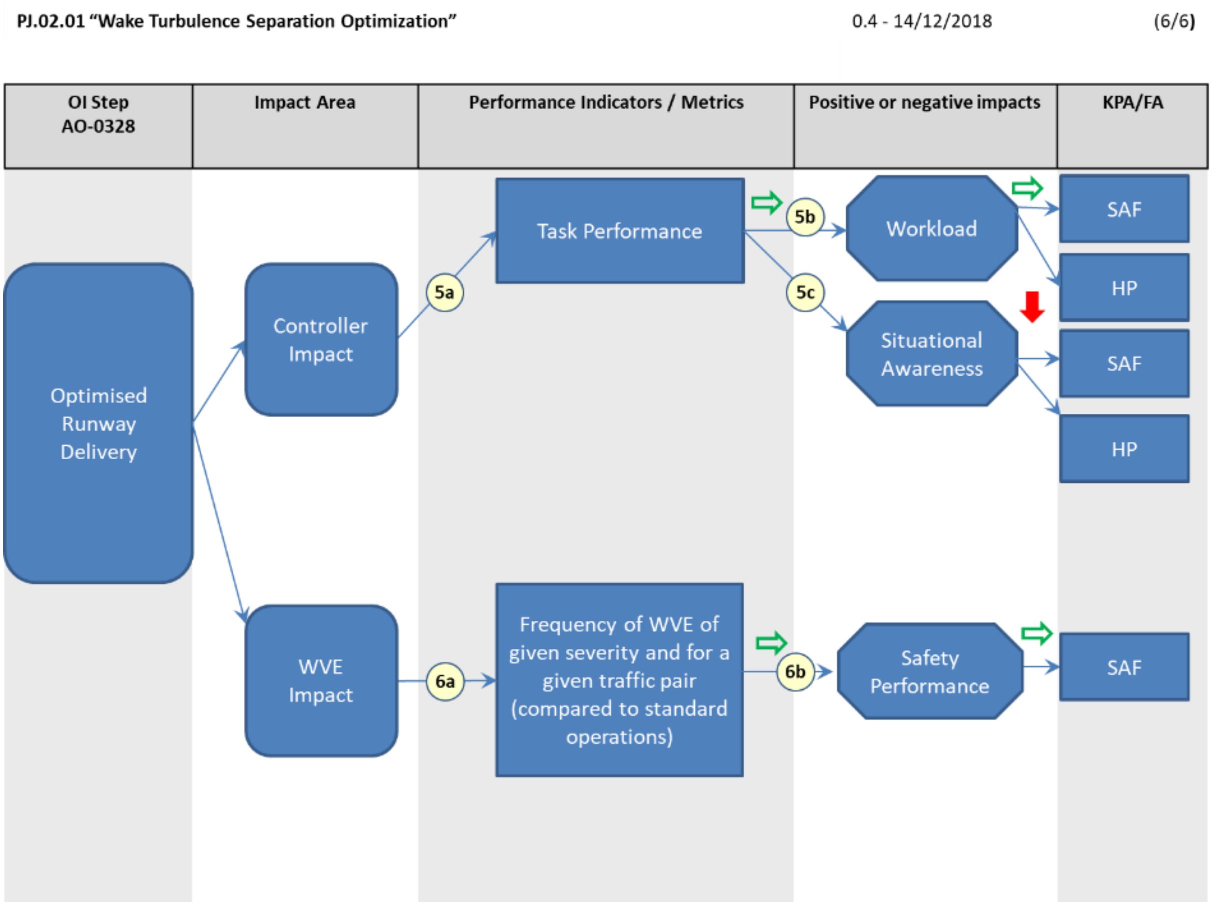
(3a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will reduce the margins delivered.

(3b) This may increase the go-around rate and will affect Capacity and Fuel Efficiency.

(4a) With the use of the target indicators, the accuracy of the spacing between aircraft is improved compared to what is achieved today (e.g. distance between pair of aircraft closer to separation minima) and will allow controllers to deliver aircraft with greater accuracy than today.

(4b) Improving spacing accuracy will reduce the number of aircraft that are under-separated which links to Safety.

(4c) Improving spacing accuracy will enable more aircraft to be sequenced with reduced spacing which links to Capacity.



(5a) Controller reliance on target indicators may impact Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

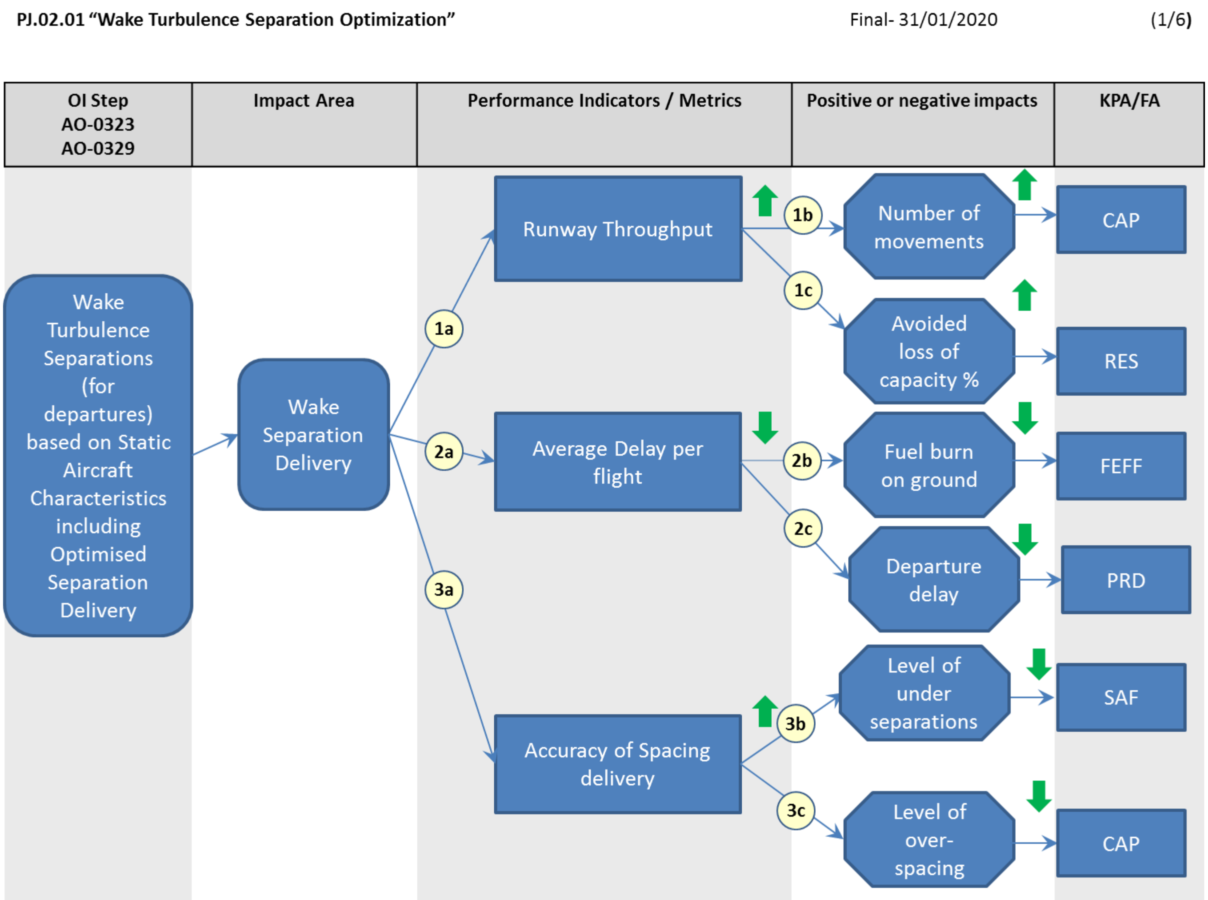
(5b) Overall workload will not increase. It is expected that workload will increase for some tasks such as using the new Sequencing tool HMI. However the benefits of tool support (i.e. the target distance indicators) will reduce workload in other areas so no changes are expected to Safety and Human Performance.

(5c) Reduced Situational Awareness (less aware of aircraft type), if below acceptable levels, could result in a decreased Safety and Human Performance.

(6a) Using ORD will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions.

(6b) No increase in potential WVEs, will not impact safety performance – links to Safety.

A.2.2 Departures Concepts Solutions



(1a) The use of PWS-D is expected to reduce wake separation between departure aircraft. OSD is expected to optimise the accuracy of the spacing delivered between departure aircraft. The reduced wake separations and optimised spacing delivery increases the runway throughput.

(1b) PWS-D reduces wake separation and OSD Optimised spacing delivery accuracy between departure aircraft has a positive impact on the runway throughput. The higher the departure aircraft throughput, the higher the number of departure aircraft movements, leading to a positive impact on Capacity.

(1c) The use of PWS-D reducing the wake departure aircraft separations and the use of OSD improving the spacing delivery will result in higher Resilience and avoid loss of capacity.

(2a) The use of PWS-D Reducing the wake departure aircraft separations will reduce the average ground delay per flight.

(2b) As ground delay uses more fuel (e.g. in case of ground holding), a reduction in this delay will result in reduced fuel burn on the ground. This has a positive impact on Fuel Efficiency.

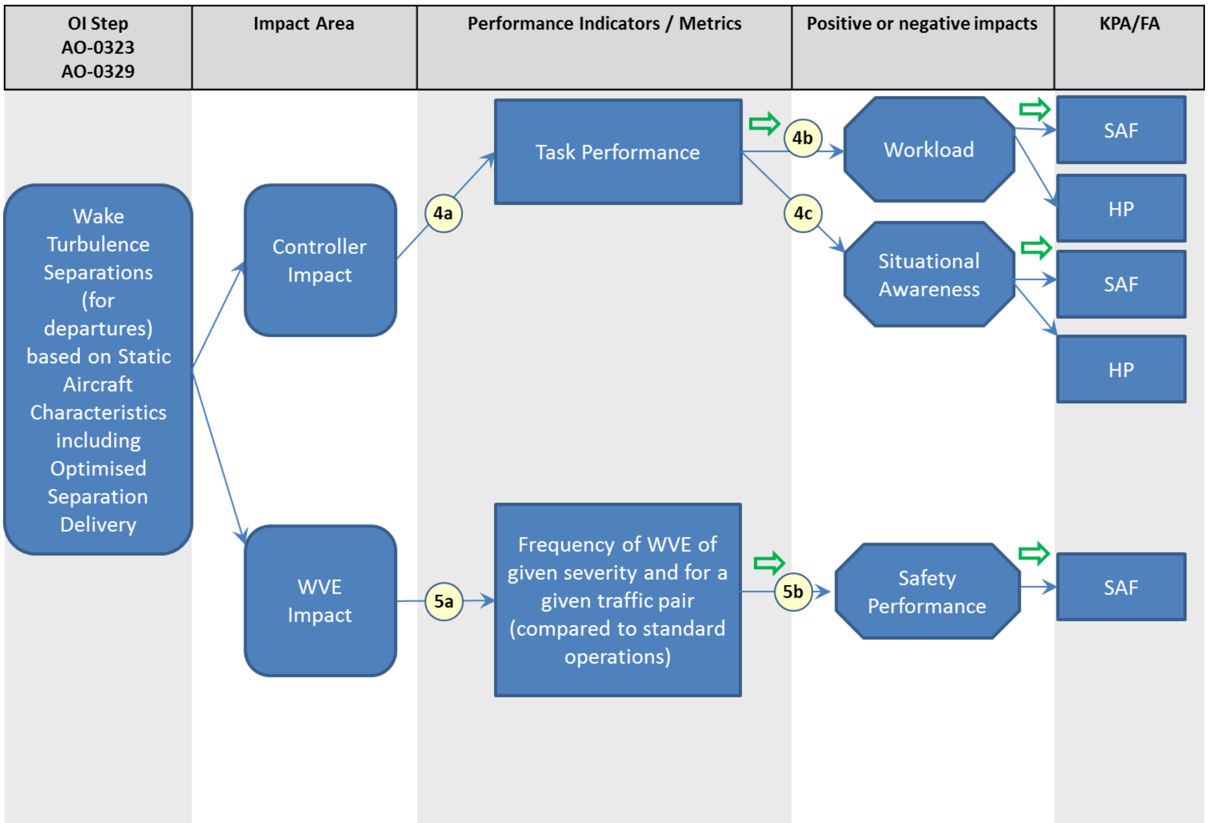
(2c) A reduction in average delay per flight will result in less variability between the planned and actual departure time and departures flying closer to their planned time will improve on-time operations. This has a positive impact on Predictability.

(3a) With the OSD system support, the accuracy of the spacing delivered between departure aircraft can be improved compared to what is achieved today.

(3b) Improved spacing delivery accuracy with the OSD system support can enable the improved separation delivery to the PWS-D rules, reducing the level of 'under separation delivery' compared to what is achieved today, thus enabling a safe reduction in the overall amount of wake separation that is required to be delivered, which links to Safety.

(3c) Improved spacing delivery accuracy with the OSD system support can enable the improved separation delivery to the PWS-D rules, reducing the level of 'over spacing delivery' compared to what is achieved today, thus enabling the efficient reduction of the overall amount of wake separation that is required to be delivered, which links to Capacity.

PJ.02.01 "Wake Turbulence Separation Optimization" Final - 31/01/2020 **(2/6)**



(4a) Controller reliance on the OSD system support should have no impact on Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

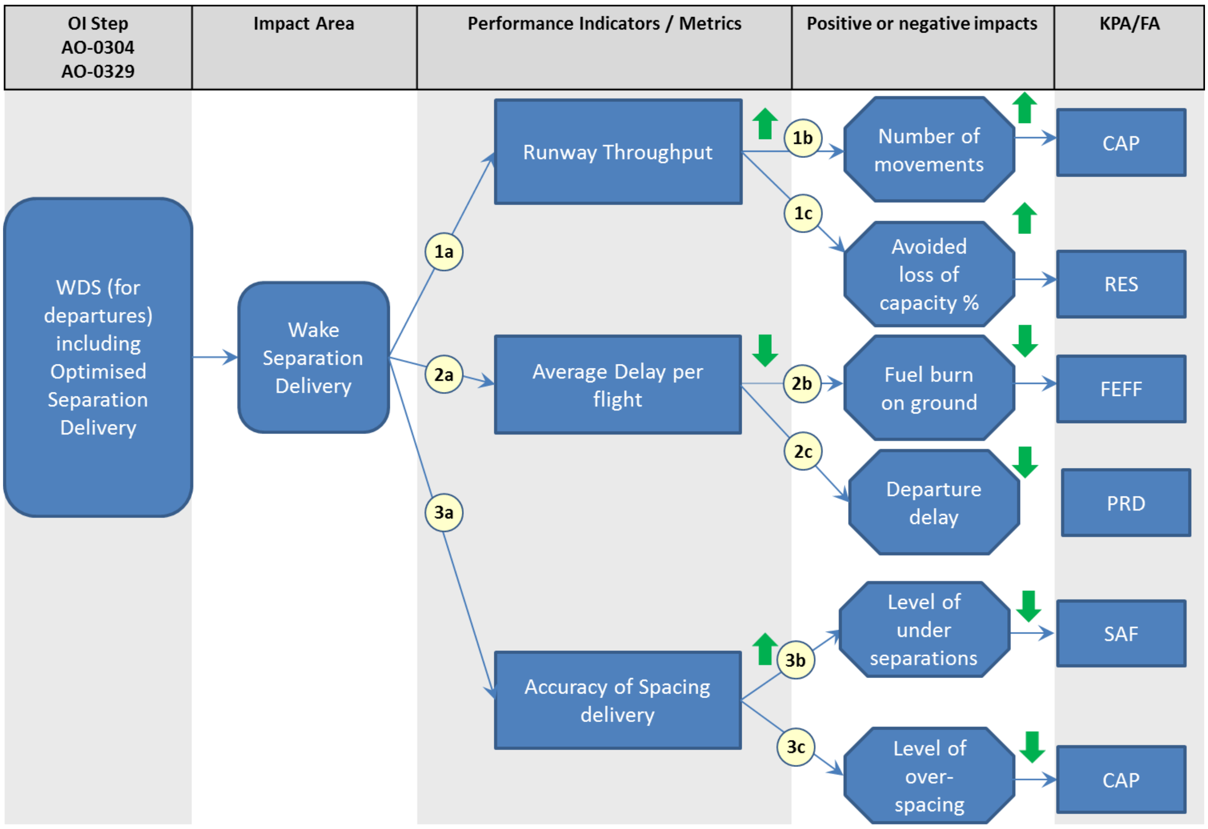
(4b) Overall workload should not increase. It is expected that any workload increase for some tasks will be offset as a result of the OSD system support and reduce workload in other areas, so no changes are anticipated to Safety and Human Performance.

(4c) Situational Awareness is not expected to be impacted and thus no changes are anticipated on Safety and Human Performance.

(5a) Using PWS-D will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions

(5b) No increase in the frequency of potential WVEs compared to reference traffic pair at current standard operations in reasonable worst case conditions, will not impact Safety Performance – links to Safety.

PJ.02.01 "Wake Turbulence Separation Optimization" Final - 31/01/2020 (3/6)



(1a) The use of WDS-D (e.g. for WDS based on crosswind when crosswind is above the activation threshold) is expected to reduce wake separation between departure aircraft. OSD is expected to optimise the accuracy of the spacing delivered between departure aircraft. The reduced wake separations and optimised spacing delivery increasing the runway throughput.

(1b) WDS-D reduced wake separation and OSD optimised spacing delivery accuracy between departure aircraft has a positive impact on the runway throughput. The higher the departure aircraft throughput, the higher the number of departure aircraft movements, leading to a positive impact on Capacity.

(1c) The use of WDS-D reducing the wake departure aircraft separations and the use of OSD improving the spacing delivery will result in higher Resilience and avoid loss of capacity.

(2a) The use of WDS-D reducing the wake departure aircraft separations will reduce the average ground delay per flight.

(2b) As ground delay uses more fuel (e.g. in case of ground holding), a reduction in this delay will result in reduced fuel burn on the ground. This has a positive impact on Fuel Efficiency.

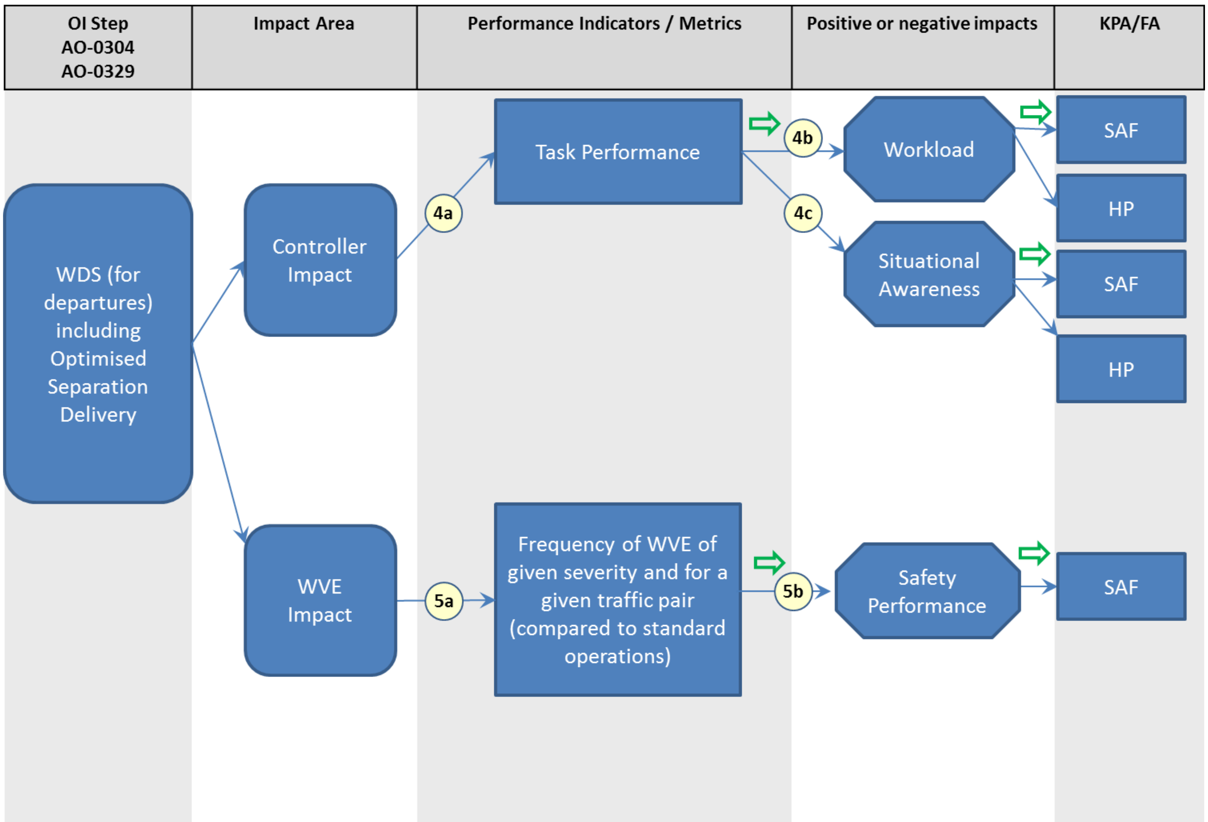
(2c) A reduction in average delay per flight will result in less variability between the planned and actual departure time and departures flying closer to their planned time will improve on-time operations. This has a positive impact on Predictability.

(3a) With the OSD system support, the accuracy of the spacing delivered between departure aircraft can be improved compared to what is achieved today.

(3b) Improving spacing delivery accuracy with the OSD system support can enable the improved separation delivery to the WDS-D rules, reducing the level of 'under separation delivery' compared to what is achieved today, thus enabling a safe reduction in the overall amount of wake separation that is required to be delivered, which links to Safety.

(3c) Improving spacing delivery accuracy with the OSD system support can enable the improved separation delivery to the WDS-D rules, reducing the level of 'over spacing delivery' compared to what is achieved today, thus enabling the efficient reduction of the overall amount of wake separation that is required to be delivered, which links to Capacity.

PJ.02.01 "Wake Turbulence Separation Optimization" Final- 31/01/2020 (4/6)



(4a) Controller reliance on the OSD system support should have no impact on Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

(4b) Overall workload should not increase. It is expected that any workload increase for some tasks will be offset as a result of the OSD system support and reduce workload in other areas, so no changes are anticipated to Safety and Human Performance.

(4c) Situational Awareness is not expected to be impacted and thus no changes are anticipated on Safety and Human Performance.

(5a) Using WDS-D will not increase the frequency of potential WV encounters for a given wind and a given traffic pair compared to reference traffic pair at current standard operations in reasonable worst case conditions

(5b) No increase in the frequency of potential WVEs compared to reference traffic pair at current standard operations in reasonable worst case conditions, will not impact Safety Performance – links to Safety.

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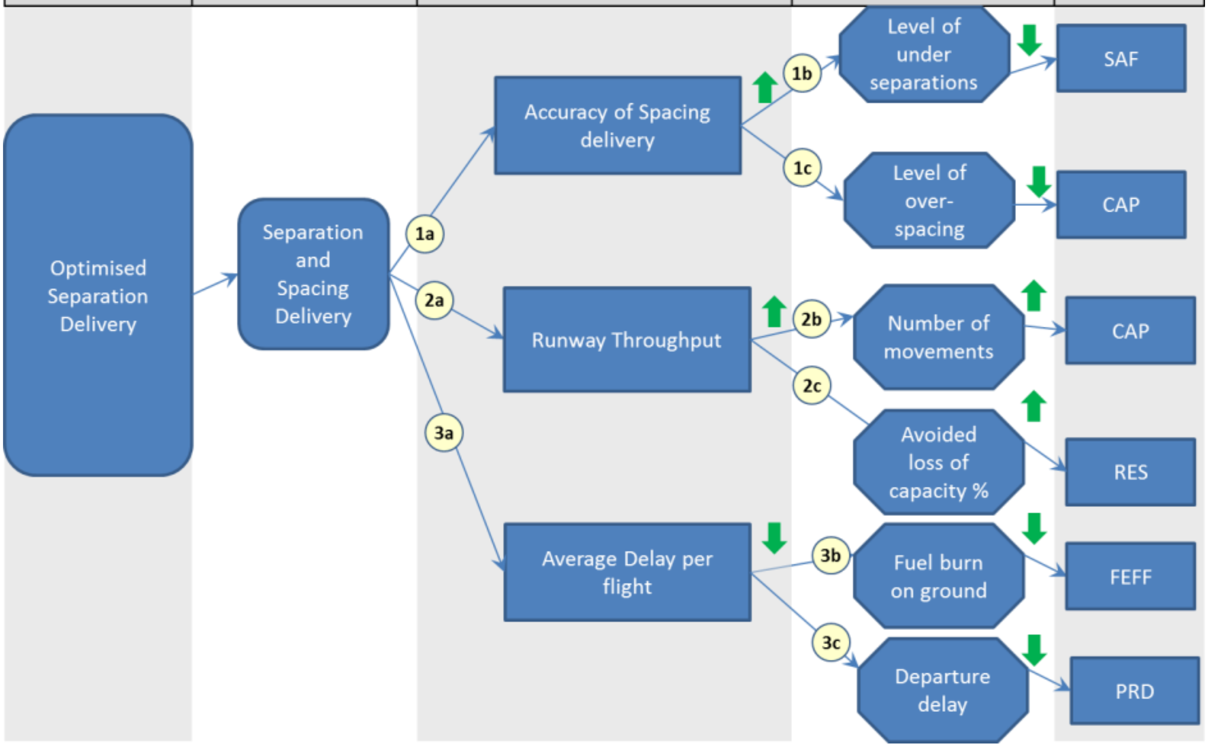
OI Step AO-0329	Impact Area	Performance Indicators / Metrics	Positive or negative impacts	KPA/FA



(1a) With the OSD system support, the accuracy of the spacing delivered between departure aircraft can be improved compared to what is achieved today.

(1b) Improving spacing delivery accuracy can enable the consistent separation delivery to the wake separation rules, with a reduced level of ‘under separation delivery’ compared to what is achieved today which links to Safety.

(1c) Improving spacing delivery accuracy can reduce the level of ‘over spacing delivery’ compared to what is achieved today, thus enabling the efficient reduction of the overall amount of wake separation that is required to be delivered, which links to Capacity.

(2a) The use of OSD is expected to optimise the delivery of departure aircraft separations and thus increasing runway throughput.

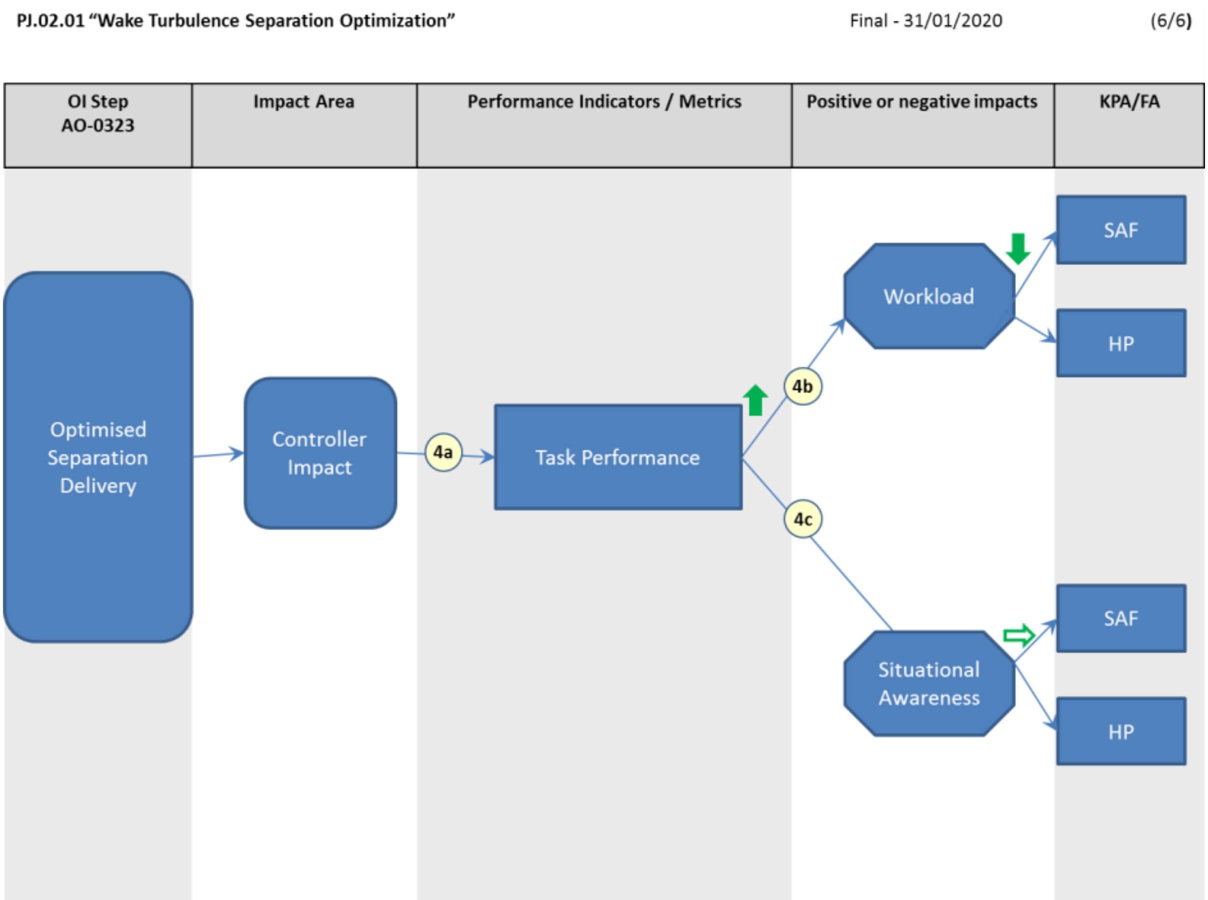
(2b) Optimised spacing delivery between departure aircraft has a positive impact on the runway throughput. The higher the departure aircraft throughput, the higher the number of departure aircraft movements, leading to a positive impact on Capacity.

(2c) Optimised delivery of departure aircraft separations can result in higher Resilience and avoid loss of capacity.

(3a) Optimised delivery of departure aircraft separations can reduce the average ground delay per flight.

(3b) As ground delay uses more fuel (e.g. in case of ground holding), a reduction in this delay will result in reduced fuel burn on the ground. This has a positive impact on Fuel Efficiency.

(3c) A reduction in average delay per flight will result in less variability between the planned and actual departure time and departures flying closer to their planned time will improve on-time operations. This has a positive impact on Predictability.



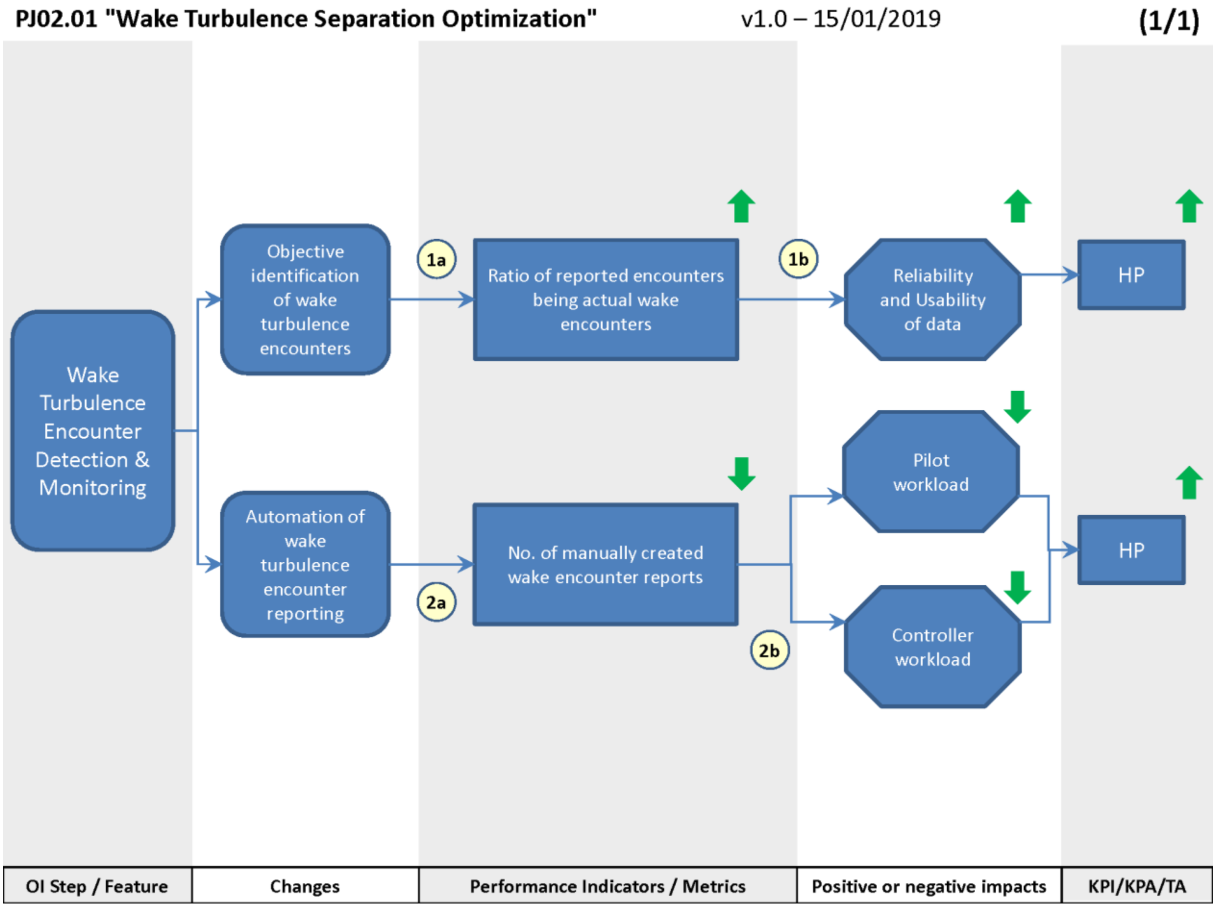
(4a) Controller reliance on the OSD system support should have no impact on Task Performance (i.e. Workload, Situational Awareness and User Acceptance).

(4b) Overall workload should not increase. It is expected that any workload increase for some tasks will be offset as a result of the OSD system support and reduce workload in other areas, so no changes are anticipated to Safety and Human Performance.

(4c) Situational Awareness is not expected to be impacted and thus no changes are anticipated on Safety and Human Performance.

A.2.3 Wake Risk Monitoring Concept Solution

The solution for **wake turbulence detection and monitoring** cannot be directly linked to any Validation Targets from the PJ19 Validation Strategy. It supports the deployment of the other concept areas of this solution. The Benefits and Impacts Model below illustrates the expected effects.



(1a) An objective means to identify wake turbulence encounters leads to a higher fraction of reports that are reliable and actually represent a wake encounter, than if only using manual reporting forms.

(1b) This higher ratio of reliable wake encounter reports leads to a higher reliability and usability of the resulting databases, making the work of the actors using them more efficient.

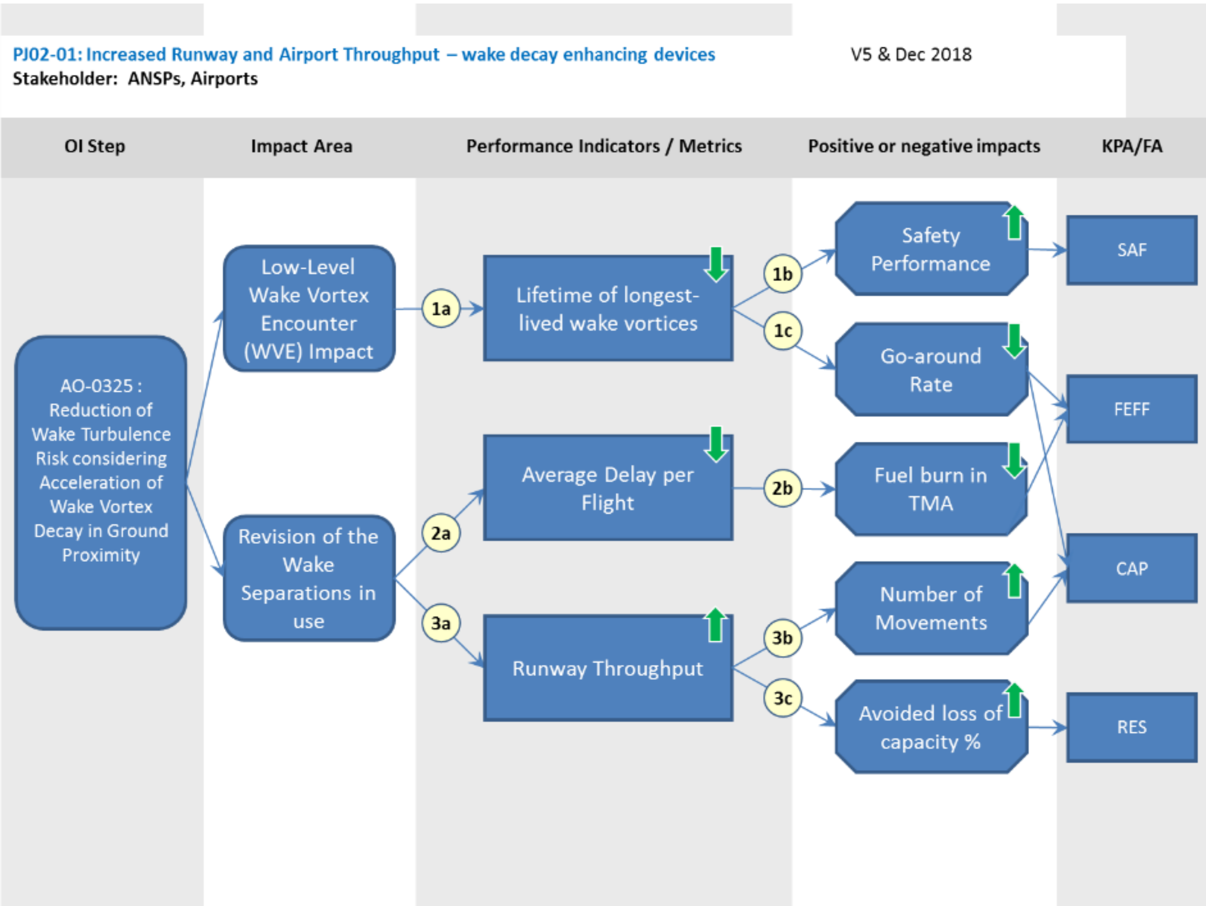
(2a) An automation of the wake encounter identification and reporting process leads to a reduced number of reports that are created manually by pilots or controllers.

(2b) This leads to a reduction in workload for pilots and controllers, ultimately leading to a positive impact on Human Performance.

A.2.4 Wake Decay Enhancing Concept Solution

Primarily, the expected benefit is an increase of safety by accelerating the decay of the longest-lived and thus potentially most hazardous wake vortices during the flight phase with most encounters. So plate lines can be considered as relevant element compensating encounter risks caused by increasing traffic and reduced aircraft separations.

Because most encounters occur during final approach further benefits may be realized by increasing runway capacity. This could be achieved by exploiting the acceleration of vortex decay in this bottleneck phase of flight for the optimisation of aircraft separations. Also the predictability of wake vortex decay could be increased because uncertainty regarding the longest lived vortices in ground proximity can be reduced. Optimisation of aircraft separations and avoidance of go-arounds due to wake vortex encounters in ground proximity improve environment/fuel efficiency. As a passive means almost without running expenses the installation of plate lines is also very cost effective. Because of the fact that the ATM procedures will be unchanged and no further systems usage is required, this concept provides a highly efficient solution method for wake-vortex decay acceleration without raising any additional workload for the controllers. Furthermore, the applicability to basically any airport environment offers a high degree of interoperability due to the flexibility in terms of plate line design and amount of plate lines and single plate elements.



(1a) Measurements indicate that the lifetime of the longest lived and thus potentially most hazardous wake vortices can be reduced by one third.

(1b) Reduced wake-vortex lifetime will reduce encounter frequency corresponding to an improved Safety Performance (SAF).

(1c) Due to reduced encounter frequency, the go-around rate is reduced, leading to positive impacts on Fuel Efficiency (FEFF) and Capacity (CAP).

(2a) Reduced vortex lifetime will allow for a revision of existing separation rules (ICAO, RECAT-EU and RECAT-PWS-EU) with smaller wake separations between arrivals in a future project. Reduced separations will reduce the average delay per flight.

(2b) A reduction in delay per flight will result in reduced fuel burn in the TMA. This has a positive impact on Fuel Efficiency (FEFF).

(3a) Reduced vortex lifetime will allow for a revision of existing separation rules (ICAO, RECAT-EU and RECAT-PWS-EU) with smaller wake separations between arrivals in a future project. Reduced wake separation for arrivals will increase the runway throughput.

(3b) Higher runway throughput allows for increased number of movements, leading to higher Capacity (CAP).

(3c) Reduction of separations will avoid losses of capacity resulting in higher Resilience (RES).

A.3 Costs mechanisms

A.3.1 Arrivals Concepts Solutions

The main cost drivers for the Arrivals Concepts Solutions are:

- The development and validation of the local method of operations covering all local nominal, non-nominal and failure scenarios.
- The training of the ATCOs and Supervisors and the development and provision of the supporting real-time simulation training facilities and briefing materials.
- The briefing of the Airline Operators and Airspace Users and the development and provision of the supporting briefing materials.
- The data mining and analysis of the local aircraft behaviour on final approach required to characterise the required performance of the aircraft type behaviour modelling in the ATC tool support.
- The data mining and analysis of the local final approach wind conditions aloft behaviour and runway surface wind conditions behaviour required to characterise the required performance of the final approach wind profile modelling in the ATC tool support.
- The data mining and analysis of the local aircraft behaviour on each arrival runway with respect to expeditious exit taxiway vacation and associated runway occupancy time profiles required to characterise the required performance of the aircraft type behaviour modelling in the ATC tool support to provide for ROT Spacing support for clearance to land.
- The development and provision of the required local ATC tool support, the associated integration with the local ATC systems and services with respect to the provision of the required information and events, and the associated integration with the controller and supervisor workstation position facilities with respect to the provision of the required display and HMI interaction facilities support.
- The support of the required optimised wake turbulence separations by the local ATC tool support.
- The development and provision of the required local final approach wind conditions aloft service.
- The provision of the required local runway surface wind conditions service.
- The preparing of the local case with the associated evidence, and the activities for obtaining the local regulatory approval.
- The development of the system support for local post operational monitoring and the provision of the associated local resources for carrying out, reporting and acting on the monitoring findings and associated recommendations.
- The local ATC tool support maintenance costs with respect to accommodating new aircraft types and with respect to actioning required refinements to the characterisation of the aircraft type behaviour modelling and actioning required refinements to the final approach wind profile modelling.

The integration with local ATC systems includes consideration of:

- Surveillance tracking of the arrival aircraft on the intermediate and final approach path legs until entering the airport surface radar blanking area approaching the runway landing threshold.

- Provision of a high integrity final approach arrival sequence order out to the horizon that separation/spacing support is required to be provide to the approach controllers. This may be through provision of the electronic flight progress strip order of the final approach controller, or through the population and controller amendment of the AMAN sequence order, or through the provision of an auto-sequence function or an automatic checking and correction function in the ATC tool support.
- Provision of the flight data for the arrival aircraft on intermediate and final approach. This may be from the AMAN System or from the Flight Data Processing (FDP) System.
- Provision of the other Separation and Spacing Minima that are required to be applied; both non-changing pre-configured criteria such as the MRS associated with the Surveillance Service being employed by the approach controllers and also the prevailing operating conditions dependent criteria such as the Spacing Minima required to be applied for the runway surface conditions and the visual conditions in order to ensure provision of the required spacing for the clearance to land procedures. The required Spacing Minima may be provided through the AMAN System.
- Provision of scenario specific spacing requirements such as gaps for accommodating crossing movements, gaps for accommodating departure aircraft in mixed mode operations, and gaps for other reasons such as for accommodating a runway inspection for foreign objects and debris.
- Provision of runway surface wind conditions from the local runway anemometer service.
- Provision of the final approach wind conditions aloft profile through a suitable MET Service which may include local derivation from the downlinked Enhanced Mode S airborne parameters in the secondary surveillance data of the local final approach surveillance service.

The above are reflected in the enablers for each of the Arrivals Concepts Solutions listed below.

AO-0328: Optimised Runway Delivery on Final Approach

- AERODROME-ATC-68: ATC system to support optimised runway delivery on final approach (Required)
- APP ATC 120: ATC system to support optimised runway delivery on final approach (Required)
- APP ATC 99: ATC System to use Real-Time Meteo Information Received from Met Systems (Required)
- STD-093: EUROCONTROL Guidelines for Optimised Runway Delivery (Required)

AO-0306: Wake Turbulence Separations (for arrivals) based on Static Aircraft Characteristics

- AERODROME-ATC-42a: Airport ATC Runway Usage Management sub-system enhanced for processing static wake-turbulence information (Required)
- APP ATC 118: ATC System to support static pair-wise wake separation (S-PWS) on approach (Required)
- REG-0523: Regulatory provisions (AMC) for static pair-wise wake separation minima (S-PWS) (Required)
- STD-HNA-13: Non-ICAO Standards for 'Airport ATC Runway Usage Management sub-system enhanced for processing static wake-turbulence information' (Required)

AO-0310: Weather-dependent reductions of Wake Turbulence Separations for final approach

- APP ATC 74: ATC System Support for Reduced, Weather-Dependent Separation Standards in Final Approach (Required)
- APP ATC 99: ATC System to use Real-Time Meteo Information Received from Met Systems (Required)

A.3.2 Departures Concepts Solutions

The main cost drivers for the Departures Concepts Solutions are:

- The development and validation of the local method of operations covering all local nominal, non-nominal and failure scenarios.
- The training of the ATCOs and Supervisors and the development and provision of the supporting real-time simulation training facilities and briefing materials.
- The briefing of the Airline Operators and Airspace Users and the development and provision of the supporting briefing materials.
- The data mining and analysis of the local aircraft behaviour on the initial departure paths required to characterise the required performance of the aircraft type behaviour modelling in the ATC tool support. This is required for distance-based wake separation procedures and may be required for time-based wake separation procedures if there is a need to actively manage airborne spacing evolution along the initial departure path.
- The data mining and analysis of the local initial departure path wind conditions aloft behaviour and runway surface wind conditions behaviour required to characterise the required performance of the runway surface and initial departure path wind profile modelling in the ATC tool support.
- The data mining and analysis of the local aircraft behaviour on each departure runway with respect to line-up position, take-off roll and initial airborne position to characterise the required performance of the aircraft type behaviour modelling in the ATC tool support. This is required for distance-based wake separation procedures and may be required for time-based wake separation procedures if there is a need to actively manage airborne spacing evolution along the initial departure path.
- The development and provision of the local ATC tool support, the associated integration with the local ATC systems and services with respect to the provision of the required information and events, and the associated integration with the controller and supervisor workstation position facilities with respect to the provision of the required display and HMI interaction facilities support.
- The support of the required optimised wake turbulence separations by the local ATC tool support.
- The development and provision of the required local initial departure path wind conditions aloft service.
- The provision of the local runway surface wind conditions service including consideration of topological influences at the initial airborne positions of the departing aircraft.
- The preparing of the local case with the associated evidence, and the activities for obtaining the local regulatory approval.
- The development of the system support for post operational monitoring and the provision of the associated resources for carrying out, reporting and acting on the monitoring findings and associated recommendations.

- The ATC tool support maintenance costs with respect to accommodating new aircraft types and with respect to actioning required refinements to the characterisation of the aircraft type behaviour modelling and actioning required refinements to the initial departure path wind profile modelling.

The integration with local ATC systems includes consideration of:

- Surveillance tracking of the departure aircraft on the ground through line-up, take-off roll, and becoming airborne. This is required when there is a need for automated detection of the line-up and the associated line-up position, the start of take-off roll time, and the airborne time.
- Surveillance tracking of the departure aircraft in the air on the initial departure path. This may be required to support monitoring of aircraft behaviour and separation conformance.
- Provision of a high integrity runway take-off sequence order. This may be through the events generated for the departure runway controller electronic environment as the departure aircraft are issued with the line-up clearance and the electronic flight progress strips is moved to the runway bay, is issued with the take-off clearance and begins the take-off roll, and then rotates and is visually conformed as airborne. This may be through or supplemented by surveillance monitoring of the line-up position, the start of take-off roll, and becoming airborne.
- Provision of the flight data for the departure aircraft issued with line-up clearances and taking-off. This may be from the departure runway controller electronic environment or from the DMAN System or from the Flight Data Processing (FDP) System.
- Provision of runway surface wind conditions from the local runway anemometer service.
- Provision of the initial departure path wind conditions aloft profile through a suitable MET Service which may include local derivation from the downlinked Enhanced Mode S airborne parameters in the secondary surveillance data of the local initial departure path surveillance service.

The above are reflected in the enablers of each of the Departure Concepts Solutions listed below.

AO-0329: Optimised Separation Delivery for Departure

- AERODROME-ATC-69: ATC system to support optimised departure separation (Required)

AO-0323: Wake Turbulence Separations (for departures) based on Static Aircraft Characteristics

- AERODROME-ATC-42a: Airport ATC Runway Usage Management sub-system enhanced for processing static wake-turbulence information (Required)
- REG-0523: Regulatory provisions for static pair-wise wake separation minima (S-PWS) (Required)
- STD-HNA-13: Non-ICAO Standards for 'Airport ATC Runway Usage Management sub-system enhanced for processing static wake-turbulence information' (Required)

AO-0304: Weather-dependent reductions of Wake Turbulence Separations for Departure

- AERODROME-ATC-19: Runway Usage Management sub-system capable of processing initial departure path wind conditions information (Required)
- REG-0522: Regulatory provisions for weather-dependent separation minima (WDS)

A.3.3 Wake Risk Monitoring Concept Solution

The main cost drivers for the Wake Risk Monitoring Concept Solution are expected to be the provision of on-board aircraft data by airlines and the storage of the data on a data analytics platform.

In order to run the detection and monitoring tool, a certain number of on-board avionics data is required, which will have to be made available by the airline owning the aircraft. This kind of data however is not exclusive to a Wake Risk Monitoring tool and can be used for a number of other purposes as well. Depending on the business model, this data may thus be available with only little or no additional cost.

Additionally a database of ADS-B Out data with sufficient coverage needs to be available. The ADS-B Out data messages broadcast by aircraft are in principle freely available. If the required data is not recorded on the aircraft themselves and included in above-mentioned avionics data, an external database may however be required from a provider with sufficient coverage of ADS-B receivers. This may induce additional recurring costs.

Finally, a data analytics platform with adequate storage and processing capabilities needs to be available to run the detection and monitoring tool. This platform may induce recurring costs.

A.3.4 Wake Decay Enhancing Concept Solution

Costs for the wake decay enhancing concept solution arise mainly from the purchase and the installation of the required plate lines. Maintenance costs are low and can be neglected. Currently, it is assumed that per runway end two plate lines are needed, each consisting of 8 plates. The planned measurement campaign will show whether a third plate line is required to cover the whole area where wake vortices may rebound to the flight track.

A first design for the permanent installation assumes aluminium lattice masts grounded with prefab concrete foundations and covered with truck tarpaulin. The costs for the purchase and installation of one plate line have been estimated to an intermediate five-digit amount of Euros. Possibly airports might prefer a plate line solution that is automatically retractable in the ground under strong wind conditions and when the other runway direction is used. Such solutions would likely require investments in the lowest six-digit amount of Euros.

The primary benefit of the installation of plate lines is the increase of safety during final approach by decreasing the lifetime of the longest lived wake vortices. As a consequence, costs can be saved by reducing the number of go-arounds and in an extreme case by the avoidance of an accident. Monetary benefits may also arise in combination with regulations and systems optimizing aircraft separations because wake vortex encounter risks during the flight phase with most encounters is reduced. An assessment indicates a reduction of tactical delay costs on the order of over a million Euros per year for a large airport.

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