Action 1:

Demonstration Report

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Abstract

This document provides the report of the iStream Large Scale Demonstration.

The iStream (integrated SESAR TRials for Enhanced Arrival Management) project investigated the feasibility and operational benefits of Target Time in various operational environments.

Exercises (live trials) have been conducted on Paris-CDG and Zurich arrival flows:

- Dynamic Demand and Capacity Balancing (dDCB),
- Target Time management for Paris-CDG arrivals,
- Target Time management for Zurich arrivals,

And in en-route ACCs:

- Target Time-based STAM

This report presents the results of the experimentation, as defined per the WP Performance Assessment, the conclusions and the recommendations for further steps.

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00.01.00		Issue 1.0 draft 2		• Integration of WP04/WP05 contribution, • Summary of COM activities, • Table of SESAR/iStream links
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This deliverable consists of SJU foreground.

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1 Executive summary

The objective of the iStream (integrated SESAR Trials for Enhanced Arrival Management) project is to pave the way for evaluating concepts from the PCP within an integrated global collaborative management of arrivals.

The project, following the FAIR STREAM demonstration, particularly addresses the Target Time Management.

- The FAIR STREAM project proved the feasibility of the use of Target Time for a few flights, and the improvement in the predictability of flights.
- The iStream Large Scale Demonstration demonstrates the feasibility and operational benefits of Target Time on complete flows.

Four exercises (live trials) were conducted from April 2015 to September 2016:

- dynamic DCB,
- Target Time management for Paris arrivals,
- TT-based STAM,
- Target Time management for Zurich arrivals.

iStream demonstrated that the TT could be usable for complete flows and provide operational benefits in the current environment. Below are the key iStream conclusions, relating to the Target Time Management:

- **Target Time adherence of participating flights has been improved,** taking into account learning effect from dispatch, FMPs and flight crews. Target Time adherence was achieved with almost 70% of trial flights to Zurich in a window of [-4;+4] around their Target Time. The reduced flight time in TMA and the reduction of flights arriving too early (before the opening of Zurich airport) led to and optimized flight arrival management in the TMA. Target Time adherence for trial flights inbound Paris-CDG was also improved.
- **Flight efficiency has been improved during iStream trials.** Holdings have been drastically reduced for Zurich arrivals (SWISS was able to measure a reduction of 96%), along with radar vectoring, with positive impact on fuel. Delay in the terminal sectors (additional time in ASMA – Arrival Sequencing and Metering Area) for Paris-CDG arrivals have been reduced by 30 seconds per flight.
- **The Target Time information allowed to better manage the flight before departure.** In LFPG exercise, the pilot could calculate a Target Take-Off Time optimising the flight profile, reducing the fuel burn and improving departure punctuality. Depending on the situation, aircrews could leave the gate earlier, which improved departure punctuality and fuel efficiency.
- **The Target Time enabled to take Airspace Users' preferences into account.** The procedures developed in iStream allowed taking into account the Airspace Users' preferences and providing arrival flexibility (AFLEX) to flights.
  - Prioritized flights saw their delay reduced by 5 to 15 minutes in Paris trial, on the 5 occurrences. Flights can also be advanced in order to solve an ATFCM hotspot.
  - With the swaps within SWISS ranking, passenger connections are ensured and help to improve passenger convenience with more time to walk to their connecting flight. This of course improves the punctuality of the first outbound flights with passenger connections as well. Therefore, a reduction of rotation delays (IR91) is also a qualitative result.
- Although there is less variability during the trials, **the adherence to Target Time is influenced by the Take-Off Time.** The Take-Off Time is influenced by departure clearance and taxi time, which are not fully manageable by the flight crew.

Furthermore, iStream demonstrated the added value of local and collaborative tools and processes to solve hotspots:

- The **local Target Time assignment allows further improving the available capacity, thanks to more accurate data**. With a new local ATFM tool, delays of regulated flights were reduced by around 20% on Paris-CDG arrivals.
- **The collaborative processes developed in iStream provided efficiency benefits for all stakeholders.** The rerouting scenarios implemented at Paris-ACC, in collaboration with Maastricht UAC, allowed to drastically reduce ATFM delay in for Paris-CDG arrivals, while providing benefits for MUAC (moving away some flights from the busy MUAC Luxembourg sector compared to baseline scenarios)

Based on the conclusions above, the key recommendation are summarised as follows:

- The inclusion of the Target Time calculated by the Network Manager in the slot messages has proved its usefulness for airspace users and is ready for deployment
- Target Time calculated by a local tool brings additional benefits (better optimization, flexibility for airspace users)
  - NM should be involved in the output of the local CDM processes, in order to assess network impact and share information at the network level. An automatic exchange between local calculation of Target Time and Network Manager is an additional value to ease the dissemination of Target Time.
  - The information of arrival Target Time sequence should be provided to relevant stakeholders.
- It is recommended to pursue work toward the maturity increase for the Adherence Feature of Target Time Management: additional work should be devoted to better integrate the Target Time with ATC departure procedures.
- The Target Time concept opens the possibility to achieve seamless integration of ATFCM and ATC (e.g. integration with XMAN concept): this needs to be investigated.

2 Introduction

2.1 Purpose of the document

This document provides the Demonstration report for iStream Large Scale Demonstration project.

It describes the results of demonstration exercises defined in the applicable version of the iStream Demonstration plan (Refer to [A-5]) and how they have been conducted.

2.2 Intended readership

This document primarily is of interest to:

- The SJU,
- The consortium members,
- The members of:
  - B04.02: SESAR Concept of Operations,
  - Operational federating projects,
  - 05.06.04 QM-4 – Tactical TMA and En-route Queue Management,
  - 05.06.07 QM-7 – Integrated Sequence Building/Optimization of Queues,
  - 06.05.03: Airport capacity and flow management,
  - 06.05.04: AirPort Operations Centre (APOC) definition,
  - 13.02.03: Enhanced DCB,
  - OFA04.01.02: : “Enhanced Arrival & Departure Management in TMA and En Route”,
  - OFA05.01.01: : “Airport Operations Management”,
  - OFA05.03.04: “Enhanced ATFCM processes”,
  - OFA05.03.07: “Network Operations Planning”,
- The partners of the FABEC initiative.

2.3 Structure of the document

This section provides a summary of the document organisation:

- Chapters 1 to 4 reminds iStream scope, context and program management,
- Chapter 5 provides a summary of all exercise scope before providing detailed results per results,
- Chapter 7 presents iStream conclusions and recommendations,
- Chapter 8 lists applicable and reference documents for iStream,
- Chapter 9 provides a summary of communication activities performed within the iStream project,
- Chapter 9 lists all internal iStream documents that are referenced in the report.

Note that the chapter 5 of the report slightly deviates from the SJU template.

This deviation has been performed to effectively manage constrained schedule for exercise report writing.

Glossary of terms

To ease the reading and to avoid some erroneous interpretation, most important terms supporting iStream work are defined below.

Arrival flow:

- A traffic volume at the arrival airport. It can include all arrivals, or be more limited (traffic volume related to a certain entry point…)

iAMAN:

- A local ATFCM tool, developed for Paris arrivals for the needs of the trials, supporting the TT Management (Calculation, distribution, revision).

Target Time (TT):

- TT is an ATM computed time over a point, used in support of DCB measures. The corresponding DCB measures can be:
  - A CASA regulation. In this case, the TT is the expected entry time (CTO) for an airspace-based regulation, or the calculated time over the first point of the STAR for an airport-based arrival regulation. The TT is linked to the CTOT, and is disseminated to all actors involved (ATC, Airspace Users and Flight Crew)
  - A DCB measure with a local solution (STAM or local sequencing tools). In this case, the TT is defined by a local process, and those TT are introduced into the NM system.

iTT:

- Proposed time over the TT-fix elaborated by a local tool (e.g. iAMAN), prior to implementation as TT value by the Network Manager.

Target Time Over (TTO):

- Refers to the Target Time over a specific point. This terminology is used for operational implementation (e.g. as used in SAM/SRM), whereas TT refers to the general concept.

2.4 Acronyms and Terminology

Term	Definition
ACARS	Aircraft Communication Addressing and Reporting System
ACC	Area Control Centre
A-CDM	Airport Collaborative Decision Making
ADAS	Aircraft Data Acquisition System
ADEP	Departure Airport
ADP	"Aéroports de Paris"
AF	Air France
AFLEX	Arrival FLEXibility
AIMA	Airport Impact Assessment
AIRE	Atlantic Interoperability Initiative to Reduce Emissions
AMAN	Arrival Manager
AMAN2	Arrival Manager Step 2
ANSP	Air Navigation Service Provider
AO	Airline Operator
AOBD	Airport Operational Database
AOBT	Actual Off-Block Time
AOC	Airline Operational Communication
AOP	Airport Operation Plan
APOC	Airport Operation Centre
APP	Approach
APR	Aircraft Position Report
ARR	Arrival message
ASM	Airspace Management
ASMA	Arrival Sequencing and Metering Area
ATA	Air Transport Association
ATC	Air Traffic Control
ATCO	Air Traffic Control Operator
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATOT	Actual Take Off Time
ATS	Air Traffic Service
AU	Airspace Users
B2B	Business to Business
CAA	Civil Aviation Authority
CALM AMAN	Zurich operational AMAN
CASA	Computer Assisted Slot Allocation
CDG	"Charles de Gaulle" Airport
CDM	Collaborative Decision Making
CFMU	Central Flow Management Unit
CFP	Company Flight
CHMI	CFMU Human Machine Interface

Term	Definition
CI	Cost Index
CNS	Communication, Navigation and Surveillance
CONOPS	Concept of Operations
CPR	Correlated Position Report
CTOT	Calculated Take-Off Time
CWP	Controller Working Position
DATM	EUROCONTROL Directorate ATM
DCB	Demand Capacity Balancing
dDCB	Dynamic Demand Capacity Balancing
DLH	Deutsche Lufthansa AG
DMAN	Departure Manager
DOD	Detailed Operational Description
DPI	Departure Planning Information
DSNA	Direction des Services de la Navigation Aérienne
DTW	Departure Tolerance Window
DWH	Data Warehouse
E-ATMS	European Air Traffic Management System
ECTL	EUROCONTROL - The European Organisation for the Safety of Navigation
EC	European Community
EDS	Etude de Sécurité (Air France)
EET	Estimated Elapsed Time
EIBT	Estimate In Block Time
EMS	Event Measurement System
ENAIRE	Aeropuertos Españoles y Navegación Aérea (Aena), literally "Spanish Airports and Air Navigation"
EOBT	Estimated Off-Block Time
E-OCVM	European Operational Concept Validation Methodology
EPP	Extended Projected Profile
ETA	Estimated Time of Arrival
ETFMS	Enhanced Tactical Flow Management System
ETO	Estimated Time over
EU	European Union
FABEC	Functional Airspace Block Europe Central
FAIRSTREAM	FABEC ANSPs and AIRlines SESAR Trials for Enhanced Arrival Management
FC	Flight Crew
FDM	Flight Data Monitoring
FL	Flight Level
FMP	ATC Flow Management Position
FMS	Flight Management System
FO	Flight Object
FPL	Flight Plan
FRAMaK	Free Route Maastricht and Karlsruhe
HR	Human Resources
I4D	Initial 4D Trajectory

Term	Definition
IAF	Initial Approach Fix
iTT	iStream local Target Time
IATA	International Air Transport Association
IFPS	Integrated Initial Flight Plan Processing System
KPA	Key Performance Area
LFPG	ICAO code for Paris CDG airport
LFPO	ICAO code for Paris Orly airport
LSZH	ICAO code for Zurich airport
MCP	Mandatory Cherry Picking
MFS	Message From Shanwick
MUAC	Maastricht Upper Area Control Centre
NATS	National Air Traffic Services
NM	Network Management
NMC	Network Management Cell
NMOC	Network Manager Operations Centre
NMVP	Network Management Validation Platform
NOP	Network Operations Plan
NOTAM	Notice To Air Men
NSA	National Supervisory Authority
OCC	Operational Control Center
OFA	Operational Focus Areas
OI	Operational Improvement
OM	Operating Manual
OPS	Operational
ORE	Operational Risk Evaluation
OSED	Operational Service and Environment Definition
PAX	Passenger
PCP	Pilot Common Project
R&D	Research & Development
RTA	Required Time of Arrival
SC	Steering Committee
SEAC	SESAR European Airports Consortium
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
STA	Scheduled Time of Arrival
STAM	Short-term ATFM Measure
STAR	Standard Instrument Arrival
STC	STeering Committee
SWIM	System Wide Information Management
SWISS	Swiss International Air Lines Ltd
TBC	To Be Confirmed

Term	Definition
TBD	To Be Defined
TMA	Terminal Area
TOT	Take Off Time
TT	Target Time
TTA	Target Time of Arrival
TTO	Target Time Over (a fixed point)
TWR	Tower
UAC	Upper Area Control Centre
VP	Verification Plan
VR	Verification Report
WBS	Work Breakdown Structure
WP	Work Package
XMAN	Cross Border Arrival Management

3 Context of the Demonstrations

3.1 Current situation with capacity constraints

The figure below provides the simplified information flow in the current situation, when a destination airport and/or its upstream ACC are capacity constrained:

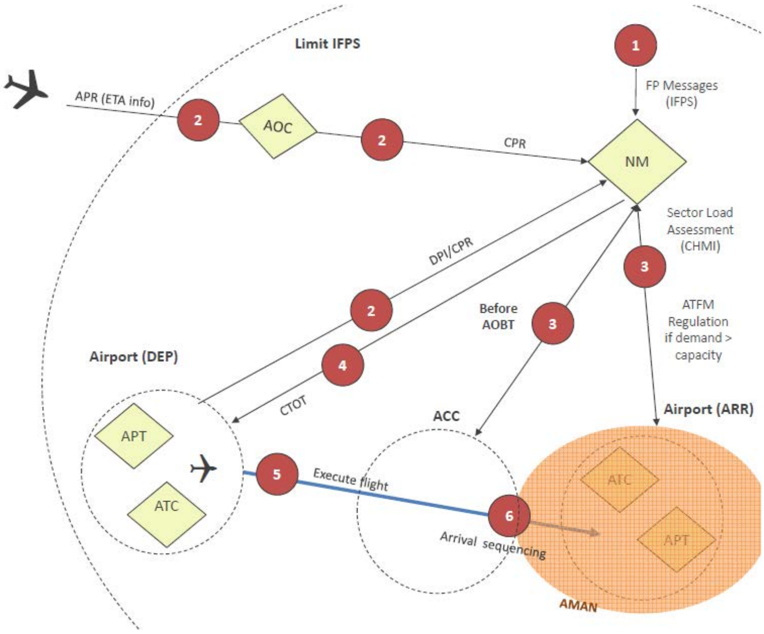

Fig. 1: Information flow when destination airport/ACC are constrained

The detailed steps involved are the following:

- (1) The NM collects flight plan information and its updates, for IFPS flights,
- (2) The NM refines Flight plan information with actual track data information: APR (when available) with ETA information for long-haul flights (transmitted via AOC, and possibly revised during flight), departure information (DPI messages for A-CDM airport), radar data (CPR, MFS – Message from Shanwick, …) when entering the IFPS zone,
- (3) The NM computes sector load information and provides it to FMP in ACCs and APP, via the CHMI interface; Local FMP assesses demand versus capacity and enforce CASA regulation where necessary,
- (4) A departure slot (CTOT) is calculated by the NM, on the "first scheduled first served" principle, and transmitted to the crew (via AOC, not represented here) and departure airport,
- (5) The flight crew executes the flight taking into account the departure slot and the slot tolerance window; No further constraint is communicated to the crew after departure (AOBT),
- (6) APP ATCOs integrate the flight in the arrival sequencing of the destination airport, potentially with AMAN systems (with the principle of first arrived first included in the sequence).

3.2 Foreseen situation with capacity constraints

When destination airport and/or ACC are constrained, the current situation presents the main following inconveniences:

Airport/ACC sector load predictability is limited, leading to increased ATC margins and consequently avoidable ATFM delays,

AUs are not aware of the actual constraints, leading to inefficient flight profiles for delay reduction.

Accordingly, the targeted concept of operation will imply the following evolutions.

The steps involved are the following:

- (1) The NM collects flight plan information and its updates, for IFPS flights,
- (2) The NM refines flight plan information with actual track data information:
- ETA information for long-haul flights (transmitted to AOC at take-off and possibly revised during flight),
- Departure information (DPI messages for A-CDM airport),
- Radar data (CPR, MFS-Message from Shanwick) when entering the IFPS zone,
- (3) The NM computes sector load information and provides it to FMP in ACCs and APP, via the CHMI interface.
- (4) A first TT is issued by a local process or tool (such as iAMAN) in support of the DCB measures. NM assigns the corresponding CTOTs.
- (5) The flight crew executes the flight taking into account the TT, with the objective to adhere to the TT in an indicative [-3 min, + 3 min] window,
- (6) A local process or tool (such as iAMAN) takes into account the actual predicted times at the TT fix and can allocate revised TT if necessary.

3.3 Scope of the demonstration and complementarity with the SESAR Programme

This section provides a high-level overview of the concept of operations addressed by the iStream project in relation with SESAR framework:

<table>
<tr><th></th><th>EXE-01.02-D-01/D02/D03/D06: TT Management for Paris Arrivals</th><th>EXE-01.02-D-04: TT-based STAM</th><th colspan="2">EXE-01.02-D-05: dDCB & Complexity</th><th>EXE-01.02-D-06: TT Management for Zurich Arrivals</th></tr>
<tr><td>Leading organization</td><td>DSNA</td><td>EUROCONTROL</td><td colspan="2">DSNA</td><td>SKYGUIDE</td></tr>
<tr><td>Demonstration exercise objectives</td><td>Evaluate the feasibility and benefits of TT for complete arrival flow</td><td>Evaluate the feasibility and benefits of TT-based STAM measures</td><td colspan="2">Evaluate the benefits of dDCB processes</td><td>Evaluate the feasibility and benefits of TT for complete arrival flow</td></tr>
<tr><td>OFA addressed</td><td>OFA 05.03.04 Enhanced ATFCM processes</td><td>OFA 05.03.04 Enhanced ATFCM processes</td><td colspan="2">OFA 05.03.04 Enhanced ATFCM processes</td><td>OFA 05.03.04 Enhanced ATFCM processes</td></tr>
<tr><td>Applicable Operational Context</td><td>Airport – TMA</td><td>En-route</td><td colspan="2">Airport-TMA
Airport-TMA</td><td>Airport-TMA</td></tr>
<tr><td>Demonstration Technique</td><td>Flight live trials</td><td>Flight live trials</td><td colspan="2">Flight live trials
Flight live trials</td><td>Flight live trials</td></tr>
<tr><td>Start of trials</td><td>May 02, 2016</td><td>April 18, 2016</td><td>April 13, 2015</td><td>May 09, 2016</td><td>June 15, 2015</td></tr>
<tr><td>End of trials</td><td>Sept 16, 2016</td><td>August 31, 2016</td><td>June 24, 2015</td><td>Sept 16,2016</td><td>June 30, 2016</td></tr>
<tr><td>Number of trials</td><td>EXE-01.02-D-01: ~1400
EXE-01.02-D-03: ~ 200
(with 50 “moves”)</td><td>6</td><td>~ 380 (2015)</td><td>~ 200 (2016)</td><td>~ 4800</td></tr>
</table>

Fig. 2: iStream exercises overview

3.3.1 Conformance with the SESAR programme

The iStream project is complementary to the SESAR RELEASE 5 exercises performed in 2015-2016.

The iStream project is strongly linked to:

- SESAR 13.02.03 (Enhanced DCB),
- In particular, VP-749 (“TTA/TTO management”).

The iStream project brings new elements to SESAR 13.02.03 OSED development for the following tasks:

<table>
<tr><th>Related projects in the SESAR Programme</th><th>OFA addressed</th><th>OI steps</th></tr>
<tr><td>13.02.03: Coordination for concept definition and release 5 exercise VP749.</td><td>04.01.02: “Enhanced Arrival & Departure Management in TMA AND En-Route”.</td><td>TS-0305-A: Arrival Management Extended to En Route Airspace – single TMA.</td></tr>
<tr><td rowspan="3">04.02, 05.02, 06.02, 07, 02: Coordination for concept definition.
05.06.04 and 05.06.07: Coordination for concept definition and validation exercises.
06.05.03 and 06.05.04: Coordination for concept definition.
11.01.01: Coordination for concept definition.</td><td>05.03.04: “Enhanced ATFCM processes”.</td><td>DCB-208 DCB in a trajectory management context,
DCB-308: Advanced Short Term ATFCM.</td></tr>
<tr><td>05.03.07: “Network Operations Management”.</td><td>DCB-0103-A Collaborative NOP for Step 1.</td></tr>
<tr><td>05.01.01: “Airport Operations Management”.</td><td>DCB-0310: Improved Efficiency in the management of Airport and ATFCM Planning.
AO-0801-A Collaborative Airport Planning Interface</td></tr>
</table>

The iStream demonstration can be considered as a complement to VP749, validating the concept in a different environment with a different set of business rules for local DCB.

<table>
<tr><th colspan="2">Feature</th><th>VP749</th><th>iStream</th></tr>
<tr><td colspan="2">Airspace Users preferences</td><td>NO</td><td>YES
(Through AFLEX)</td></tr>
<tr><td colspan="2">En-route ATC participation</td><td>NO
(Simulated)</td><td>YES</td></tr>
<tr><td colspan="2">Live Trial</td><td>NO
(Shadow Mode)</td><td>YES</td></tr>
<tr><td colspan="2">AOP/NOP Integration</td><td>YES</td><td>NO</td></tr>
<tr><td colspan="2">Network Objectives Focus</td><td>YES</td><td>Partly</td></tr>
<tr><td colspan="2">ATC Objectives Focus</td><td>NO</td><td>YES</td></tr>
<tr><td colspan="2">Airport Objectives Focus</td><td>YES</td><td>Partly</td></tr>
<tr><td colspan="2">Airline Objectives Focus</td><td>NO</td><td>YES</td></tr>
<tr><td>TT Dissemination</td><td rowspan="4">Common building blocks</td><td>YES</td><td>YES</td></tr>
<tr><td>TT Adherence & Execution</td><td>YES
(Simulated)</td><td>YES</td></tr>
<tr><td>TT Revision & Monitoring</td><td>YES</td><td>YES</td></tr>
<tr><td>Local DCB preferences</td><td>YES</td><td>YES</td></tr>
</table>

Fig. 3: Feature Status between VP749 and iStream

VP749 validates the benefits of the Network Management TT services as well as DCB functionality related to hotspot resolution and monitoring in a shadow mode environment (VP749 validates as well the benefits of AOP-NOP Integration).

iStream validates the benefits of the use of the Network Management TT services by ATC and Airlines in a live trial environment.

AFLEX experiments the ability to optimise the arrival sequence according to Airspace Users business requirements i.e. User Driven Priorization Process, by swapping flights (TT) in the arrival sequence. A similar idea for the pre-departure phase has been demonstrated by D-Flex (TSAT swapping).

The combination of the results of both validation streams constitutes a valuable input to the PCP for Target Time Management.

4 Programme management

4.1 Organisation

As coordinator of the iStream project, DSNA will be in charge of:

- The overall project management activities and submission of the deliverables to the iStream Steering Committee (as defined in [A-3]) for approval,
- The breakdown of the project in work packages (Refer to Fig. 4: iStream organization and Work breakdown below).

4.2 Work Breakdown Structure

The iStream project organization is relying on a project management package and 10 work packages that are detailed in the Demonstration Plan (Refer to [A-5]).

The project organisation is reminded in the figure below:

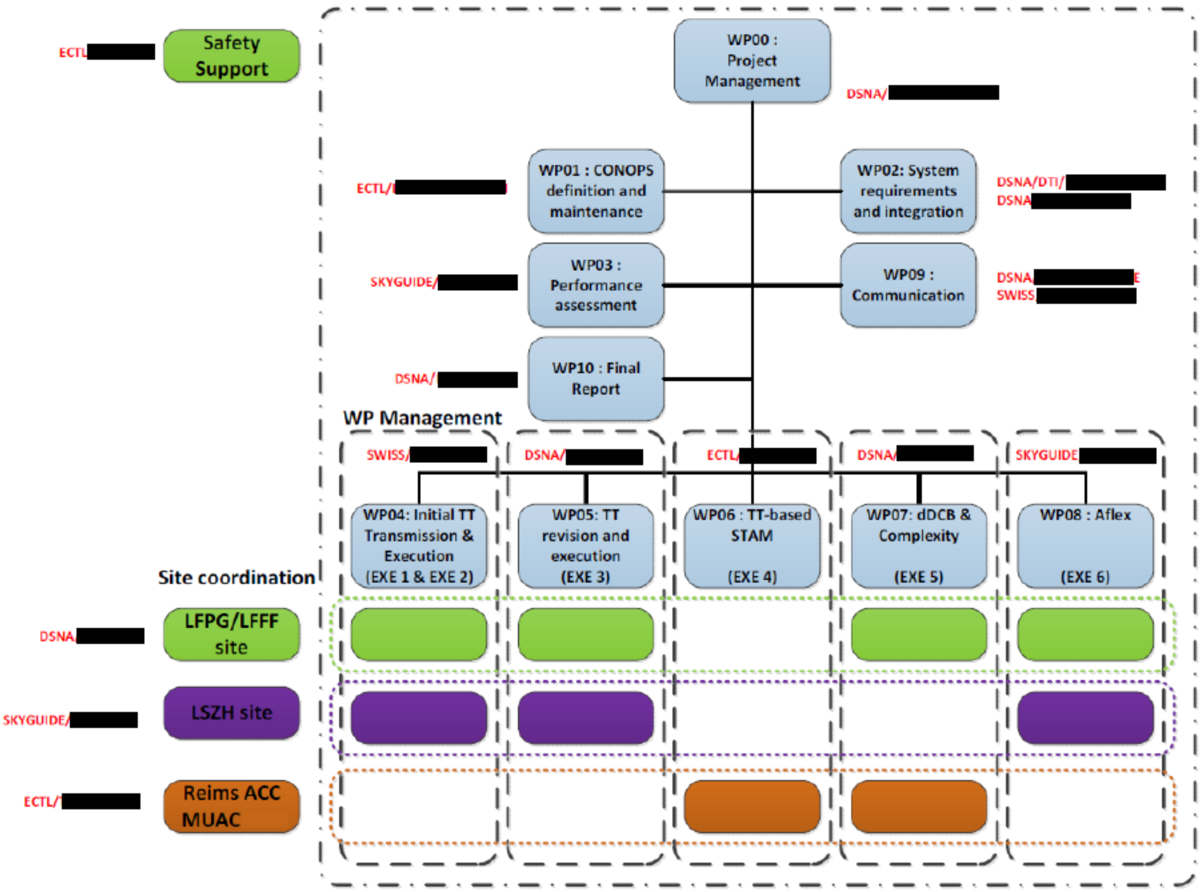

Fig. 4: iStream organization and Work breakdown

4.3 Deliverables

The deliverable list is provided in the Demonstration Plan (Refer to [A-5] "iStream Demonstration Plan issue 3.0 dated June 2016"), consisting in

- Issues of iStream Demonstration Plan,
- Issues of iStream Demonstration Report,
- First and final Critical project reviews,

- Quarterly reports.

4.4 Risk Management

The list of risks is provided in the Demonstration Plan (Refer to [A-5] “iStream Demonstration Plan issue 3.0 dated June 2016”) and is presented at each Steering committee.

5 Exercises presentation and results

This chapter introduces the different exercises (reminder of the scope, the operational concept):

- dynamic DCB,
- Target Time management for Paris arrivals,
- TT-based STAM,
- Target Time management for Zurich arrivals.

The coming chapters (From 5.1.4 "TT Management for Paris arrivals" to chapter 5.4 "TT Management for Zurich arrivals") will provide a detailed report on the exercise definition and results.

They will provide also specific conclusions at exercise level.

They will rely on the performance assessment methodology proposed by WP03 (refer to [R-1] "iStream Performance Assessment Document").

A more general conclusion and way forward according to all iStream exercises will be provided in the chapter 7 "Next Steps", including conclusions and also recommendations.

5.1 Presentation of iStream Exercises

5.1.1 Target Time management for Paris arrivals

The TT Management for Paris Arrivals is split into two exercises:

- Initial TT transmission and execution for IFPS flights (EXE-01.02-D-01), with TT based on CASA regulation
- TT revision and execution (EXE-01.02-D-03), with TT optimized with a local ATFM tool (iAMAN)

The TT Management for Paris Arrivals took place in two phases.

EXE-01.02-D-01 started from May 2nd.

EXE-01.02-D-03 started from June 29, 2016, and was implemented on selected dates where iAMAN experts were on duty. On other dates, EXE-01.02-D-01 was implemented.

The dates of activation of the two exercises are reported in annex ([R-3]).

5.1.1.1 Target Times based on CASA regulation (EXE-01.02-D-01)

The exercise concerns the transmission and execution of the Target Time for regulated flights inbound Paris-CDG during the second morning peak (flights landing between 08H00 and 9H30, local time), when traffic demand exceeds capacity and ATFM measures are needed.

For this exercise, the iAMAN is not used (the TT is solely based on the CASA regulation).

The following table details the sequence of actions from the different stakeholders.

Actor	Step	>Time	Action
FMP (Office)	0	D-1 , around 10h30 LT	Send MUAC potential TV to be regulated on day D
AOC	1	-3 hrs from EOBT	AOC Submits FPL to IFPS
FMP	2	Continuous monitoring	Detects hotspot requiring CASA regulation. Request CASA Regulation to NMOC; Monitors evolution of solution.
NMOC	3	Step 2+	Create CASA regulation as instructed by FMP REGID="TRIAL" Publish Regulation (ANM).
NMOC	4	EOBT – 2 hrs	SAM (CTOT + TT) calculated and transmitted.
AOC	5a	EOBT – x mins	*(Optional) Update FPL to match TT. Send CHG message.*
NMOC	5b	EOBT – x mins	*SRM with CTOT changed in line with CHG message received. TT remains unchanged.*
AOC	6	Before EOBT – 10 mins	Transmit TT to Flight Crew.
Crew	7a	Before EOBT	TT available in cockpit. FC may inform ADEP tower of their TOT to respect TT.
TWR ATC	7b	Before ATOT	Whenever possible, ATCOs manage the flights in accordance with the wish of the flight crew.
Crew	8	After ATOT	When REGUL="TRIAL..." FC may introduce TT into flight management and do their best to safely achieve target within ATS ICAO rules and limits of company policy. Current flown speed variations of 0.04 Mach or more are coordinated with ATC.
ATC en-route	9	After ATOT	Apply safety standard rules and LoA ensure flight separation. No priority rules for trial flights; whenever possible, ATCOs manage the flights in accordance with the wish of the flight crew.

5.1.1.2 Target Times based on a local solution (EXE-01.02-D-03)

The exercise concerned the transmission, revision and execution of the Target Time for regulated flights inbound Paris-CDG during the second morning peak (flights landing between 08H00 and 9H30, local time), when traffic demand exceeds capacity and ATFM measures are needed.

For this exercise, the iAMAN was used by the FMP to optimise the sequence of TT for selected flights.

The following tables detail the sequence of actions from the different stakeholders.

Actor	Step	>Time	Action
FMP (Office)	0	D-1 , around 10h30 LT	Send MUAC potential TV to be regulated on day D
AOC	1	-3 hrs from EOBT	AOC Submits FPL to IFPS
FMP	2	Continuous monitoring	Detects hotspot requiring CASA regulation. Request CASA Regulation to NMOC, recalling the "TRIAL" REGID; Monitors evolution of solution.
NMOC	3	Step 2+	Create CASA regulation as instructed by FMP: REGID="TRIAL". Publish Regulation (ANM).
NMOC	4a	EOBT – 2 hrs	SAM (CTOT + TT) calculated and transmitted.
FMP	4b	Step 3+	Informs (phone) MUAC about morning exercise status (G/NG). Send MUAC regulated flight list impacting MUAC sectors, including changes
AFR AOC	4c	Hotspot – 1 hrs 30	May send (phone) Paris FMP "AFLEX" requests. Three possible use cases: • Exchange the position of 2 given AFR flights in the sequence at the same MF • Prioritize (reduce the delay by some amount) a given AFR flight • Departure before EOBT for a given AFR flights
FMP	4d	Hotspot – 1 hrs 30	May Optimise TT sequence by performing moves/swaps on the iAMAN timeline, for ATC purposes, or on AFR request ("AFLEX"). Sends the requests to NM using iAMAN "PUSH" command, and phones the NMOC to advise of the demands.
NMOC	4e	Hotspot – 1 hrs 30	Visualises the requests on a dedicated HMI. Enters the CTOT in the NM OPS system, provided the network assessment allows it. Advises Paris FMP of the outcome of the process (full acceptance, refusal). Coordinates with Paris FMP in case of partial acceptance. SRM (CTOT + TT) calculated and transmitted. Note: MUAC will monitor its local impact and contact NMOC if needed. NMOC will perform the network assessment and, when the impact is considered too high, coordinate with MUAC to confirm they can accept the change.
FMP	4f	Hotspot – 1 hrs 30	Advises AFR of the outcome of the process

Actor	Step	>Time	Action
AOC	5a	EOBT – x mins	*(Optional) Update FPL to match TT. Send CHG message.*
NMOC	5b	EOBT – x mins	*SRM with CTOT changed in line with CHG message received. TT remains unchanged.*
AOC	6	Before EOBT – 10 mins	Transmit TT to Flight Crew.
Crew	7	Before EOBT	TT available in cockpit. FC may inform ADEP tower of their TOT to respect TT, for take-off to facilitate target achievement
Crew	8	After ATOT	When REGUL="TRIAL…" FC introduce TT into flight management and do their best to safely achieve target within ATS ICAO rules and limits of company policy. Current flown speed variations of 0.04 Mach or more are coordinated with ATC.
ATC en-route	9	After ATOT	Apply safety standard rules and LoA ensure flight separation. No priority rules for trial flights; whenever possible, ATCOs manage the flights in accordance with the wish of the flight crew.

5.1.2 Target Time-based STAM

This exercise concerns the generation, dissemination and adherence to target times derived from dynamic Demand Capacity Balancing (DCB) STAM Mandatory Cherry Picking (MCP) mechanism ATFM measures that are implemented to overcome a detected hotspot in en route or TMA airspace sectors.

The operational concept is a combination of two concepts:

- STAM MCP,
- CTOT to Target Time.

The Target Time-based STAM exercise started in April 18th for Reims UAC, and in May 2nd for Maastricht UAC.

The following tables detail the sequence of actions from the different stakeholders.

Actor	Step	>Time	Action
AOC	1	-3 hrs from EOBT	AOC Submits FPL to IFPS
EDYY or LFEE FMP	2	Continuous monitoring	Detects hotspot requiring MCP. Request MCP Regulation to NMOC; Monitors evolution of solution.
NMOC	3	Step 2+	Create MCP Measure as instructed by EDYY or LFEE FMP REGID ="TRIAL" Publish Regulation (ANM).
NMOC	4	EOBT – 2 hrs	SAM (CTOT + TT) calculated and transmitted.
AOC	5a	EOBT – x mins	*(Optional) Send CHG message to update FPL matching TT.*
NMOC	5b	EOBT – x mins	*SRM with CTOT changed in line with CHG message received. TT remains unchanged.*
AOC	6	Before EOBT – 10 mins	Transmit TT to Flight Crew.
Crew	7	Before EOBT	TT available in cockpit. FC may inform ADEP tower of their TOT to respect TT, for take-off to facilitate target achievement
Crew	8	After ATOT	When REGUL="TRIAL..." FC introduce TT into flight management and do their best to safely achieve target within ATS ICAO rules and limits of company policy. Current flown speed variations of 0.04 Mach or more are coordinated with ATC.
ATC en-route	9	After ATOT	Apply safety standard rules and LoA ensure flight separation. No priority rules for trial flights; whenever possible, ATCOs manage the flights in accordance with the wish of the flight crew.

5.1.3 Dynamic Demand and Capacity Balancing

5.1.3.1 Current operating methods for Paris arrivals

The current operating methods for Paris arrivals are described in the chapter 3.1 of the [A-5] “iStream Demonstration Plan issue 3.0 dated June 2016” document.

The dDCB flight trials aim at finding solution to better manage the arrival Hub « P2 » in LFPG between 07h30 and 09h30 LT.

This « P2 » period presents the following major issues:

- High peaks (up to 110 arrivals in 1h40) are requiring CASA regulations to smooth the traffic, generating ground delay for many European flights,
- High workload on Paris ACC TE sector feeding LORNI IAF into CDG and CDG Approach North (handling MOPAR+LORNI arrivals).

The current situation during this « P2 » period presents the following major inconveniences:

- Imbalance between North IAF (MOPAR, LORNI) feeding Northern runways (09/27) and South IAF (BANOX, OKIPA) feeding South runways (08/26) deteriorating overall capacity,
- North IAFs: 56% of inbound traffic, should by default land on north runway 09L/27R,
- South IAFs: 44% of inbound traffic should by default land on south runway 08R/26L,

The dDCB flight trials will try to improve the situation by combining two solutions:

- Solution #1: Reroute flights on the ground (between LORNI and OKIPA) effective for Paris ACC TE sector, but insufficient for CDG APP North traffic loads,
- Solution #2: Reroute tactically transatlantic flights and LFRB flights inbound CDG from MOPAR IAF to BANOX IAF thanks to a CDM process between CDG Approach supervisor, Paris FMP, Brest FMP & ATCOs, and the flight crews.

5.1.3.2 iStream operating methods

The operating methods for Paris arrivals are designed to address the issues described above.

In essence, these are two complementary, combinable methods that respectively aim at:

- dynamic Demand Capacity Balancing (dDCB), to reduce the need of applying one or several regulations impacting Paris CDG arrivals, or reduce the magnitude (total ATFM delay) of such regulations (done by developing new ATFCM scenarios to better balance sector loads),
- TT management, to increase the efficiency of regulations for Paris arrivals, such that when regulations still need to be enforced, their effectiveness is increased (done by using a newly-developed local ATFCM tool called “iAMAN”).
- The live trials that were performed between April and June 2015 focused on Scenario SCN-0102-501 of the [A-5] “iStream Demonstration Plan issue 3.0 dated June 2016” document ("Basic dDCB" without TT management).

They shall assess the feasibility of implementing ATFCM rerouting scenarios, in the context of CDG arrivals, to:

- Balance the North and South CDG arrival traffic loads to balance the workload in CDG Approach Control,
- Balance the arrivals between the LFFF North East (TE) and LFFF South East (AR) terminal sectors to balance the workload in Paris ACC sectors,
- Reduce ATFCM delays impacting Paris-CDG arrivals via LORNI (North East IAF) without creating or increasing delays for Paris-CDG arrivals via OKIPA or BANOX (South East IAF).

The combination of dDCB and TT were tested in the Scenario SCN-0102-511 that had been performed between May and September 2016.

5.1.3.3 dDCB processes

5.1.3.3.1 General frame

The objective dDCB trials is to develop and to validate the target operational concept of dynamic Demand & Capacity Balancing (dDCB) using a combination of tactical dDCB measures and ATFCM scenarios on Paris CDG arrival flows.

This concept shall balance traffic loads and workload between Paris ACC sectors and CDG Approach control sectors.

In 2015, the target window frame of the trial was during IATA 2015 summer season from April 13th, 2015 to June 24th, 2015. In 2016, the target window frame was during IATA 2016 summer season from May 9th until the 16th of September.

The combination of rerouting ATFCM scenarios & tactical rerouting was used in order to more efficiently manage the P2 arrival peak into Paris-CDG airport between 07h30 and 09h30 LT.

Since trials in 2007 and the STAR LATGO implementation in 2008, LFFF and LFPG, with the help of LFRR, use to reroute some NAT flights for a better balance between Paris ACC sectors and LFPG runways.

During 2015 trials, as we set ATFCM scenarios on the east front, it was also based on the principle that routes constraints on the west front for inbound flights to LFPG are minimized as much as possible.

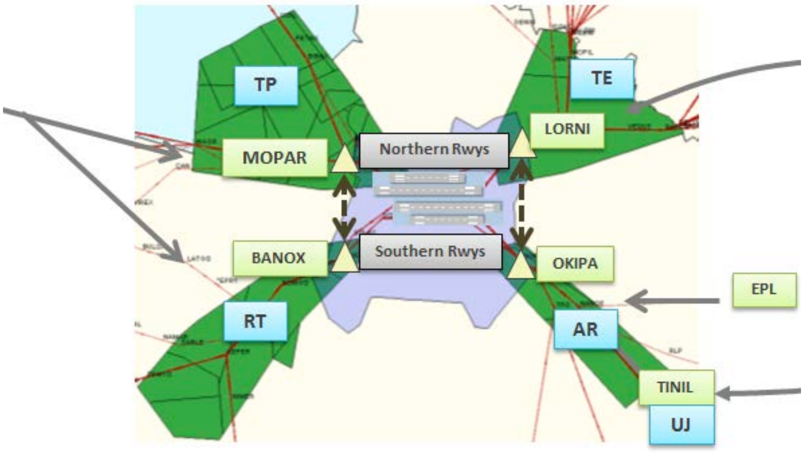

Fig. 5: Geographical situation & operational perimeter

5.1.3.3.2 East front

On the east front, a set of ATFCM rerouting scenarios to be implemented prior to take-off have been built to reroute flights from Paris TE sector to Paris AR & UJ sector:

- RR1FTE capturing flights departing from Munich and Stuttgart to Paris-CDG and Le Bourget via TE sector (North East quadrant),
- RR2FTE capturing flights departing from Turkey and Egypt to Paris-CDG and Le Bourget via TE sector (North East quadrant),
- RR3FTE capturing flights departing from Romania to Paris-CDG and Le Bourget via TE sector (North East quadrant),
- RR4FTE capturing flights departing from Austria to Paris-CDG and Le Bourget via TE sector (North East quadrant)
- RR5FTE capturing flights departing from Hungary to Paris-CDG and Le Bourget via TE sector (North East quadrant).

5.1.3.3.3 West front

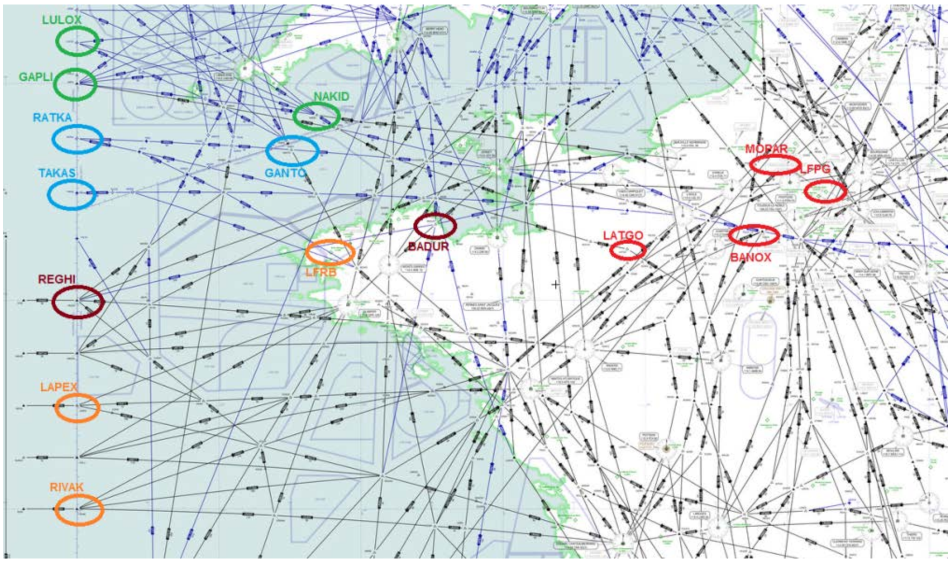

Fig. 6: Map and specific points

1: On the west front, two RAD measures were removed (Refer to figure below).

Change record	AIRWAY	FROM	TO	Point or Airspace	Utilization	Restriction Applicability	ID Number	Operational Goal
	UN873	OLEBA	BAKUL		Not available for traffic ARR LFPB/PG/PN/PO/PV	H24	LF2804	Specific traffic forced via a route
				INGOR	Not available for traffic ARR LFPG/LFPB 1. Via REGHI : This traffic shall file via UN482 ANG UN741 KEPER 2. Via LAPEX: This traffic shall file UN471 NTS UN741 KEPER 3. Via RIVAK: This traffic shall file UT460 ERIGA UN741 KEPER	H24	LF3172	Traffic organization Arrivals restriction

Fig. 7: Removed RAD measures

2: specific “traffic volume” to facilitate and choose the best NAT candidates:

- LFFRTGO or RTGO capturing NAT flights inbound to LFPG coming from:
  - RATKA, TAKAS, PHILI, MOSIS, GANTO, ETIKI, REGHI, BADUR,
- LFFRTGW or RTGW capturing NAT flights inbound to LFPG coming from:
  - RATKA, TAKAS, PHILI, MOSIS, GANTO,
- LFFRTGW1 or RTGW1 capturing NAT flights inbound to LFPG coming from:
  - RATKA, TAKAS, PHILI, MOSIS, GANTO, LAPEX, RIVAK and LFRB,

3: DCT LATGO-ROMGO was created on April 02, 2015. In that case, a shorter route could be filed and planned by AO.

	FROM	TO	Lower Vertical Limit (FL)	Upper Vertical Limit (FL)	Available (Y) Not available (N)	Utilization	Time Availability	ID	Operational Goal	Remark	Direction of Cruising Levels	ATC Unit
NEW	LATGO	ROMGO	195	265	Y	Only available for traffic via STAR ROMGO	SUM : 0000-0700, WIN : 0100-0800	LF****	Shorter route for traffic via LATGO			LFFFACC

Fig. 8: DCT LATGO-ROMGO

5.1.3.3.4 General procedure for East side

This procedure were added in 2016 live trials in order to improve the coordination between MUAC and Paris ACC, and ensure mutual benefits from using rerouting scenarios.

D-3:

- Paris FMP unit prepared the P2 arrival peak in CDG for the D-Day according to NM PREDICT data using the CHMI on the relevant traffic volumes capturing LFPG arrivals,
- Depending on the traffic demand on the different traffic volumes, Paris FMP unit took the decision of which ATFCM rerouting scenarios to implement on D-day and sent the activation request to NMOC for pre-tactical implementation via the LFFF ATFCM Daily Plan,
- Proper coordination was ensured strategically before the start of the trial with Paris-CDG ATFCM unit and neighbouring ACCs impacted by the trial: Maastricht UAC, Reims ACC, Zurich ACC, and Geneva ACC.
- In 2016, before 09h30 LT, MUAC sent via email to Paris FMP the time period of activation of Paris dDCB scenarios that could be helpful for MUAC, together with the call signs of the "impacted" traffic. Taking into account MUAC inputs but bearing in mind Paris ACC performance was the primary objective, Paris FMP then built the dDCB scenario activation strategy. Paris FMP accepted to help MUAC without penalizing Paris ACC sectors and airspace users.
- In 2016, before 12h00 LT, Paris ACC sent MUAC FMP the dDCB scenario activation strategy.

D-2: (in 2016)

- Before 16h00 LT MUAC could suggest adaptations to this scenario via email.

D-1:

- Paris FMP unit made a final assessment using NM PREDICT data using the CHMI on the traffic volumes capturing LFPG arrivals. If the neighbouring ACCs impacted by the trial didn't object to the implementation of the chosen ATFCM scenarios, the LFFF ATFCM Daily Plan for the D-day remained unchanged,
- Should the scenarios be modified, removed, or added, Paris FMP unit would coordinate the change with the neigh boring ACCs and NMOC before 12:00 local time. The modifications would be made to the ATFCM Daily plan and Paris FMP would be notified of the change,
- In 2015, Air France OCC was notified of the ATFCM scenario activation by email.
- In 2016, Paris FMP studied whether MUAC adaptations were compatible with Paris ACC needs, and when appropriate, modified the strategy. At 10h00 LT, Paris FMP unit sent the revised strategy to MUAC in case of update.
- At 19:00 local time, Paris FMP briefed Paris Supervisor and CDG Approach Supervisor taking over for the night shift about the ATFCM scenarios for the D-day,
- Between 19:00 local time and the next day 6:00 local time, Paris Supervisor was able to modify, remove, or add any ATFCM scenario if he decides to.

D-day:

- Between 06:00 and 07:00, coordination between Paris FMP and CDG Approach Supervisor is established to resolve hotspots appearing in traffic volumes capturing LFPG arrivals using the most efficient dDCB measures such as the implementation of ATFCM regulation & dDCB tactical measures (e.g. tactical rerouting).

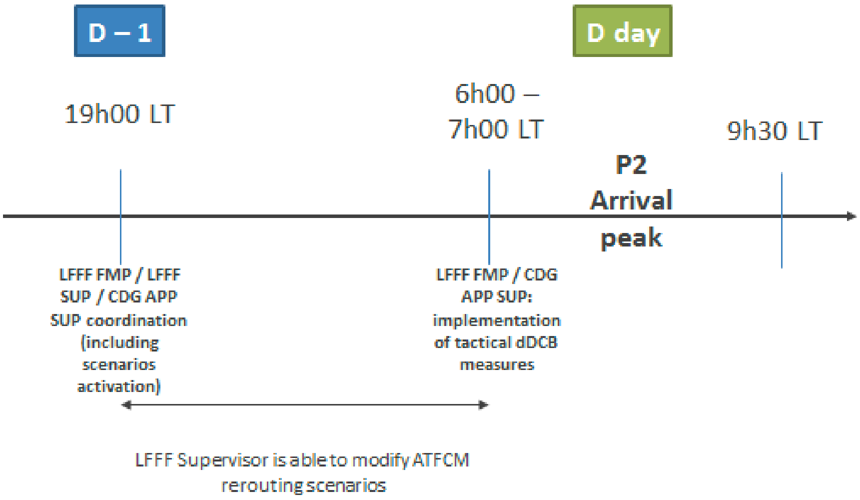

Fig. 9: General procedure for east side

5.1.3.3.5 General procedure for West side

The operational process on the West side is described below.

LFPG APP Supervisor/LFFF FMP/ LFFF ACC supervisor rerouting MOPAR-BANOX procedure:

- Between 06.00 and 06.30 LT: Monitor LFPGARR1, ARN and ARS traffic loads. In case of strong unbalance between ARN and ARS and heavy traffic load on ARN, study the flight list around this peak hour,
  - Verify the TH and RT traffic load during the ARN hotspot,
  - Evaluate with the specific traffic volume the numbers of possible/eligible flights having ETAs within the ARN hotspot,
  - Verify military activity,
- Between 06.30 and 07.00 LT: LFPG APP supervisor and LFFF FMP in association (FMP coordinate with LFFF supervisor) select flights to reroute,
  - Communicate to LFRR/FMP the flight list at least 1 hour before the entry in Paris ACC airspace (the sooner, to minimize the impact of rerouting),
- Between 07.00 and 07.30 LT: LFRR agrees or not with the rerouting and advises the flight crew,
  - In case of rejection by the crew, another flight to reroute can be chosen,
  - After obtaining all the necessary agreements and sending AFP messages, check the LFPGARN and LFPGARS traffic volumes to see the impact of the rerouting,
- Between 07.30 and 08.00 LT : FMP inform APP supervisor and Paris ACC ATCOs of the rerouted flights (number and call signs),
  - APP supervisor inform LFPG ATCOs of rerouted flights.
  - Check the terminology for actors to be consistent in the document (Refer to line 2 of the chapter: APP supervisor, …)
  - Furthermore, it is expected that rerouting a few flights via BANOX will:
  - Decrease the probability of radar vectoring in Paris ACC for flights via BANOX,
  - Increase the probability of landing on the south runway for flights via BANOX and greatly reduce taxi time,
  - Help balancing the loads and improve overall LFPG capacity & efficiency,
  - Help reducing the ground delay for other airlines.

5.1.4 Target Time management for Zurich arrivals

The skyguide FMP team, the difference Airspace Users' Flight Crews & AOCs and NM (CHMI tool) were the actors of the iStream process at Zurich.

The general procedure aiming at optimizing the early arrival wave (06:00 – 07:00 LT) is described below.

FMP generated the arrival sequence based on the Estimated Time Over (ETOs) received from the airlines (long-hauls) or taken from the CHMI (short/medium-hauls), resulting in a distribution of Target Times Over (TTO) the **IAF** to the aircraft operators.

In a chronological order, here are the undertaken actions:

1. After reaching their Top Of Climb (TOC), long-hauls' Flight Crews send their ETO over the IAF to their Airline Operation Centres (AOC).
2. AOCs forward the ETO over the IAF of their participating flights approximately four and a half hours prior expected arrival between 01:00 - 01:30LT latest.
3. Based on the received information and the integration of CHMI data for the short/medium haul flights, FMP generates the arrival sequence via Excel and adjusts it manually if necessary.

FMP distributes the resulting TTOs over the IAF via e-mail to the different AOCs until latest 02:00LT.

4. The AOCs transmit the TT information to their Flight Crews via ACARS message.
5. Flight Crews takes into account the TTO in their flight management.
6. FMP monitors the adherence to the TTO and provides feedback by noting it accordingly in a dedicated form.

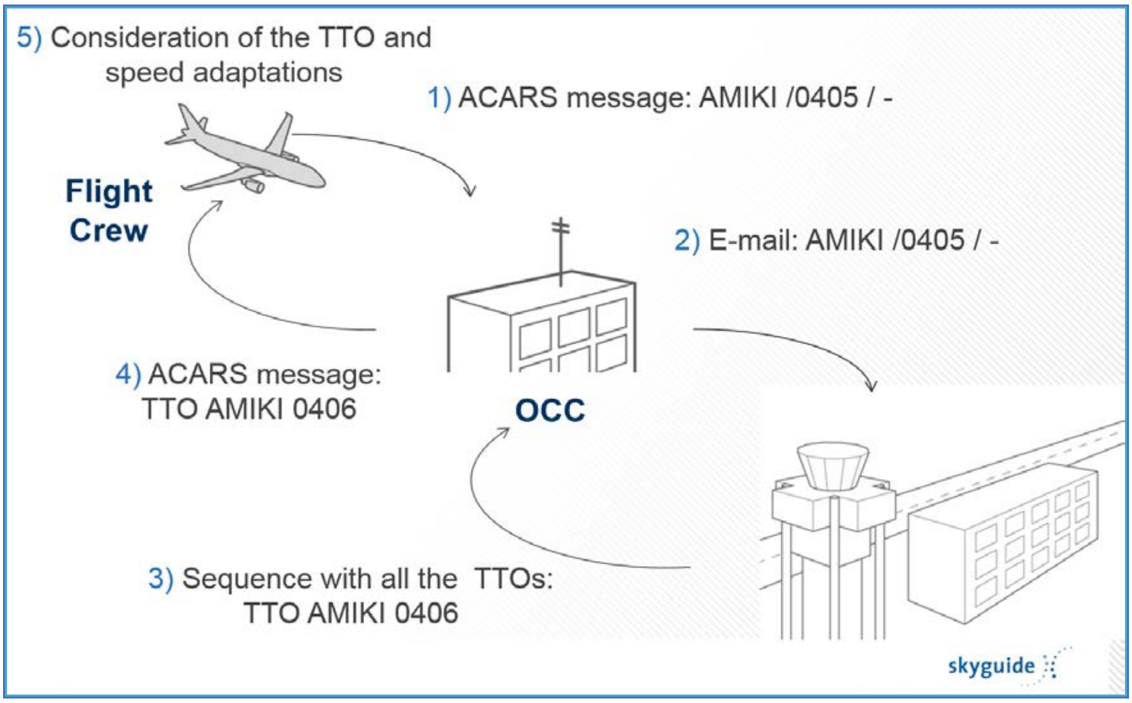

Figure 1: Target Time Management for Zurich arrivals

5.2 Target Time management for Paris arrivals results

5.2.1 Execution of Demonstration Exercise

5.2.1.1 Exercises Preparation

The main activities undertaken to prepare the demonstration exercises for Paris arrivals are summarised in the table below.

Event	Dates	Goal
Design of the exercises	June 2015 – May 2016	Define the procedures
WebEx Kick-Off meeting	June 12th, 2015	Launch the design activities for the exercises
Meeting in Zurich	September 15th, 2015	Refine the design
Meeting in Paris-CDG	February 19th, 2016	Finalize the design
Safety activities	November 2015 - June 2016	Ensure safety of the Exercise
1st Hazard identification meeting	November 23rd, 2015	Prepare the trial Safety Case
Deliverance of initial Safety Plan to EASA	January 13th, 2016	Inform of the safety activities to be conducted
2nd Hazard identification meeting	February 19th, 2016	Prepare the trial Safety Case
Deliverance of updated Safety Plan ([R-4]) to EASA	March 11th, 2016	Inform of the safety activities to be conducted
Deliverance of Safety Case to EASA for EXE-01.02-D-01	April 25th, 2016	Provide the safety argument
Deliverance of Safety Case ([R-5]) to EASA, updated for EXE-01.02-D-03	June 17th, 2016	Provide the safety argument
Systems development, test and validation	October 2015 – June 2016	Ensure the necessary system environment is ready for the Exercise
Delivery of the 1st version of the Paris ATFM tool (iAMAN)	April 7th, 2016	Deliver a tool with the functionalities to allow 1st tests
Tests and verification	April-May 2016	Ensure the correct functioning of the tools and data exchange with other systems
Delivery of the 2nd version of the Paris ATFM tool (iAMAN)	May 27th, 2016	Fixing bugs and integrating advanced functionalities

Event	Dates	Goal
Final tests	June 2016	Ensure technical readiness for the exercise
Technical configuration ready for EXE-01.02-D-03	June 17th, 2016	
Training	March-May 2016	Ensure the participating staff is adequately trained
Operational communication	April 2016	Ensure awareness and operational acceptability of trials
Exercise start		
EXE-01.02-D-01 GO/NOGO meeting	April 25th, 2016	Start EXE-01.02-D-01
EXE-01.02-D-03 GO/NOGO meeting	June 13th, 2016	Start EXE-01.02-D-03

5.2.1.1.1 Systems development, test and validation

The following tools were developed, or upgraded, in order to perform EXE-01.02-D-03:

- Development of The Paris ATFM tool (iAMAN), able to generate Target Times based on locally defined constraints and to propose those Target Times to the NMOC,
- Development of a tool in Air France OCC allowing to visualize the sequence of arrival in order to identify the AFLEX opportunities,
- Development of a tool in NMOC to display the iAMAN requests,
- Upgrade of the XMAN Portal by MUAC to display the iAMAN information

The systems were tested and validated to ensure correct functioning and correct data exchange between the systems.

Tests were performed after each delivery of a new version of the Paris tool software, and before the trial GO/NOGO meeting.

5.2.1.1.2 Training of the participating units

5.2.1.1.2.1 Paris ACC Flow Management Position

EXE-01.02-D-01 had no impact on working methods and standard operating procedures for Paris FMP therefore no training but just information was provided.

EXE-01.02-D-03 involved a change in the working method for Paris FMP. The set of experimenters involved in this exercise was trained on the tool as soon as it was available in Paris ACC in April 2016, with the help of the Experimenter Instructions booklet [R-10].

5.2.1.1.2.2 Paris ACC supervisor

EXE-01.02-D-01 and EXE-01.02-D-03 had no impact on working methods and standard operating procedures for Paris ACC supervisors, therefore no training but just information was provided.

5.2.1.1.2.3 Paris ACC ATCOs

EXE-01.02-D-01 and EXE-01.02-D-03 had no impact on working methods and standard operating procedures for Paris ACC ATCOs therefore no training but just information was provided.

5.2.1.1.2.4 Paris-CDG Approach supervisor

EXE-01.02-D-01 had no impact on working methods and standard operating procedures for Paris-CDG Approach supervisors therefore no training but just information was provided.

EXE-01.02-D-03 involved coordination between Paris FMP and Paris-CDG Approach supervisor prior to implementing the local Target Times. Consequently, the Paris-CDG Approach supervisors were briefed on the Paris ATFM tool used by Paris FMP.

5.2.1.1.2.5 Paris-CDG Tower supervisor

EXE-01.02-D-01 and EXE-01.02-D-03 had no impact on working methods and standard operating procedures for Paris-CDG Tower supervisors, therefore no training but just information was provided.

5.2.1.1.2.6 NMOC

An operational instruction (OI) was published to brief the NMOC OPS for both EXE-01.02-D-01 ([R-6]) and EXE-01.02-D-03 ([R-9]).

5.2.1.1.2.7 Air France OCC

A set of ATC coordinators was trained in order to be able to take part in EXE-01.02-D-03.

EXE-01.02-D-01 and EXE-01.02-D-03 had no impact on working methods and standard operating procedures of the other agents of the ATC cell, therefore no training but just information was provided.

5.2.1.1.2.8 HOP and Air France FC

HOP and Air France pilots were provided with information to brief them on the trial procedure, and call for their use of the TT information. (Refer to [R-13] document).

5.2.1.1.2.9 SWISS

SWISS also took part in this EXE. If the Regulation ID of the Paris Arrival regulation was “TRIAL”, SWISS participated with the concerned trial flight. Flight Dispatch transmitted the TTO information manually via ACARS to the flight crew. The reason for the manual work was that the current tool used for slot management was not able to automatically process the TTO in the SAM/SRM message. In future developments of OCC tools this has to be taken into account.

5.2.1.1.2.10 Maastricht UAC

EXE-01.02-D-01 and EXE-01.02-D-03 had no impact on working methods and standard operating procedures for Maastricht UAC therefore no training but written briefing was provided to ATCOs ([R-12]) and FMPs.

Particularly during the first days of EXE-01.02-D-03, the project team monitored the situation in the OPS room, to ensure that the new regulation method in Paris ACC had no negative impacts on MUAC sectors.

This was important since the potentially long flying time within MUAC’s airspace (flights from Scandinavian airspace) and the crossing of very dense and complex airspace in the Brussels sectors. Feedback was collected from operational staff on regular basis to assess the impact and apply corrective measures if required (which was not needed).

5.2.1.1.3 Operational communication

Information about the trials was provided to the different stakeholders potentially impacted:

- An AIM was published during the whole trial and was publicly available on the NOP Public portal,
- A letter of information was sent to the ATC units impacted (departure TWR, ACC units) ([R-7]),
- Communication material to airlines was presented to IATA ([R-8])

5.2.1.2 Exercises Execution

Exercise ID	Exercise Title	Actual Exercise execution start date	Actual Exercise execution end date	Actual Exercise start analysis date	Actual Exercise end date
EXE-01.02-D-01	Initial TT transmission and execution for IFPS flights	02/05/16	16/09/16	31/07/16	16/09/16
EXE-01.02-D-03	TT revision & execution	30/06/16	16/09/16	16/08/16	16/09/16

Fig. 10: Exercises execution/analysis dates

Two mutually exclusive scenarios were designed and executed for Paris exercise:

- Scenario 1: Target Time from CASA regulation (EXE-01.02-D-01),
- Scenario 2: Target Time from CASA regulation, optimized using Paris ATFM tool (EXE-01.02-D-03).

EXE-01.02-D-01 was executed according to the scenario design, on all days where regulations were enforced for Paris-CDG early morning arrivals (between 08H00 and 09H30 local time), between May 2nd and September 16th, 2016.

EXE-01.02-D-03 required trained staff from Paris FMP, and was only implemented on pre-defined days, when regulations were enforced for Paris-CDG early morning arrivals, between June 30th and September 16th.

Detailed trial days and associated scenarios are provided in [R-3].

5.2.1.3 Deviations from the planned activities

The activities did not deviate from the ones described in the last version of the Demonstration Plan ([A-5])

Nevertheless, EXE-01.02-D-03 deviated from the concept of operations of the project.

Initially, the Paris ATFM tool was supposed to directly interface with the ETFMS, in order to propose locally computed Target Times to NM for all the regulated flights in the hotspot. A network impact assessment would then have been performed by the ETFMS to validate (or not) the proposed Target Times.

The architecture developed for the trials deviated from this, and instead the Paris tool interfaces with a “proxy” of ETFMS. This proxy allows the NM OPS to visualize the Paris tool proposed Target Times, on a dedicated HMI. The NM OPS then performs an impact assessment and manually inserts the proposed Target Times in the ETFMS, provided the impact assessment allows it.

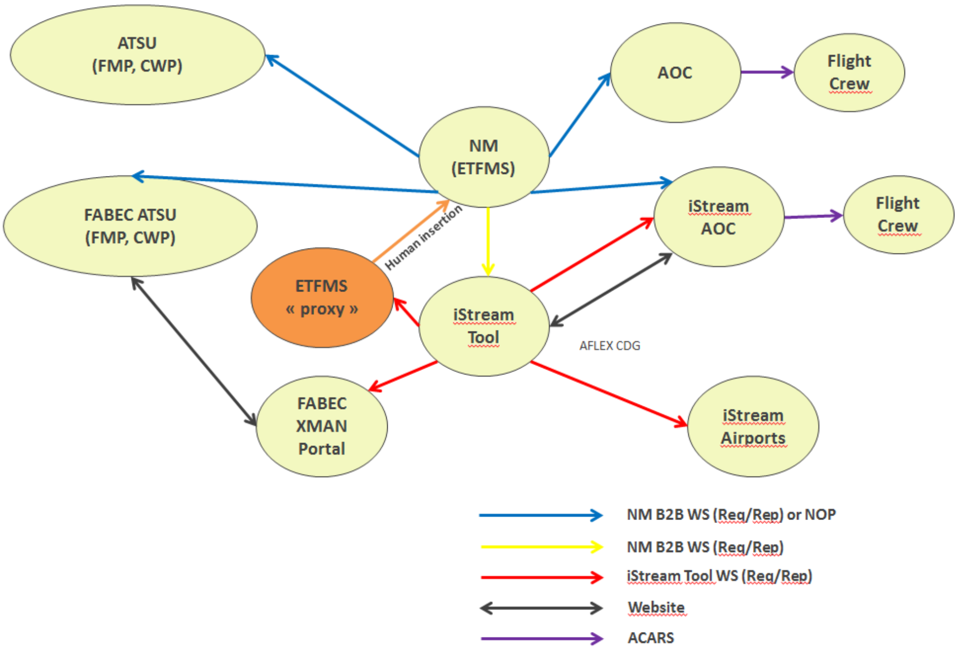

Fig. 11: Paris Exercise data flow and architecture

This results in a manual process, and therefore the possibility to only propose and implement a limited number of locally-computed Target Times.

This deviation may have undermined the expected benefits of EXE-01.02-D-03.

5.2.2 Exercises Results

5.2.2.1 Summary of Exercises Results

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Exercise(s) ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
EXE-01.02-D-01 EXE-01.02-D-03	Evaluate the impact on flight crew workload and safety	OBJ-0102-001	The usage of TTs does not have a negative impact on flight crew and OCC staff workload and safety	No TT-related safety incident was reported during the trial. Reports from flight crew show TT information can be easily taken into account without impact on workload.	OK
EXE-01.02-D-01 EXE-01.02-D-03	Evaluate the impact of using TTs on ATM workload and safety (NM and ATCOs and/or FMP)	OBJ-0102-002	The usage of TTs does not have a negative impact on ATM operational staff (NM, ATCOs and/or FMP) workload and safety	No TT-related safety incident was reported during the trial. Analyse of Paris-FMP questionnaire showed moderate impact on workload for EXE-01.02-D-03.	OK
EXE-01.02-D-01 EXE-01.02-D-03	Evaluate the feasibility to calculate a TT where (and when) needed by ANSP	OBJ-0101-110	Demonstrate by collecting the TT information from operational logs (NMOC)	TTs for Paris arrivals were successfully computed on the Paris-ACC entry points	OK

Exercise(s) ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
EXE-01.02-D-01	Evaluate the feasibility of exchanging efficiently TT information to all relevant Stakeholders: AO, Crews, ATC facilities…	OBJ-0101-120	The exchange of TT information is efficient and done in a timely manner so that all partners are aware of TTs and able to act on it if necessary, to ensure that flights receive their TTs early enough to be reachable (so the flight crews are able to manage their flight accordingly without impacting negatively on cost index of flight).	TT was successfully distributed to all stakeholders, using NM systems (CASA).	OK
EXE-01.02-D-01	Evaluate the deviation to the initial TT	OBJ-0102-310	The variance of the TT adherence (compared to baseline) is improved. Percentage of aircrafts within a TT deviation of [-X;X] min is improved (window time frame to be defined accordingly by scenario).	Adherence to TT is slightly improved. The variance of Target Time adherence of the trial flights has been reduced compared to the 2015 baseline.	Partial OK
EXE-01.02-D-03	Evaluate the feasibility to revise the initial TT and efficiently transmit it to relevant stakeholders	OBJ-010-320	Same as OBJ-0102-120	The process for revising TT was successfully implemented between Paris and NM, and the corresponding TT efficiently shared with stakeholders	OK

Exercise(s) ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
EXE-01.02-D-03	Evaluate the deviation to revised TT(s)	OBJ-0102-330	Same as OBJ-0102-310. Plus, the deviation to revised TT is smaller than the deviation of the initial TT.	Because the design of the exercise has set that the revision occurs in the pre-departure phase (as for initial TT), there is no increase in predictability compared to initial TT	NOK
EXE-01.02-D-03	Evaluate the consistency between the initial and/or revised TT and the actual arrival sequence	OBJ-0102-340	Collect trajectory data and analyse TT performed for each trial flight in regards to the arrival sequence for each trial flight.	Because the TT has only been used in the pre-tactical phase, it is not relevant in the frame of the iStream project to compare the initial TT sequence (pre-departure) and the actual arrival sequence.	NOK
EXE-01.02-D-01	Evaluate the feasibility to achieve the allocated TT	OBJ-0102-410	The TTs are adhered to within a bound of [-x .. +x] minutes without negative impacts on the flight's cost index (e.g. drastic speed increase, etc..).	Adherence to TT is slightly improved: the variance of Target Time adherence of the trial flights has been reduced compared to the 2015 baseline.	Partial OK
EXE-01.02-D-01	Evaluate the impact of TT execution on the deviation to predicted arrival time / entry time into sector	OBJ-0102-420	Evaluate the impact of TT execution on the deviation to predicted arrival time / entry time into sector.	Improved adherence to TT implies improved predictability of entry time into Paris-ACC sectors (as TT is set on the Paris-ACC entry points).	Partial OK

Exercise(s) ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
EXE-01.02-D-01 EXE-01.02-D-03	Evaluate the impact on flight efficiency	OBJ-0102-430	The usage of TT; by enhancing flight profiles and/or reducing ATFCM delays and/or reduced vectoring and/or reduced number of holdings; reduces the fuel burn compared to OFP data and/or baseline data.	No data could be measured related to fuel burn. Yet we can conclude to a positive impact on fuel due to improved departure strategy and less vectoring (additional time in ASMA reduced by 30 seconds per flight).	Partial OK
EXE-01.02-D-01 EXE-01.02-D-03	Evaluate the impact of TT execution on capacity use of airport and sectors (arrival / en-route)	OBJ-0102-440	The usage of TT does not reduce either airport capacity or sectors (TMA/En-route) capacities.	EXE-01.02-D-01 shows no negative impact on LFFF and LFPG capacity. EXE-01.02-D-03 shows improved use of capacity for LFFF/LFPG due to the optimized TT (reduction of 18% of ATFM delay). Both EXE did not have a negative impact on MUAC capacity.	OK
EXE-01.02-D-01	Evaluate the effect of TT management on CTOT deviation at departure	OBJ-0102-540	The usage of TT does not impact negatively the CTOT adherence. (CTOT deviation during Trials should not be larger than CTOT deviation from baseline scenario).	The TT management did not impact negatively the CTOT adherence.	OK

Exercise(s) ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
EXE-01.02-D-03	Evaluate the possibility of swapping/modifying TTs based on airline's requests'	OBJ-0102-710	Airlines are able to provide their TT modification requests and ATC is able to take Users Preferences into account and accommodate them.	Air France OCC was able to easily request prioritization or swaps between its flights. ATC was able to take into account these requests and accommodate them most of the time. The arrival flexibility allowed reducing delay between 5 and 15 minutes for prioritized flights.	OK
EXE-01.02-D-01 EXE-01.02-D-03	Assess the impact of using TT on speed changes in ACCs	OBJ-0102-810	The usage of TT and potential inherent speed changes should not induce safety concerns for ATC	The EXE did not cause any safety issue to MUAC. The procedures were strictly respected.	OK

Fig. 12: Summary of Demonstration Exercises Results

5.2.2.1.1 Results per KPA

5.2.2.1.1.1 EXE-01.02-D-01 (Target Time from CASA regulation)

5.2.2.1.1.1.1 Safety and workload

5.2.2.1.1.1.1.1 Impact on flight crew workload and safety

The analysis of the 22 pilot's questionnaires received show no report of safety concerns related to TT management, or impact on workload.

5.2.2.1.1.1.1.2 Impact on ATM workload and safety

On the first trials days, questionnaires were distributed to both Paris FMP, and ATCOs operating on the sectors with regulated iStream flights. The 4 questionnaires analysed indicated that:

- The amount of coordination (with Flight Crew, adjacent sectors and NM) did not increase,
- The traffic complexity was not increased (nor reduced),
- Situational awareness was not affected during iStream,
- ATCOs were confident working with iStream trial flights,
- Safety was not compromised due to iStream operations,

No workload or safety issues were reported during the trial.

EXE-D-01 has operated transparently and no safety or workload impact has been reported by the NMOC operations room.
In addition, NMOC have received no feedback from the non-participating FMPs and airports that handled iStream traffic; which implies that the iStream procedure has operated transparently in those ACCs and airports.

The use of TT did not have any impact on MUAC workload and safety despite long flying time and crossing of dense and complex airspace volumes.

5.2.2.1.1.2 Results on predictability

<u>Results on predictability of P2 regulated flights</u>

The predictability of the iStream flights (regulated flights inbound LFPG during the P2 peak) is slightly improved during the trials, as shown on the picture below.

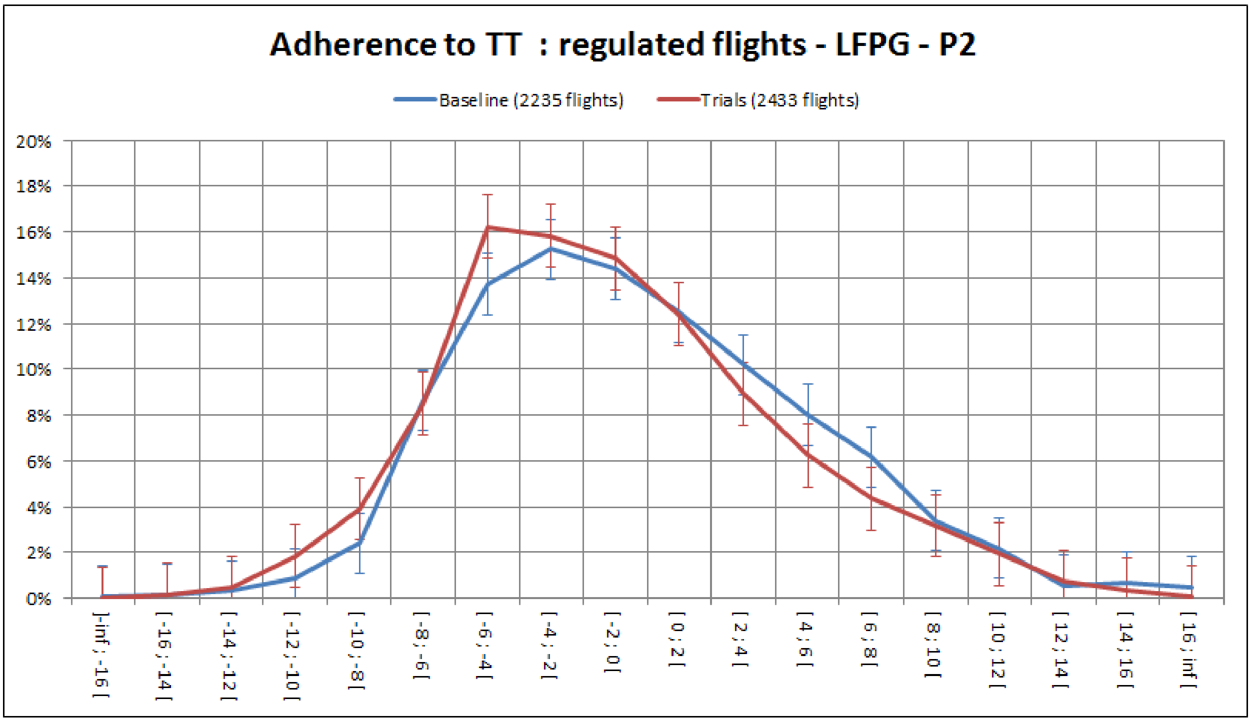


Fig. 13: Adherence to TT : regulated flights - LFPG - P2

The predictability of the Air France/HOP iStream flights (regulated flights inbound LFPG during the P2 peak) is slightly improved during the trials, as shown on the picture below.

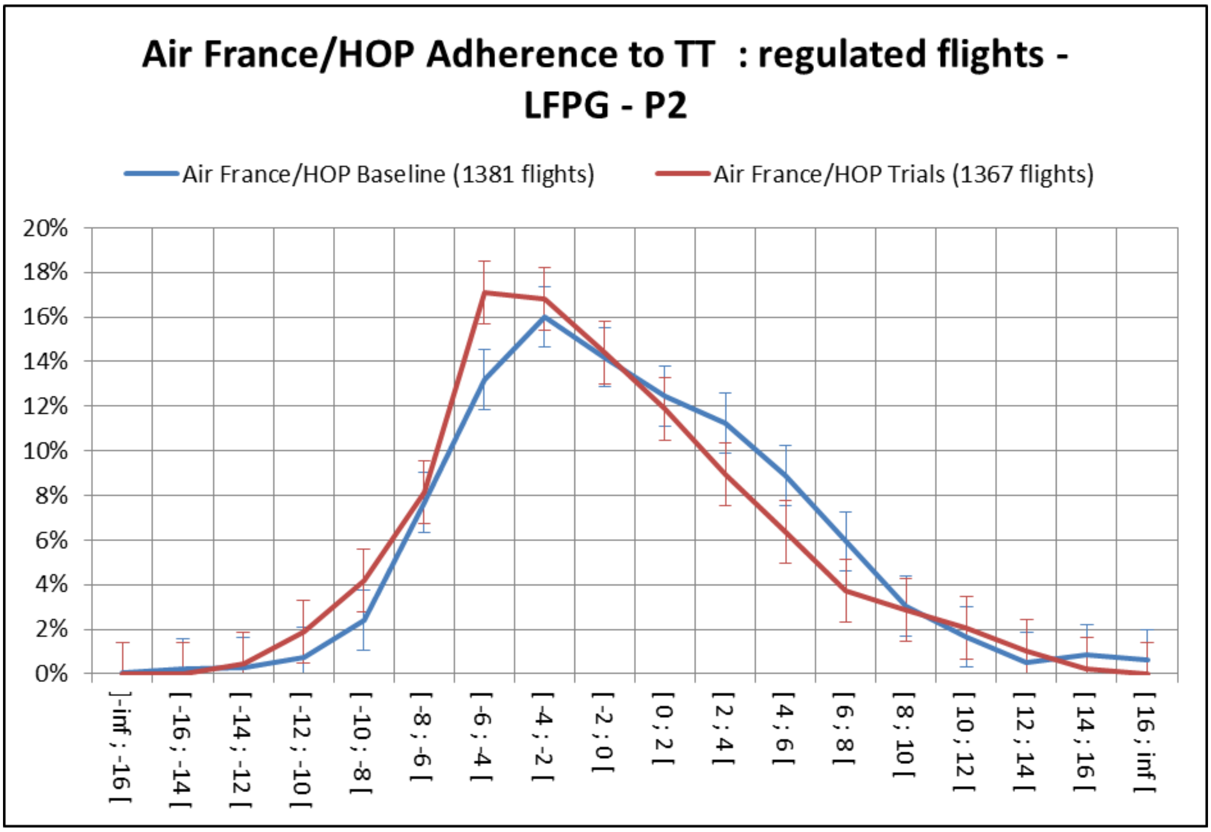


Fig. 14: Air France/HOP Adherence to TT: regulated flights - LFPG - P2

The adherence to TT in the [-3;+3] and [-4;+4] windows is similar between the baseline and the trials, both for all flights and AFR/HOP flights.

Adherence to TT		**All flights**	**AFR/HOP**
Baseline	[-4;4]	52,8%	54,4%
	[-3;3]	39,9%	39,5%
Trials	[-4;4]	52,4%	52,4%
	[-3;3]	40,7%	40,2%

The reduction of variance and standard deviation of TT adherence distribution between the baseline and the trial shows the increased predictability, both for all flights and AFR/HOP flights.

Variance and standard deviation of TT adherence distribution		**All flights**	**AFR/HOP**
Baseline	Variance	29,7	28,4
	Standard deviation	5,5	5,3
Trials	Variance	23,6	21,9
	Standard deviation	4,9	4,7

It should be noted that there is a difference of repartition of ATFM delay between the baseline and the trial, and that a correlation between the TT adherence and the ATFM delay can be observed, as shown on the pictures below.

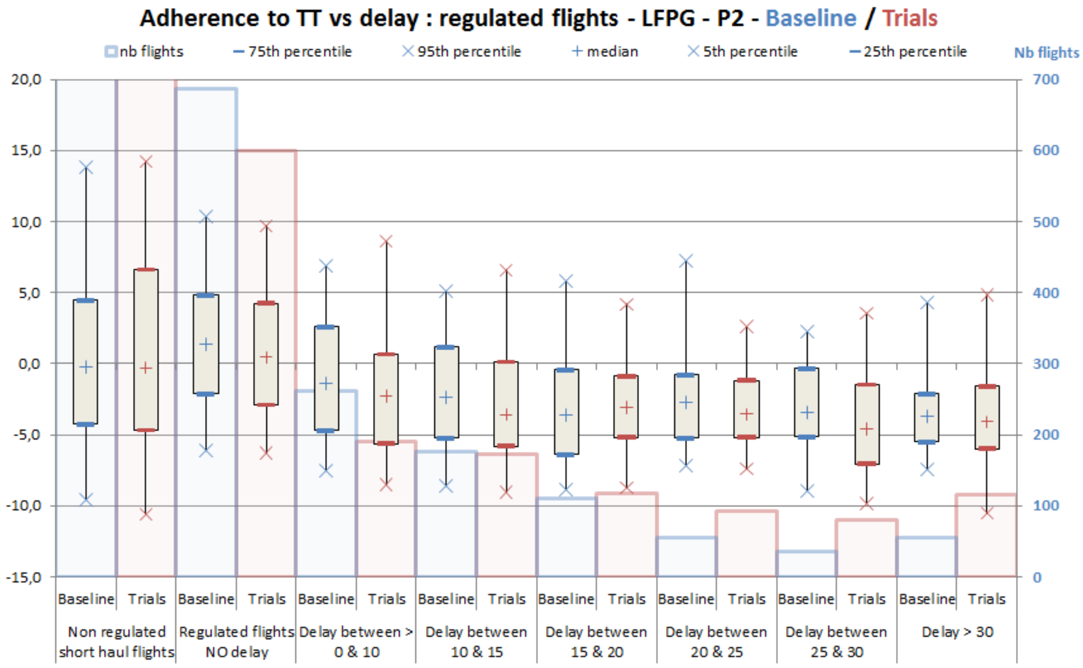


Fig. 15: Air France/HOP Adherence to TT in function of the ATFM delay, Baseline and Trial

This picture shows show that TT adherence is significantly influenced by ATFM delay: for small ATFM delays TT adherence is centred on 0, whereas as ATFM delay increases, it is closer to -5.

It also shows significant differences in ATFM delays between the trial and the baseline, with bigger (20 minutes and more) ATFM delays in trials than in the baseline, and less small ATFM delays (10 minutes and less).

The relation between adherence to TT and ATFM delay suggests that, as a flight gets more delayed, it tends to take-off closer to the lower-end of its slot tolerance window (CTOT-5'). This could de due to several parameters adding up to minimize the impact of delay on the delayed flight, such as early off-block clearance request by the flight crew and ATC facilitation of early off-block and take-off. Departure manager runway pressure parameters, which aim at continuously feeding the runway, could also be a contributing factor.

NM is actively investigating the calculation and use of traffic count confidence factors as an indication for decision making, and these confidence factors are likely to contain probabilistic parameters, with inputs such as the relationship that is described above.

SWISS flights

The flight crews did their best to manage their Take off Time in Zurich accordingly to their TTO in Paris. Unfortunately due to Zurich as an A-CDM airport and their departure manager, there was no possibility to take off at the flight crews requested take off time. This resulted that flight crews were not able to fly their TTO even with speed changes in flight. Due to the short flight time of one hour in average, the flight crews possibilities were limited. The returned flight crew questionnaires confirmed these findings.

5.2.2.1.1.2.1 Efficiency

Results on ASMA+ additional time of P2 regulated flights

Refer to chapter 5.4.2.1.2.3.1 "ASMA additional time & ATFM delay relationship" to detail ASMA+ additional time definition.

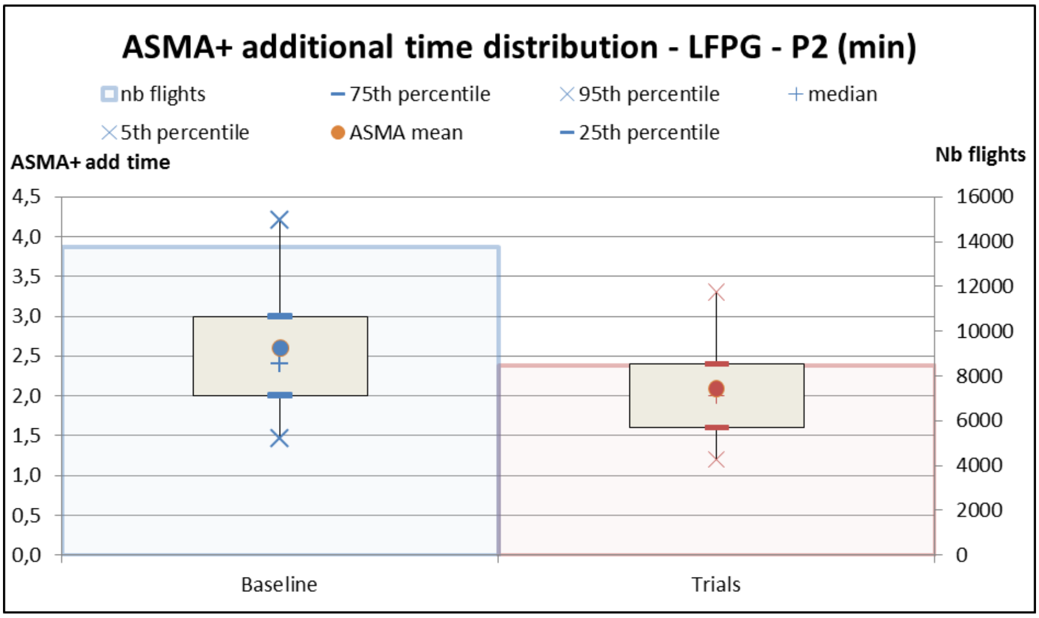


Fig. 16: ASMA+ results Distribution of additional time per flight on P2

The Baseline and Trials samples refer, in this paragraph, to all LFPG-P2 (08:00-9:30) flights (included non-regulated flights, long haul flights).

The Baseline is calculated from May 2015 to mid-September 2015. The Trial sample is computed from May 2016 to end of July 2016. In the second edition of the report (due end of November 2016), it will be updated to cover the complete reference period (2nd May 2016 – 16th September 2016).

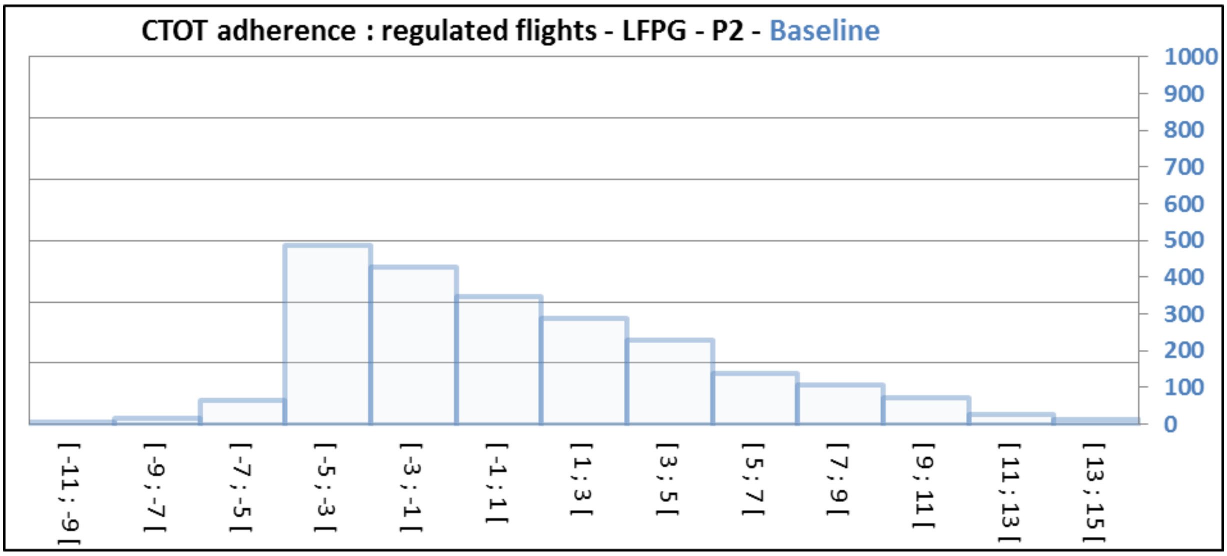
There is a reduction of the ASMA+ additional time between the trials and the baseline (around 30 seconds per flight).

Results on efficiency of participating flights:

The TT procedure did not negatively impact fuel efficiency.

Some flights could depart earlier, which improve departure punctuality.

Furthermore, the TT management did not impact negatively the CTOT adherence, as shown on figures below.



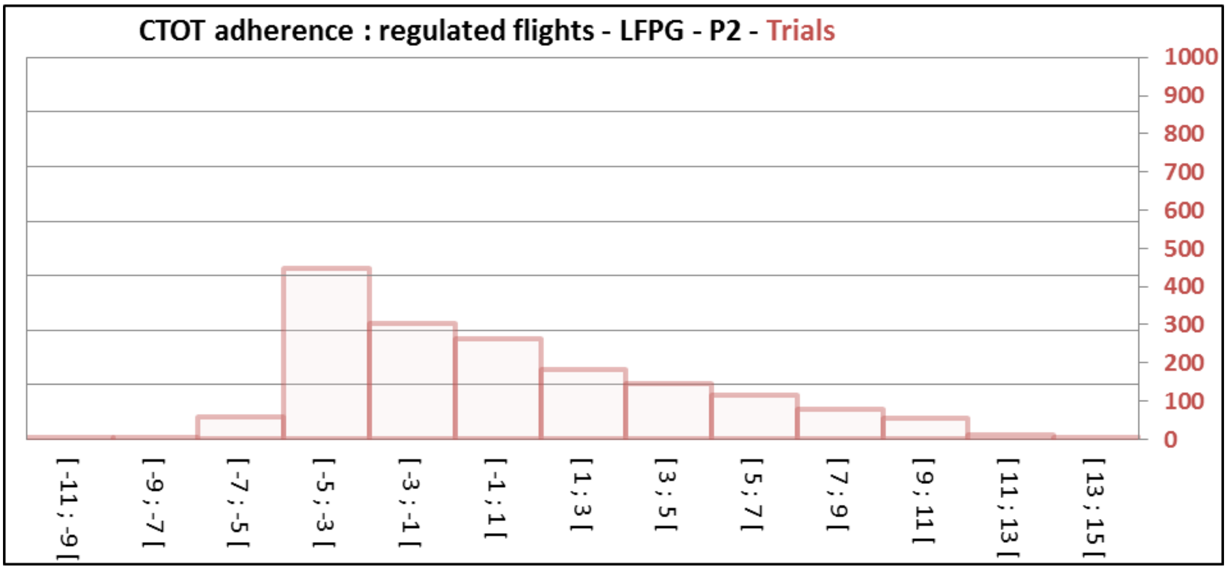


Fig. 17: CTOT adherence for P2 regulated flights, Baseline and Trial

5.2.2.1.1.2.2 Capacity

On trials days, questionnaires were distributed to Paris FMP. Questionnaires indicated no impact on Paris-ACC sectors capacity.

The potential use of TT did not have any impact on MUAC workload and safety despite the potentially long flying time and crossing of dense and complex airspaces volumes.

5.2.2.1.1.3 EXE-01.02-D-03 (Target Time from CASA regulation, optimized using Paris ATFM tool)

5.2.2.1.1.3.1 Safety & workload

5.2.2.1.1.3.1.1 Impact on flight crew workload and safety

See section 5.2.2.1.1.1.1.1: there is no difference in the procedure for flight crews.

5.2.2.1.1.3.1.2 Impact on ATM workload and safety

Questionnaires were distributed to ATCOs and Paris experimenters on the days of EXE-01.02-D-03 trials.

<u>Impact on Paris-ACC ATCOs:</u>

The results from ATCOs questionnaires are in line with EXE-01.02-D-01:

- For all ATCOs (14/14) there were no increase in ATC-Flight Crew communications,
- For all ATCOs (14/14) there were no increase in adjacent ATS units coordination,
- For all ATCOs (14/14) there were no noticed increased traffic complexity, nor change in situational awareness.

<u>Impact on Paris FMP (iAMAN experimenters) workload and safety:</u>

Experimenters experienced an increase in their workload: to the affirmation “My workload increased compared to routine operations”, all experimenters answered “Agree” (6/10) or “Strongly Agree” (4/10).

No experimenters encountered difficulties to perform the actions on the iAMAN system.

Some experimenters stated that iStream increases ATS/NMOC coordination (4/10), but not coordination with other ATC units (8/10).

In the comment sections, the main rationales given for Paris-FMP workload increase is the increase of coordination (with NM and Paris-CDG supervisor), and the fact that this new regulation method requires to focus attention both on the iAMAN and on the CHMI.

The workload increase thus seems biased by the trial conditions:

- The amount of coordination with NM would not increase, would the iAMAN tool directly interface with NM OPS via B2B services, as planned in the CONOPS
- The improvement of the tool (e.g. addition of a “what if” function, in order to assess the impact on traffic counts), in addition to FMP more used to the new regulation method, could reduce workload.

Concerning the impact of this workload increase, most experimenters (6/10) considered that it did not affect their overall performance or other duties.

Some experimenters (3/10) considered that it did affect their other duties, one of which strongly.

Despite the workload increase, most of the experimenters were confident working with iStream methods (8/9 answered), and none felt that safety was compromised with iStream (0/9 answered).

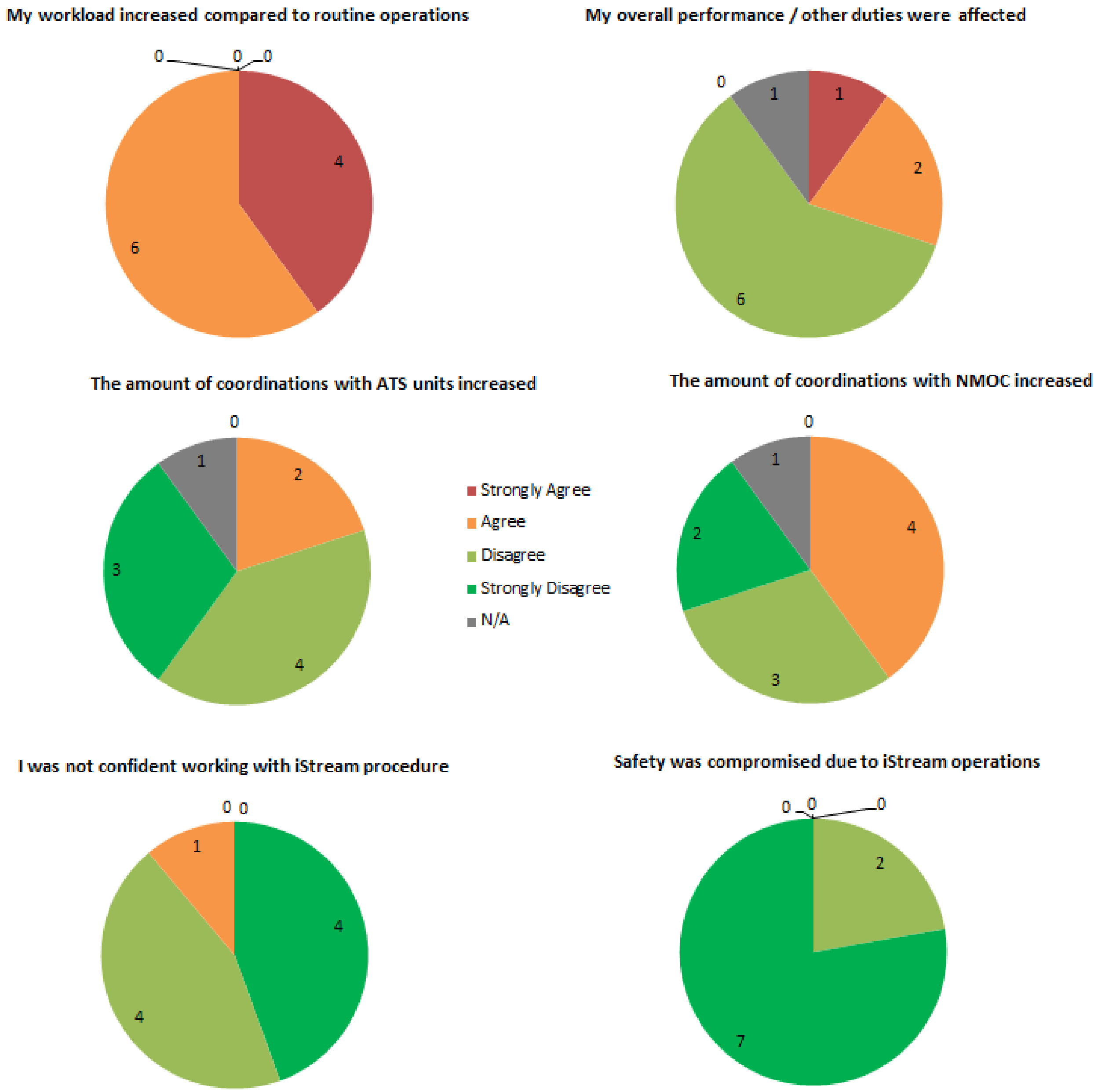


Fig. 18: Paris-FMP experimenters questionnaire's results: workload and safety

Impact on NMOC OPS workload and safety:

A slight increase in NMOC workload was induced by the NMOC manual procedure to perform the updates of TT.

This workload increase is biased by the trial conditions: would the iAMAN tool directly interface with NM OPS via B2B services, there would be no effect on the NMOC OPS workload.

In isolation, these infrequent and small workload increases were tolerable within NMOC.

However, in the context of the summer traffic, adverse weather planning and a series of planned trials run in parallel to iStream trials, the overall aggregated effect did increase the workload of the NMOC operations room.

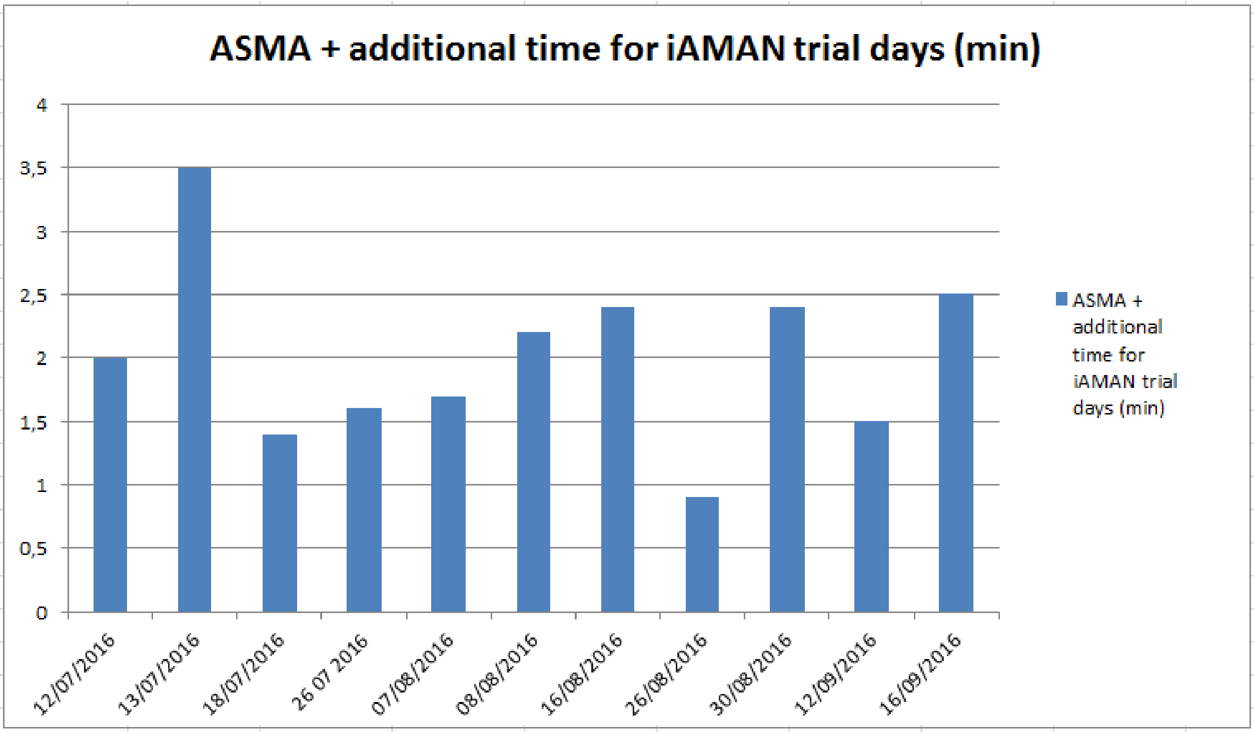
This workload increase did not compromise safety.

5.2.2.1.1.3.2 Predictability

The results on predictability of participating flights are the same as for EXE-01.02-D-01, by design (revision occurs in the pre-departure phase, as for initial TT). Refer to 5.3.2.1.2.1.2.

5.2.2.1.1.3.3 Efficiency

The ASMA results for the EXE-01.02-D-03 are provided below.



The average ASMA additional time on iAMAN trial days is 2,0 minutes, which is very similar to the average ASMA additional time with the TT but without the iAMAN optimization (refer to 5.5.1.1.2.1).

There is therefore no noticeable – positive or negative – effect on the ASMA additional time of the iAMAN optimization compared to the TT without iAMAN.

5.2.2.1.1.3.4 Capacity

5.2.2.1.1.3.4.1 Impact on LFFF capacity use

ATFM delays:

For assessing the impact of EXE-01.02-D-03 on ATFM delays, we compare the figures after the end of the process of optimization with the iAMAN (all TT have been sent to NM, assessed and implemented) with the figures after the initial CASA regulation was set, but just before the local optimization has started.

The following figures provide the ATFM results on for Paris-CDG regulations during the morning peak (P2).

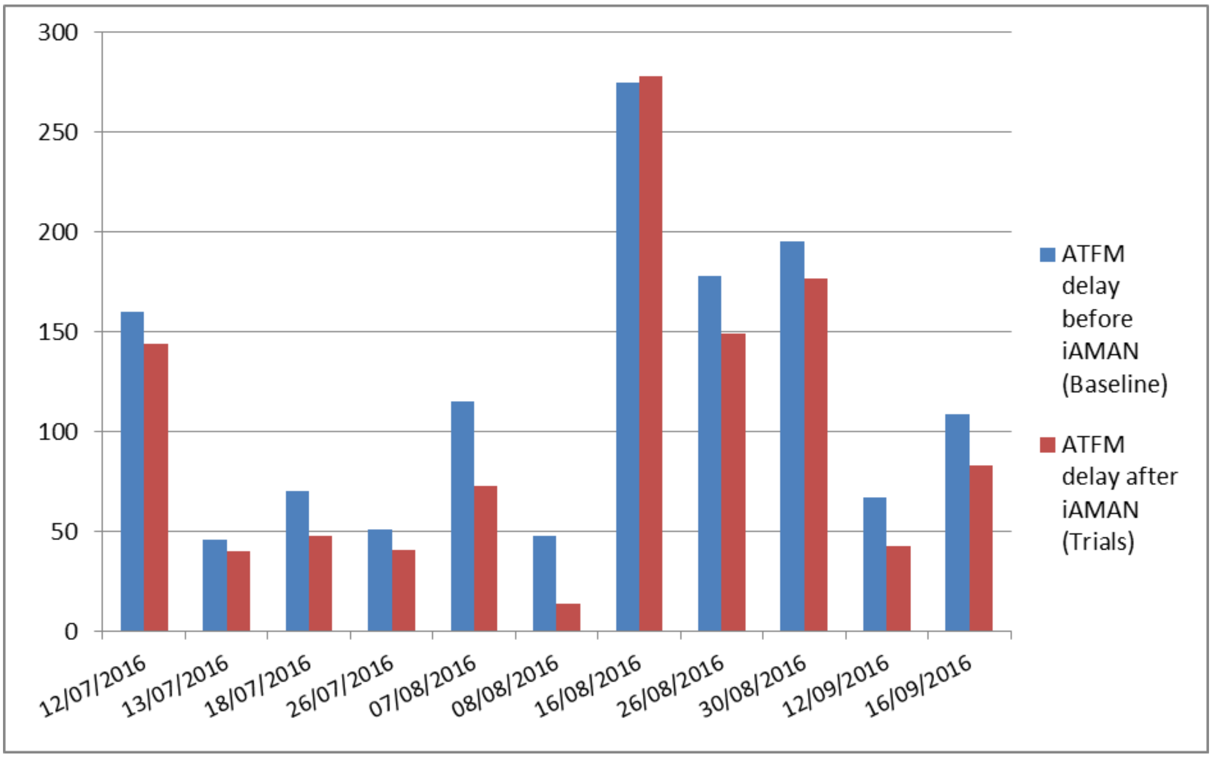


Fig. 19: Daily ATFM delay for Paris-CDG arrivals during the iAMAN trials days

Overall during the 11 trial days, 234 minutes of ATFM delay were saved, corresponding to a reduction of 18% of total ATFM delay (see Figure below).

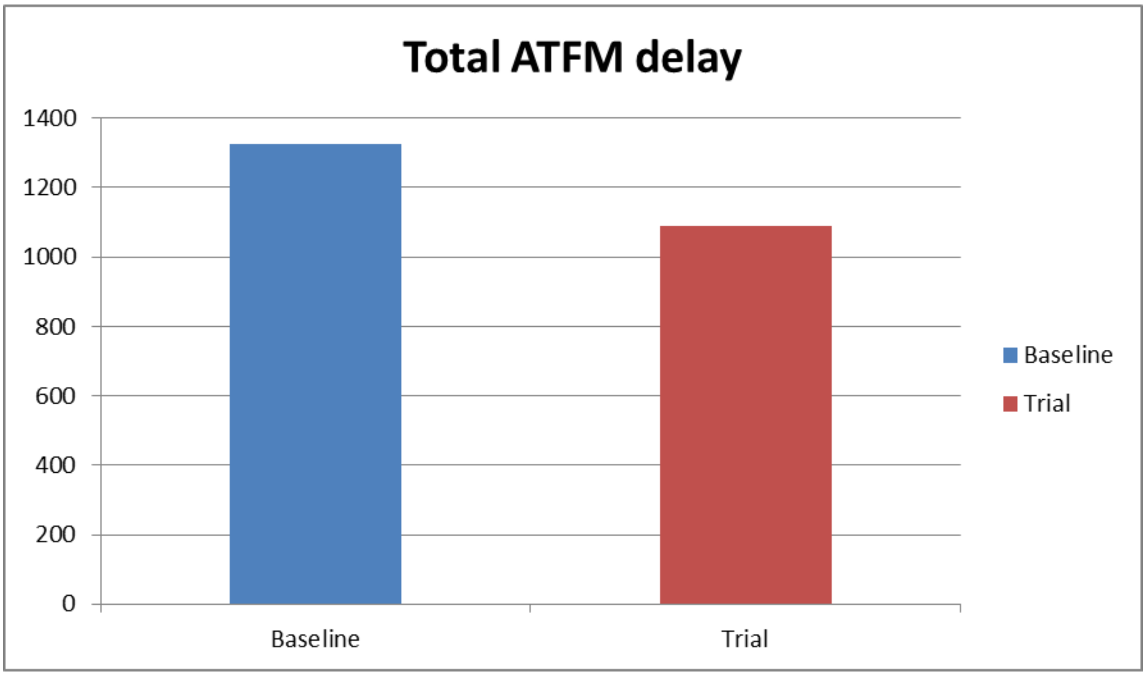


Fig. 1: Total ATFM delay for Paris-CDG arrivals during the iAMAN trial

During the 10 trial days, the TT of 51 flights were changed, 43 of which were advanced (84%) and 8 delayed (16%).

For the flights advanced, the average improvement of the TT (and consequently CTOT) is 6,3 minutes.

For the flights delays, the average deterioration of the TT (and consequently CTOT) is 4,5 minutes.

Overall, the flights moved improved their TT (and consequently CTOT) by 4,6 minutes in average.

Results of Paris-FMP questionnaires

Experimenters mostly considered that iStream operations did not increase sector capacity (4/9 answered), one of which strongly.

But the comment section show that most experimenters did consider that iStream allows optimizing the available capacity in the pre-tactical phase. In particular, for the experimenter that answered "Strongly Disagree", we can find the following comment: "*iStream is **beneficial for planning the traffic with less delay as possible**. But as TTs are far from being respected, **it is complex to assess the operational and tactical impact** of the trial*".

This qualitative assessment illustrates the fact that the objectives of iStream (optimizing the arrival flow management in the pre-tactical phase) have been fulfilled.

To further provide operational and tactical benefits, investigations need to be undertaken to achieve seamless integration of ATFCM and ATC (see recommendations).

Overall, experimenters considered that iStream is beneficial to operations (7/9 answered).

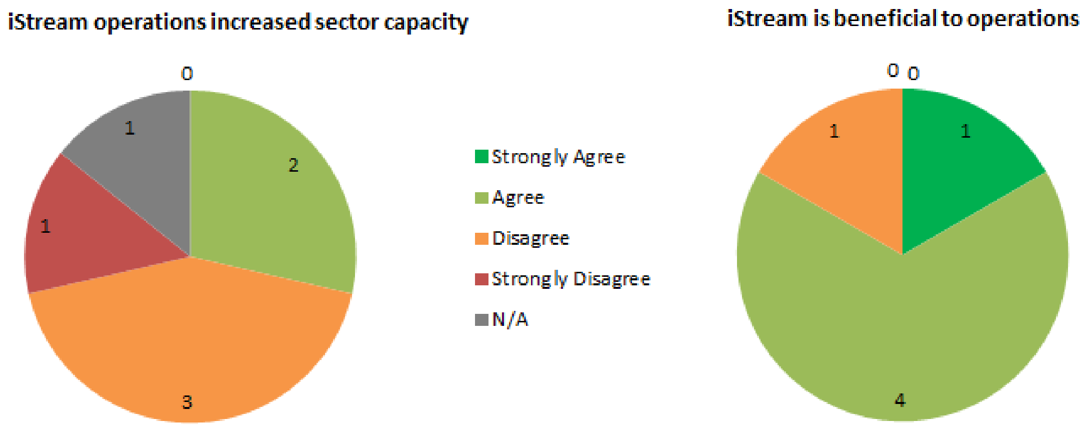
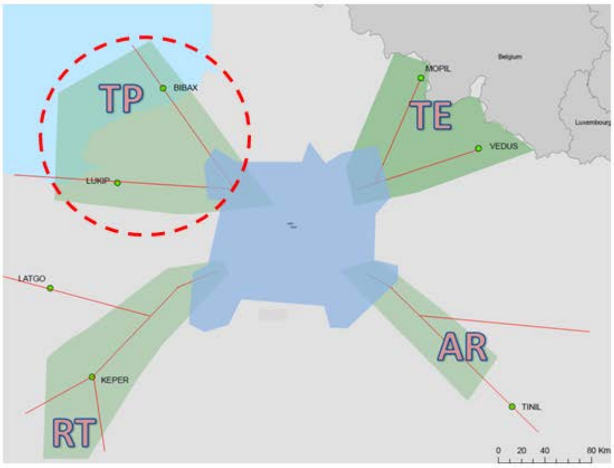


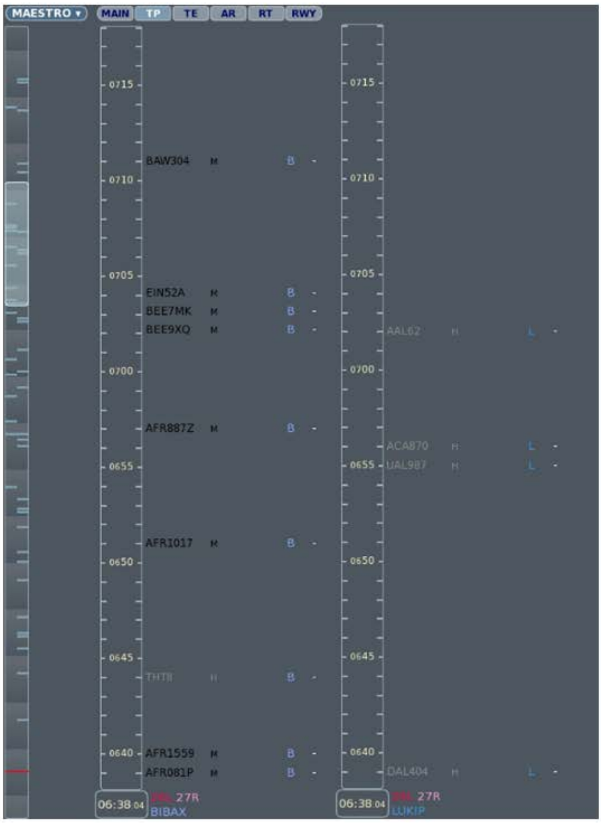
Fig. 2: Paris-FMP experimenters questionnaire's results: capacity and benefices

To better understand how iAMAN was used to plan the traffic with as little delay as possible, the analysis of iAMAN and CASA sequence on a given trial day is provided below.

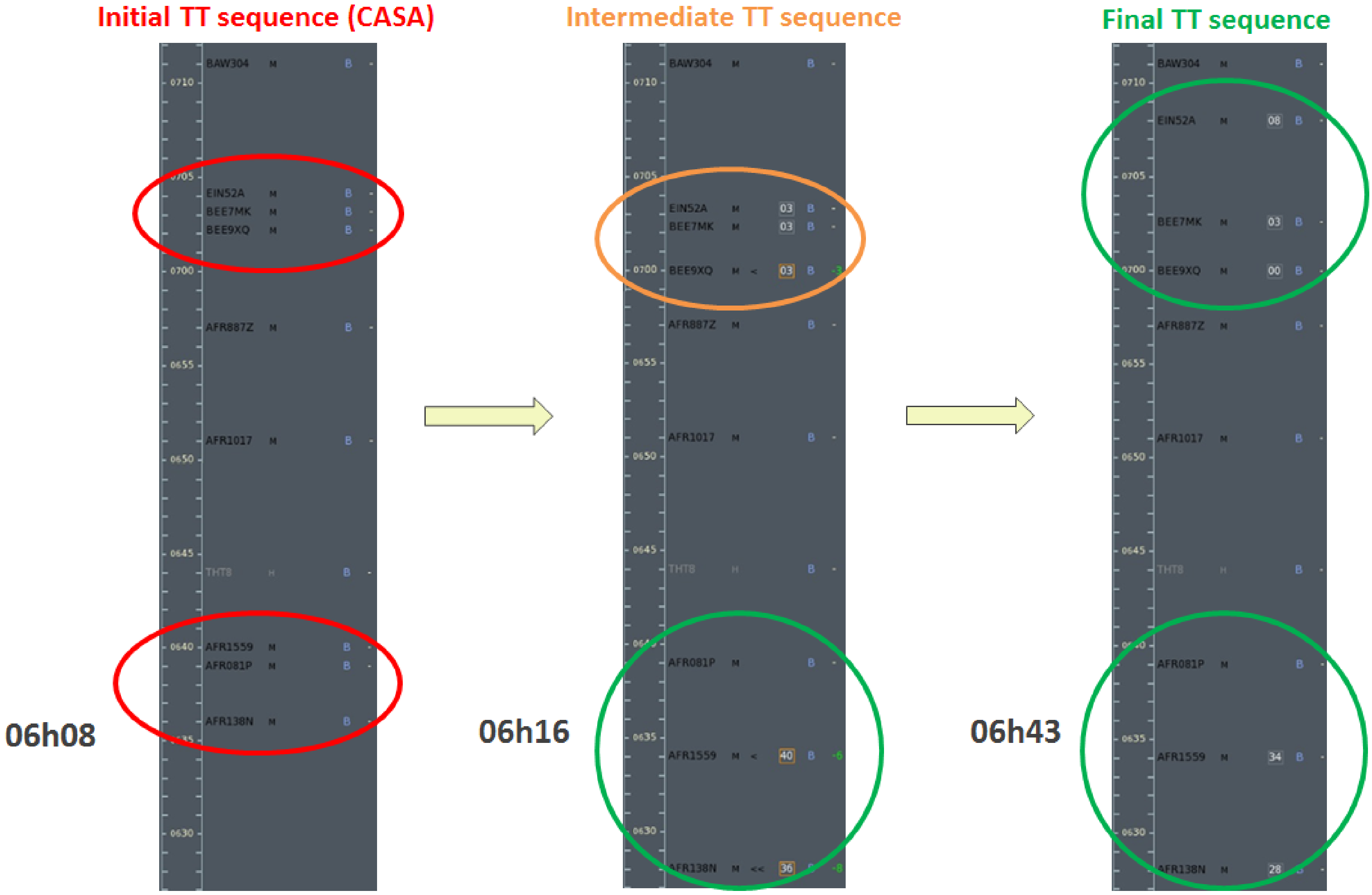
In the example, a regulation was enforced on northern LFPG arrivals (regulation identification: LFPGARN).

The result of this regulation on the North-West arrival sector is visualized as Target Time sequences on the different TT-fix on the iAMAN timeline.





From this visualisation, the Paris FMP is then able to optimise the hotspot resolution by advancing arrivals from the North-West, as seen from the sequence of screenshots below, focused on one particular metering fix of the north-west sector (“BIBAX”):



Compared to the original TT sequence from CASA, with two bunches of traffic remaining, the final TT sequence has no bunches and the flights had their ATFM delay reduced.

This example illustrates how the iAMAN, by providing visualization adapted to the local environment, allows a better assessment of the hotspot and thus an optimized planning of the traffic.

5.2.2.1.1.3.4.2 Impact on LFPG capacity

EXE-01.02-D-03 had no impact on CDG capacity during the trials, but the results on the KPIs and the work on the KPIs (predictability, additional time in ASMA) will help to increase Paris-CDG operational capacity.

5.2.2.1.1.3.4.3 Impact on other ATC units

In MUAC, the potential volatility on sector loads induced by the flights “moved” in the sequence was considered as what would happen in the case where an adjacent ATC unit would cancel ATFM regulations.

No impact was noticed on MUAC capacity.

No issue was reported from non-participating ATC units, which implies that the iStream procedure has operated transparently in those ATC units.

5.2.2.1.1.3.4.4 Flexibility

During the “AFLEX” procedure, two use cases were used:

- Reduction of the delay of a given flight: as described above (5.2.2.1.1.3.4.1), the iAMAN allows optimizing the available capacity. Sometimes CASA regulation delays a flight while it could have been advanced in an earlier available slot. This gives the opportunity for the airline to indicate to ATC flights that should be improved in priority.
- Swap of two AFR flights

During the trial, 5 “AFLEX” demands have been passed from AFR OCC to Paris-FMP. The requests occurred on 3 days and consisted of:

- A swap of two AFR flights and the delay reduction of an AFR flight (first accepted and second refused due to a negative impact on Occupancy Counts),
- A delay reduction of an AFR flight (which was accepted),
- A swap of two AFR flights and the delay reduction of an AFR flight (which were accepted).

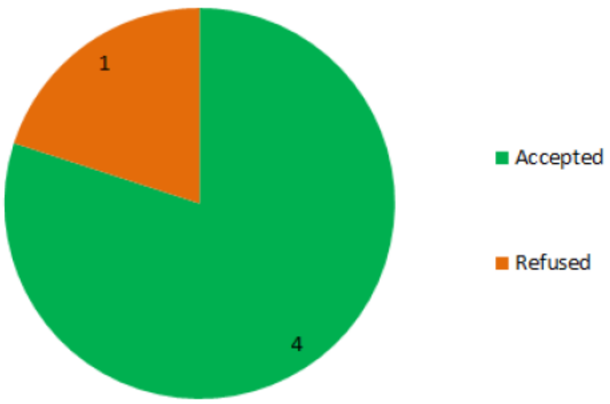


Fig. 3: “AFLEX” requests

The arrival flexibility allowed reducing delay between 5 and 15 minutes for prioritized flights.

Furthermore, with AFLEX and Target Time, and even though it has not been performed during the trials, a flight could possibly be advanced to solve a hotspot (before its EOBT), instead of delayed.

5.2.2.2 Summary of Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
ASS-0201-101	Participation		Participation of pilots and OCCs from partners and of other airlines to the greater extent.						Airlines	
ASS-0201-102	NM/OCC TT transmission		NM provides TT						NM, OCC	

	process									
ASS-0201-103	iAMAN inputs		The iAMAN receives and processes the ETFMS data inputs.						DSNA, NM	

Fig. 4: Demonstration Assumptions

5.2.2.3 Analysis of Exercises Results

Target Time Management results' analysis (EXE-01.02-D-01)

The EXE-01.02-D-01 showed that the Target Time allowed to better manage the Paris-CDG arrival flows during the "P2" peak through several KPIs.

Safety was not degraded during the trial, as reported by all the operational stakeholders.

Predictability, measured as the difference between Target Time over the TT-fix and Actual Time over the TT-fix, has been slightly improved during the trial.

Yet, difference in ATFM delay repartition between the Baseline and the Trial has been observed, which is thought to account for the observed difference in TT adherence.

Results from the FC questionnaires show that the Target Time adherence is strongly influenced by departure clearance and taxi time, which are not fully manageable by the FC (Refer to recommendations).

Flight efficiency has improved between the baseline and the trial:

- Additional time in Arrival Sequencing and Metering Area (ASMA) has decreased by 30 seconds in average per flight
- Some flights could depart earlier, improving departure punctuality

Capacity was not negatively impacted by the trial, neither airport and terminal capacity, nor upstream sectors capacity (MUAC).

By scenario construction, no positive impact on LFPG or LFFF capacity was experienced during the EXE-01.02-D-01, as the regulation method remained unchanged.

Qualitative assessment tend to expect that capacity increase could be achieved, provided further predictability increase can be achieved, allowing to reduce ATC margins.

Local Target Time optimization results' analysis (EXE-01.02-D-03)

The EXE-01.02-D-03 showed that the local Target Time optimization allowed to further optimize the ATC capacity in the pre-tactical phase.

The local ATFM tool (iAMAN) allowed Paris-FMP to visualize the output of a CASA regulation in the form of Target Time sequences on the relevant points in Paris-ACC, which was not possible in the Baseline situation.

This increased awareness of traffic flows allowed a better assessment of the ATFM situation and consequently a fine-tuning of the Target Time sequences.

This fine-tuning allowed both solving the hotspot (CHMI assessment remained the reference) and reducing ATFM delay (reduction of 18% of ATFM delay during the 11 trial days).

This ATFM delay reduction was operationally transparent for ATCOs:

- The Paris-ACC ATCO qualitative assessment shows no increase in traffic complexity or RT transmissions

- The MUAC qualitative assessment shows no impact of the local optimization on MUAC sectors capacity

This local process had an impact on:

- Paris-FMP workload (significant)
- NMOC OPS workload (slight)

It should be noted that the impact on workload for Paris-FMP and NMOC OPS is mainly biased by the trial conditions. In particular, a direct interface between iAMAN and NM (via B2B services) would significantly reduce the amount of coordination between NMOC OPS and Paris-FMP, and consequently the workload (Refer to chapter recommendations).

No significant impact on other ATC KPIs was measured (ASMA, landing rate).

The arrival flexibility (AFLEX) has been improved due to the sequence sharing with Air France OCC and the possibility for Air France to express their needs to Paris FMP. Most of the AFLEX demands were accepted by Paris FMP, resulting in reduction of delay from 5 to 15 minutes for prioritized flights.

5.2.2.4 Confidence in Results of Demonstration Exercises

5.2.2.4.1 Quality of Demonstration Exercises Results

No issue related to quality of results is to be reported.

5.2.2.4.2 Significance of Demonstration Exercise Results

The EXE-01.02-D-01 captured more than 1.300 trial flights, which provides a statistically significant number of flights.

These flights originated from more than 20 different European airports, both CDM and non-CDM airports, which ensures a good representability of the Paris-CDG “P2” inbound flow.

For these reasons, the Target Time adherence figures of the trial flights are considered statistically significant and operationally significant (because representative of the complete arrival flow).

The results provided on additional time in ASMA concern all the “P2” incoming flights (between 08:00 and 09:30 LT), regulated and non-regulated, all airlines included.

Among those flights, the regulated flights only concern a limited percentage of the overall flow (less than 20%), and the participating flights (regulated Air France / HOP flights), a smaller percentage (about 10%).

The rational for this choice of ASMA Trial and Baseline samples is the technical difficulty to isolate smaller samples (e.g. only regulated flights, or only Air France / HOP flights) added to the possible erroneous interpretation it would induce (because from a conceptual point of view, ASMA only well relates to a complete flow). Overall, it has been considered more relevant for this exercise to consider the samples over the all may 2nd to September 16th period.

Due to the limited percentage of participating flights relative to the overall ASMA sample (about 10%) it is dubious that the measured decrease in ASMA (30 seconds per flight) can only be attributable to Target Time management. On the other hand, the Target Time management contribution, if any, cannot be isolated, which is one of the inherent limitation of the live trial activity (it is not always possible to isolate the effect of one parameter).

Evaluation of the impact through a theoretical or simulated model could help identify iStream impacts more precisely.

EXE-01.02-D-03:

The EXE-01.02-D-03 captured about 200 flights over 11 trial days, which provides a statistically significant number of flights.

The 10 questionnaires collected and analysed allowed to draw conclusions on the Paris-FMP qualitative assessment of the trial (safety, workload, confidence in the procedure, benefits), considering the unanimous answers on these topics.

The results on ATFM delays are based on the comparison between the figure at the end of the process of optimization with the iAMAN and the figure after the CASA regulation has been enforced. This approach has the advantage of providing two samples (Baseline and Trial) that share exactly the same initial conditions (traffic demand, complexity…). Thus, it well reflects the impact of the iAMAN actions.

For this reason, the noticed improvements in ATFM delays are considered statistically and operationally significant.

The results on additional ASMA results, considering the high volatility of the indicator and the difficulty to define a proper baseline, cannot be considered significant for these 11 EXE-01.02-D-03 trial days.

Evaluation of the impact through a theoretical or simulated model could help identify iStream impacts more precisely.

5.2.3 Conclusions and recommendations

5.2.3.1 Conclusions

The Target Time Management exercises for Paris arrivals trials (EXE-01.02-D-01 and EXE-01.02-D-03) allowed providing results and drawing conclusions both on the Target Time Management (EXE-01.02-D-01) aspects and on the benefits of the local Target Time calculation (EXE-01.02-D-03).

These conclusions are presented below.

On Target Time Management:

- The Target Time have been safely trialled on complete arrival flow, with more than 1.300 flights involved. Pilots could calculate an optimal Take-Off Time and communicate it to departure ATC. The procedure has proved to be safe to all actors (pilots, departure ATC, en-route ATC, LFFF and LFPG ATC, Network Manager), with no incident reported.
- The Target Time adherence has improved for the trial flights during the trial: the variance of Target Time adherence of the 1.400 trial flights has been reduced compared to the 2015 baseline.
- Improvement of the flight efficiency: delays in ASMA (Arrival Sequencing and Metering Area) over the trial period have been reduced by 30 seconds per flight compared to the 2015 baseline.
- The Target Time information allowed to better manage the flight before departure and improve the ATC delay: the pilots feedback show that the Target Time information allowed some flights to depart earlier, thus improving departure punctuality.

On the local Target Time optimization

- Locally optimized Target Times allow to improve the use of ATC capacity in the pre-tactical phase: ATFM delays have been reduced by nearly 20% on trial days
- Allowed to take into account Airspace Users' needs (AFLEX): Air France was able to express their need for arrival flexibility to ATC, and ATC able to take them into account, reducing delay by 5 to 15 minutes for prioritized flights.

5.2.3.2 Recommendations

The TT procedure for Paris-CDG arrivals, using a local ATFM tool (iAMAN), has shown promising results. It is recommended that it is further studied and improved, especially in PJ-025:

- By developing full B2B exchanges between iAMAN and NM OPS systems, in order to reduce the Paris-FMP and NMOC workload,
- By studying the possible improvements to the iAMAN tool in order to ease the use by Paris-FMP,
- By studying possible increase in arrival flexibility opportunities (exchange between two flights TT are currently being limited to the same Metering Fix)
- By including long haul flights

Furthermore, it is recommended in SESAR2020 to pursue work towards maturity increase for the Adherence Feature of Target Time Management, involving more Airspace Users:

- The exercises have shown that the Target Time adherence is influenced by the departure clearance and the taxi time, which are not fully manageable by the flight crew. Additional work should be devoted to better integrate the Target Time with departure procedures.
- More work to be done to achieve seamless integration of ATFCM and ATC (e.g. integration of TT with XMAN concept)

5.3 Target Time-based STAM results

5.3.1 Execution of Demonstration Exercise

5.3.1.1 Exercises Preparation

The main activities undertaken to prepare the demonstration exercises for EXE-01.2-D-04 Target Time based STAM are summarised in the table below.

Event	Dates	Goal
Design of the exercises	June 2015 – May 2016	Define the procedures
WebEx Kick-Off meeting	27 May , 2015	Launch the design activities for the exercises
Meeting in Brussels	23 June , 2015	Refine the design
Meeting in Paris-CDG	19 February, 2016	Finalize the design
Safety activities	November 2015 - June 2016	Ensure safety of the Exercise
1st Hazard identification meeting	23 November, 2015	Prepare the trial Safety Case
Deliverance of initial Safety Plan to EASA	13 January, 2016	Inform of the safety activities to be conducted
2nd Hazard identification meeting	19 February, 2016	Prepare the trial Safety Case
Deliverance of updated Safety Plan to EASA	11 March, 2016	Inform of the safety activities to be conducted
Deliverance of Safety Case to EASA for EXE-01.2-D-04	25 April, 2016	Provide the safety argument
Systems development, test and validation	October 2015 – June 2016	Ensure the necessary system environment is ready for the Exercise
Delivery of Release NM20.0 with Target Time information contained within SAM and SRM messages	05 April, 2016	All recipients of SAM and SRM messages now receive Target Time information
Technical configuration ready for EXE-01.2-D-04	11 April, 2016	(GNG meeting)
Training	March 2016	Ensure the participating staff is adequately trained
NMOC briefing	March and April 2016	Performed during normal Team briefings

Operational communication	February 2016	NM communication to Airlines, airports and ACCs to ensure awareness and operational acceptability of trials
Exercise start		
EXE-01.2-D-04 GO/NOGO meeting	11 April, 2016	Start EXE-01.2-D-04
Exercise Complete		
	31 August, 2016	End EXE-01.2-D-04

5.3.1.1.1 Systems development, test and validation

There were no NM tools developed specifically to perform EXE-01.2-D-04. However, the exercise assumed dependencies upon an NM enabler project that delivered Target Time information in the Slot Allocation Message (SAM) and Slot Revision Message (SRM) messages as part of NM Release 20.0.

The change was tested and validated by the NM release process to ensure correct functioning and correct data exchange between the systems.

SWISS International Airlines updated their procedure and Air France updated their OCC procedure and software to enable ACARS transmission of the TT information contained with the SAMs and SRMs, with the traditional SAM information to their aircraft cockpits.

5.3.1.1.2 Training of the participating units

EXE-01.2-D-04 had no impact on working methods or standard operating procedures for iStream participants and non-participants.

Information describing the operational instruction was provided during local briefings. There was no specific training given.

5.3.1.1.2.1 NMOC

A local operational instruction (OI) was published to brief the NMOC OPS staff for EXE-01.2-D-04 and briefings were undertaken to prepare staff.

5.3.1.1.2.2 Air France OCC

No specific training was undertaken for this exercise.

Target time information received in SAM/SRM messages was included into the data automatically transmitted by the OCC to cockpit. Flight Crew were informed of the iStream instructions during pilot briefings.

5.3.1.1.2.3 SWISS OCC

No specific training was undertaken for this exercise.

Target time information received in SAM/SRM messages and with Regulation ID beginning with letters TRIAL was included into the data transmitted by the OCC to cockpit. OCC staff received iStream instructions during local briefings.

5.3.1.1.2.4 Maastricht UAC

EXE-01.2-D-04 no training but written briefings were provided to FMP officers to request NMOC to perform the MCP "trial" procedure when HOP, AFR or SWR flights were cherry picked.

Note:

- MUAC intended to only use classic ATFCM regulations during summer 2016.

5.3.1.1.2.5 Reims UAC

EXE-01.2-D-04 no training but briefing was provided to FMP officers to request NMOC to perform the MCP "trial" procedure when HOP, AFR or SWR flights were cherry picked.

5.3.1.1.3 Operational communication

Information about the trials was provided to the different stakeholders potentially impacted:

- An AIM was published covering the complete trial duration. This information was publicly available on the NOP Public portal headline news.
- A letter of information was sent to the ATC units impacted and to non-participating airlines through the Airline Operations Group (AOG)),

5.3.1.2 Exercise Execution

Exercise ID	Exercise Title	Actual Exercise execution start date	Actual Exercise execution end date	Actual Exercise start analysis date	Actual Exercise end date
EXE-01.2-D-04	Target-Time based STAM	18/04/16	31/08/16	31/07/16	31/08/16

Fig. 5: Exercises execution/analysis dates

Even though, the exercise EXE-01.2-D-04 was active during the entire period, accepting days lost due to ATC industrial action, the procedure was only executed four times affecting 6 flights from participating airlines, according to the scenario design.

For the procedure to be executed, both an MCP regulation AND participating iStream flights needed to be present together.

The risk of low iStream flight participation had previously been identified and assessed under the project risk management process and this was re-iterated by the ANSPs and airlines during the exercise Go-no-go meeting. Maastricht UAC articulated that their 2015 preference to use traditional ATFM regulations would again be applied during summer 2016 and it was known that this decision would limit the EXE-01.2-D-04 effectiveness. Maastricht UAC used the MCP procedure five times in 2015 and only three times during summer 2016.

Reims UAC used the MCP procedure on 64 occasions during April-August 2015 and 92 occasions in 2016 with the increased use experienced during May and June. However, only 17 MCP contained participating airline flights during summer 2016 and the EXE-01.2-D-04 was executed only once by Reims UAC which affected two flights only.

5.3.1.3 Deviations from the planned activities

After consideration of the exercise's poor situation, the WP06 team considered alternative and new opportunities to trigger the EXE04 once the busy summer traffic demand had slackened:

- Reims UAC proposed to trigger zero delay mandatory cherry picking measures to invoke EXE-01.2-D-04. This method would select SWR flights into MCP regulations with "zero delay" target times set for them.
- Maastricht UAC also proposed to attempt mandatory cherry picking measures with "zero delay" target times to invoke EXE-01.2-D-04.
- An unanticipated consequence of EXE-01.02-D-03 (Paris Trial) had been the allocation of Target Times to SWR participating flights transiting the Paris FUJ sector with destinations to aerodromes other than the arrivals regulated LFPG. EXE-01.2-D-04 could take benefit of these exercise flights and consider them as if the MCP procedure had been applied.

5.3.2 Exercises Results

5.3.2.1 Summary of Exercises Results

The EXE-01.2-D-04 was executed four times.

For operational reasons, Maastricht UAC continued to prefer the use of traditional ATFCM delay regulations over MCP and performed the trial's Mandatory Cherry Picking Procedure on three occasions, affecting 5 flights during summer 2016.

ARCID	ADEP	ADES	Delay	Date	Reg Id	TV Id	D.TOT	D.TO	D.FT	ET to MCP
AFR151M	EKCH	LFPG	9	09 08 2016	TRIAL09	MASD5WH	-15	-17	-2	44
SWR125B	LSZH	EKCH	5	10 08 2016	TRIAL10	MASHSDCT	3	0	-3	41
SWR185J	LSZH	ESGG	7	10 08 2016	TRIAL10	MASHSDCT	-2	-2	0	46
SWR127J	ESGG	LSZH	1	10 08 2016	TRIAL10X	MASDHOL	3	2	-1	35

Reims UAC performed the trial's MCP once during summer 2016 and affected two flights. The trial opportunity came after the summer peaks had abated and through special cooperation with the local iStream team.

ACID	ADEP	ADES	Delay	Date	Reg Id	TV	D.TOT	D.TO	D.FT	ET to MCP
SWR86	LSZH	CYUL	14	2016/08/24	TRIAL24	LFEXR	-1	-3	-2	32
AFR1638	LFPG	EDDV	19	2016/08/24	TRIAL24	LFEXR	-8	-3	5	14

The opportunities for Reims UAC to perform the EXE-01.2-D-04 exercise did not manifest in the initial months and this largely led to the ACC FMP users losing their familiarity with the exercise's existence and method.

In the subsequent busy summer months, the opportunities arose, however by then, ACC FMP users were occupied and prioritised upon busy summer service provision and less inclined to switch their focus to performing the unfamiliar exercise in parallel with ATS provision.

In all 16 MCP opportunities affected 24 of the participating airlines' flights were lost to EXE-01.2-D-04:

- 2 x MCPs with 3 flights
- 4 x MCPs with 2 flights
- 10 x MCPs with 1 flight.

5.3.2.1.1 Summary of the Exercise Deviation Results

5.3.2.1.1.1 Reims UAC "Zero Delay" MCPs

Reims UAC was able to apply a Zero Delay MCP to two SWR flights.

ACID	ADEP	ADES	Delay	Date	Reg Id	TV	D.TOT	D.TO	D.FT	ET to MCP
SWR12J	LSZH	EGLL	0	2016/08/09	TRIAL09L	LFEHYR4	-6	Cf. note	Cf. note	35

								1	1	
SWR31V	LSZH	EGCC	0	2016/08/09	TRIAL09L	LFEHYR4	-4	-2	2	34

Note1:

- The flight SWR12J did not fly abeam the TT fix and so there was no actual time over from which to derive a delta time.

5.3.2.1.1.2 MUAC UAC "Zero Delay" MCPs

The application of this deviation caused some challenges for the participants.

For the unaccustomed NMOC users, there was confusion between the later application of this exercise from mid-August and the ongoing EXE-01.02-D-03 (Paris trial) which had been running very frequently since May.

In addition, the NMOC users did not wish to mix iStream MCP for participating AUs with standard MCP for other AUs in the same hotspot.

They complained that the application of zero delay target times was counter-intuitive and offered nil operational benefit to the network's delay performance.

Further, it was observed that flights departing from A-CDM airports – where the applied CTOT (equal to the ETOT) was earlier than the airport's published Target take-off time, would be *impossible* to implement.

MUAC did attempt to coordinate two zero-delay MCPs (TRALCP11 and TRILCP11) on 11th August but were advised to cancel them after application by NMOC staff.

In addition, two of the candidate SWR flights were wet leased aircraft without standard SWR capability and would have been unable to execute with Target Times.

5.3.2.1.1.3 EXE-01.02-D-03 (Paris Trial) flights with destination EG airfields

ARCID	ADEP	ADES	Entry Date	Delay	Reg Id	AS	D.TOT	D.TO	D.FT	ET to MCP
SWR46E	LSGG	EGLC	2016/07/01	17	TRIAL01	LFFFUJ	-6	-4	2	10
SWR28T	LSGG	EGLL	2016/07/01	18	TRIAL01	LFFFUJ	-6	-4	2	8
SWR410	LSGG	EIDW	2016/09/09	0	TRIAL109	LFFFUJ	2	6	4	7
SWR28T	LSGG	EGLL	2016/09/09	13	TRIAL109	LFFFUJ	-2	2	4	6

All four of the flights had <= 10 minutes elapsed time from LSGG take-off to the regulated FUJ sector which does not provide the SWR Flight Crew with time to make flight adjustments to the given target times.

A more detailed view of the planned and actual flight profiles has shown that the flights' flown profile was longer in distance/time than that considered by the NMOC planned flight trajectory.

On further analysis of the NM flight op logs, it was observed that the LSGG Departure Planning messages contained updated SIDs which had been rejected by NM because the updated SID route did not intersect with the FPL route. An NM technical improvement should be considered to address such SID updates.

5.3.2.1.2 Results per KPA

The EXE-01.02-D-04 results are statistically insignificant and should not be discussed further in this report.

The attempted objectives are entered here for completeness purposes only.

5.3.2.1.2.1 EXE-01.02-D-04 (Target Time from CASA regulation)

5.3.2.1.2.1.1 Safety and workload

5.3.2.1.2.1.1.1 Impact on flight crew workload and safety

OBJ-0102-001	Evaluate the impact on flight crew workload and safety
Criteria	Usage of TTs doesn't have a negative impact on flight crew & OCC staff workload and safety
Result	No Result – No safety reports received during trial phase. Only one questionnaire was returned. No conclusion can be drawn from that..

5.3.2.1.2.1.1.2 Impact on ATM workload and safety

OBJ-0102-002	Evaluate the impact of using TTs on ATM workload and safety (NM, ATCOs and/or FMP)
Criteria	Usage of TTs doesn't have a negative impact on ATM operational staff workload and safety
Result	No Result – No questionnaires returned. No safety observations reported to or by NM.

OBJ-0102-810	Assess the impact of using TT on speed changes in ACCs
Criteria	The usage of TT and potential inherent speed changes should not induce safety concerns for ATC
Result	No Result – No questionnaires returned. No safety observations reported to or by NM.

5.3.2.1.2.1.2 Predictability

<u>Predictability of participating flights</u>

OBJ-0102-310	Evaluate the deviation to the initial TT
Criteria	The variance of the TT adherence is improved compared to the baseline data. Percentage of aircraft within a TT deviation of [-X;X] min is improved
Result	No Result there were statistically too few observations from which to make such a comparison

OBJ-0102-340	Evaluate the consistency between the initial and/or revised TT and the actual arrival sequence
Criteria	The usage of TT enhances the adherence of the estimated times (entry times into a sector / arrival times), compared to baseline scenario.
Result	No Result there were statistically too few observations from which to make such a comparison

OBJ-0102-420	Evaluate the impact of TT execution on the deviation to predicted sector entry time.
Criteria	The usage of TT reduces the deviation to predicted entry time into sector
Result	No Result there were statistically too few observations from which to make such a comparison.

OBJ-0102-540	Evaluate the effect of TT management on CTOT deviation at departure
Criteria	The usage of TT does not increase the deviation to CTOT adherence (compared to baseline).
Result	No Result there were statistically too few observations from which to make such a comparison.

5.3.2.1.2.1.3 Efficiency

OBJ-0102-430	Evaluate the effect of TT management on Flight Efficiency.
Criteria	The usage of TT; by enhancing flight profiles and/or reducing ATFCM delays and/or reduced vectorings and/or reduced number of holdings; reduces the fuel burn compared to OFP data and/or baseline data.
Result	No Result.

5.3.2.1.2.1.4 Capacity

OBJ-0102-440	Evaluate the impact of TT execution on capacity use of en-route sectors.
Criteria	The usage of TT does not reduce sector (TMA/En-route) capacities.
Result	No Result there were statistically too few observations from which to make such a comparison.

OBJ-0102-550	Evaluate the operational opportunities and risks of the STAM target times technique.
Criteria	The STAM target times' technique should not add operational risks and should provide more effective operational opportunity to ensure smoothing of traffic.
Result	Practical Result Reims UAC observed the requirement to safeguard sector traffic demand predictability by also acting upon the non-MCP flights, possibly by issuing zero-delay TTs.

5.3.2.2 Summary of Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
ASS-0201-101	Participation		Participation of pilots and OCCs from partners and of other airlines to the greater extent.						Airlines	

Fig. 6: Demonstration Assumptions

The early monitoring of the trial execution identified and confirmed the low use of EXE-01.02-D-04 as an issue. The issue manifested because EXE-01.02-D-04 design relied upon the co-dependency between the application of MCP procedure AND the selection of participating airline iStream flights. This situation did not sufficiently materialise during the early and later exercise periods.

Unfortunately the initial recovery action relied too heavily upon future projected traffic growth to provide the necessary exercise opportunities.

This recovery strategy was abjectly flawed because it took several months for ample traffic growth to manifest and by which time the exercise's instructions were unfamiliar to the operational resources who were understandably employed to manage the busy summer traffic.

When the deviations described above were introduced, their communication was not sufficiently thought through to avoid operational confusion of the unaccustomed operational staff who is participating in other iStream exercises running in parallel. The exercise deviations only had limited success.

5.3.2.3 Analysis of Exercises Results

The low quantity of results renders them unsuitable for trend analysis or to be compared against the baseline analysis and consequently the analysis was very limited. The localised analysis is described above within the exercise result summaries.

5.3.2.4 Confidence in Results of Demonstration Exercises

5.3.2.4.1 Quality of Demonstration Exercises Results

For those results recorded by EXE-01.02-D-04, the quality matches the good quality of their NM archive source. In addition the NM archives present ample opportunity to analyse the evolution of the flights based upon received: FPL, ACDM, CASA, FSA, and CPR data.

The overall EXE-01.02-D-04 result set is deficient because there were no EXE-01.02-D-04 specific questionnaires returned by those executing the participating flights.

Therefore, only the NM data has been used for assessment purposes and so only provides a single perspective on the exercise.

5.3.2.4.2 Significance of Demonstration Exercise Results

The significance of the recorded results is low because of the very low quantity of recorded results. This makes any trend and baseline comparison statistically irrelevant.

5.3.3 Conclusions and recommendations

5.3.3.1 Conclusions

The infrequent conduct of exercise EXE-01.02-D-04 did not provide adequate flight instances from which sufficient results could be recorded and analysed.

Consequently the exercise success criteria were un-assessable. Nevertheless, exercise observations were made and these have been expressed in the recommendations section. This exercise EXE-01.02-D-04 is inconclusive.

It has neither shown a positive or negative outcome. Future opportunities should be sought to demonstrate the principles, benefits and responsibilities of the EXE-01.02-D-04 operational concept.

5.3.3.2 Recommendations

To find new opportunities to demonstrate the application of TT to en-route sector hotspots solutions

To investigate the potential predictability gains for ACCs won by zero-delay MCPs applied to flights remaining within the hotspot period

To investigate the interaction between A-CDM setting of TTOT and ATFCM Target Times when the TTOT is set after the CTOT time

Investigate the NM-Airport interface anomalies in the NM processing of SID changes.

Re-consider the process interactions between the ADEP-NM-ADES and extend this to other coincident planning processes e.g., UDPP, XMAN.

5.4 Dynamic Demand and Capacity Balancing results

5.4.1 Execution of Demonstration Exercise

5.4.1.1 Exercises Preparation

5.4.1.1.1 Coordination with actors

5.4.1.1.1.1 NMOC

In order to prepare the trial, an AIM (Refer to document [R-14] “AIM” in chapter 9) was prepared by the Paris FMP unit and sent to NMOC to be published on the NOP portal.

An operational instruction (OI) (Refer to document [R-15] “OI” in chapter 9) for NMOC was also jointly prepared between NMOC & Paris FMP unit.

NMOC was informed at D-3 of the requested ATFCM rerouting scenarios to be activated when the LFFF ATFCM Daily Plan was sent by Paris FMP unit.

5.4.1.1.1.2 Adjacent ACC

In 2015 and 2016, the trials were prepared and coordinated with the adjacent ACCs weeks before the start of the trial.

The coordination was made by Paris FMP unit in order to have the ATFCM rerouting scenarios accepted by the impacted ACCs, such as:

- Geneva ACC: coordination was made in April 2015 & 2016 by email and resulted in an agreement by Geneva FMP for both trials,
- Zurich ACC: coordination was made in April 2015 & 2016 by email and resulted in an agreement by Zurich FMP for both trials,
- Reims ACC: coordination was made in April 2015 & 2016 by email and resulted in an agreement by Reims FMP for both trials,
- Maastricht ACC: a coordination meeting took place on the 17th of March 2015 at MUAC between Paris ACC & MUAC staff for the 2015 trials and by email & WebEx in April 2016 for the 2016 trials which both resulted in an agreement by MUAC FMP for both trials. In 2016, a collaborative process was established between Paris FMP & MUAC, with the possibility for MUAC to request the addition of scenarios to the Paris FMP unit in order to lower the pressure on their sector. The resulting procedure is detailed in §5.1.3.3.2.

All the adjacent ACCs therefore agreed with the proposed ATFCM rerouting scenarios creation & activation.

In case of any problems detected by the adjacent ACCs (such as detected overload in their respective sectors), their FMP unit had the possibility to contact Paris FMP by email to modify the planned ATFCM scenarios.

5.4.1.1.2 Aeronautical information

In 2015, information about the trial to airlines operating into Paris-CDG & Le Bourget during the P2 peak was distributed as follows:

- An AIM (Refer to document [R-14] “AIM” in chapter 9) was published during the whole trial and was publicly available on the NOP Public portal.
- A description of the trial was published on the CDM@CDG website and sent by mail to the main airlines.
- A dedicated forum organized by Paris ACC Operations staff at Paris-CDG airport took place on the 20th of March 2015 with the main impacted airlines.

- In 2016, Paris ACC estimated it was necessary to distribute the same information as in 2015. This had no impact on the following trials.

5.4.1.1.3 Training

5.4.1.1.3.1 Paris ACC Flow Management Position

Paris FMP operators were trained for the trial during their general FMP training course during March 2015 delivered by Paris FMP unit.

5.4.1.1.3.2 Paris ACC supervisor

Paris ACC supervisors were informed of the trial by the issuance of a local operational instruction (refer to (Refer to document [R-15] "OI" in chapter 9).

5.4.1.1.3.3 Paris FMP unit

Paris FMP unit was the initiator of the trial and therefore didn't need any training.

5.4.1.1.3.4 Paris ACC ATCOs

The trial had no impact on working methods and standard operating procedures for Paris ACC ATCOs therefore no training but just information was provided.

5.4.1.1.3.5 CDG Approach supervisor

CDG Approach Supervisors were trained during the Flow Management formation, during Approach Supervisors seminars and an operational instruction has been issued ([R-16]).

5.4.1.1.3.6 CDG Tower supervisor

The trial had no impact on working methods and standard operating procedures for CDG Tower Supervisors therefore no training but just information was provided ([R-16]).

5.4.1.1.3.7 CDG ATCOs

The trial had no impact on working methods and standard operating procedures for CDG ATCOs there no training but just information was provided, during OPS monthly meeting.

5.4.1.2 Exercises Execution

Exercise ID	Exercise Title	Actual Exercise execution start date	Actual Exercise execution end date	Actual Exercise start analysis date	Actual Exercise end date
EXE-01.2-D-055 SCN-0102-510	LFPG arrivals basic dDCB, with collaborative processes	April 13, 2015	June 24, 2015	July 01, 2015	August 31, 2015
		May 09, 2016	Sept 16,2016	Sept 19, 2016	Sept 30, 2016

Fig. 7: Exercises execution/analysis dates

- Works were conducted on CDG and Orly runways from mid-July to mid-September 2016. The dDCB scenarios were successfully used during the whole summer. However only the period before the works (from May 09, 2016 to July 17) can be compared to the results of 2015 trials, or to the baselines, to only assess the efficiency of the sole dDCB measures, without statistical bias.
- The runway works obviously had a negative impact on the capacity of both airports and on ATFCM delays that could not be fully compensated by dDCB measures, which focus mostly on the optimization of the use of capacity in pre-approach airspace. However, additional

simulations, not in the scope of iStream project, seem to suggest that dDCB measures helped mitigating the negative impact of the reduction of capacity due to the works.

5.4.1.2.1 2015 Trials

During the 2015 trials, 3 scenario combinations were used:

- The combination of RR1FTE (1) + RR2FTE (2) + RR3FTE (3): 30% of the days
  - Flights departing Munich, Stuttgart, Turkey, Egypt, Romania and inbound LFPG/LFPB were not allowed to file their flight plan via Paris TE sector.
- The combination of RR1FTE (1) + RR2FTE (2) + RR4FTE (4): 51% of the days
  - Flights departing Munich, Stuttgart, Turkey, Egypt, Austria and inbound LFPG/LFPB were not allowed to file their flight plan via Paris TE sector
- The combination of RR1FTE (1) + RR2FTE (2) + RR3FTE (3) + RR4FTE (4): 19% of the days
  - Flights departing Munich, Stuttgart, Turkey, Egypt, Romania, Austria and inbound LFPG/LFPB were not allowed to file their flight plan via Paris TE sector,
  - This combination of scenarios was less used in order not to overload Paris ACC's UJ sector.

Scenario RR5FTE concerning flights from Hungary to Paris CDG and Paris Le Bourget via TE sector was never activated to avoid overloading Paris ACC's UJ sector and to avoid penalizing the concerned Air France flight as Air France stated during the early coordination process of the trial.

The scenarios were all activated from 5h30 UTC until 7h30 UTC except for RR4FTE scenario that was modified from the 13th of May 2015, which was activated between 6h00 UTC and 7h30 UTC to avoid an unnecessary penalization of a flight.

An average of 5,2 flights were concerned per day by the dDCB scenarios, with an average of 2,2 having sent a CHG message to file a route accordingly to the scenario.

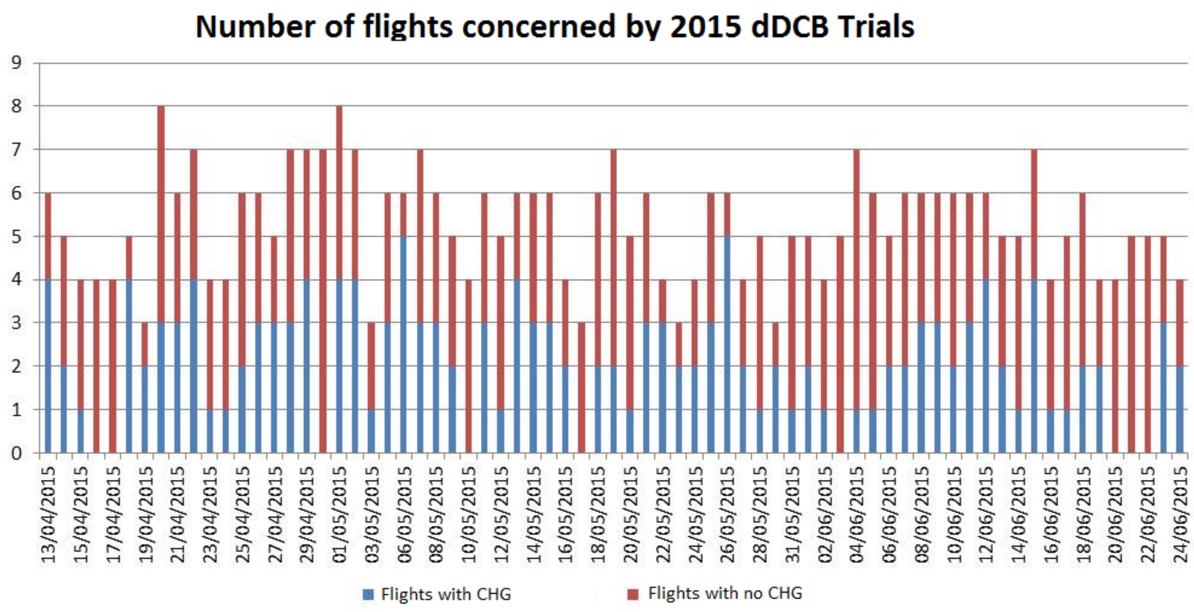


Fig. 8: Number of flights concerned by 2016 dDCB trials

5.4.1.2.2 2016 Trials (before runway works)

During the 2016 trials, 3 scenario combinations were used to adequately balance the loads between the north and the south sectors in Paris ACC:

- RR1FTE (1): 9% of the days

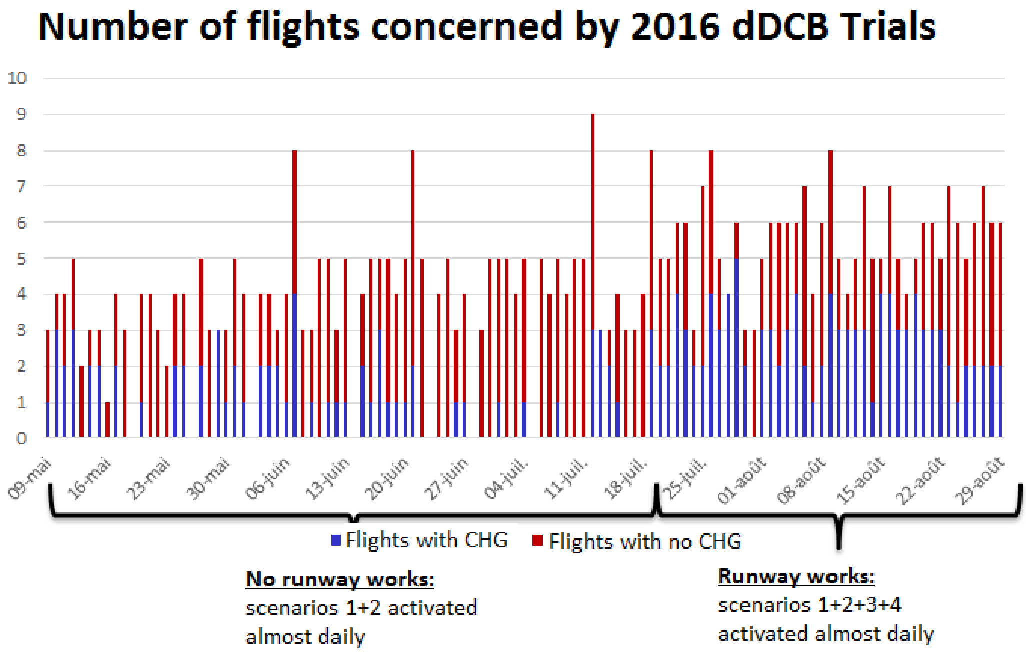
- Flights departing Munich, Stuttgart inbound LFPG/LFPB were not allowed to file their flight plan via Paris TE sector.

- The combination of RR1FTE (1) + RR2FTE (2): 85% of the days
  - Flights departing Munich, Stuttgart, Turkey, Egypt and inbound LFPG/LFPB were not allowed to file their flight plan via Paris TE sector.
- The combination of RR1FTE (1) + RR2FTE (2) + RR3FTE (3) + RR4FTE (4): 6% of the days
  - Flights departing Munich, Stuttgart, Turkey, Egypt, Romania, Austria and inbound LFPG/LFPB were not allowed to file their flight plan via Paris TE sector,

Scenario RR5FTE concerning flights from Hungary to Paris CDG and Paris Le Bourget via TE sector was never activated to avoid overloading Paris ACC's UJ sector and to avoid penalizing the concerned Air France flight as Air France stated during the early coordination process of the trial.

The scenarios were all activated from 5h30 UTC until 7h30 UTC except for RR4FTE which was activated between 6h30 UTC and 7h30 UTC to avoid an unnecessary penalization of a flight.

An average of 4,3 flights were concerned per day by the dDCB scenarios, with an average of 1 having sent a CHG message to file a route accordingly to the scenario.



5.4.1.2.3 2016 Trials (during runway works)

During the 2016 trials (during runway works periods), 2 scenario combinations were used to adequately balance the loads between the north and the south sectors in Paris ACC and to cope with strong arrival traffic figures coming from the North to LFPG and to comply with MUAC request to add new scenarios to the dDCB strategy following the planned collaborative process with Paris FMP unit and MUAC FMP:

- The combination of RR1FTE (1) + RR2FTE (2): 8% of the days
  - Flights departing Munich, Stuttgart, Turkey, Egypt and inbound LFPG/LFPB were not allowed to file their flight plan via Paris TE sector.
- The combination of RR1FTE (1) + RR2FTE (2) + RR3FTE (3) + RR4FTE (4): 92% of the days
  - Flights departing Munich, Stuttgart, Turkey, Egypt, Romania, Austria and inbound LFPG/LFPB were not allowed to file their flight plan via Paris TE sector,

Scenario RR5FTE concerning flights from Hungary to Paris CDG and Paris Le Bourget via TE sector was never activated to avoid overloading Paris ACC's UJ sector and to avoid penalizing the concerned Air France flight as Air France stated during the early coordination process of the trial.

The scenarios were all activated from 5h30 UTC until 7h30 UTC except for RR4FTE which was activated between 6h30 UTC and 7h30 UTC to avoid an unnecessary penalization of a flight and except for the RR1FTE which was activated until 07h00 to allow the concerned flights to file the shortest route with no RAD restriction.

An average of 5,6 flights were concerned per day by the dDCB scenarios, with an average of 2,7 having sent a CHG message to file a route accordingly to the scenario.

5.4.1.3 Deviations from the planned activities

The activities did not deviate from the ones described in the last version of the Demonstration Plan.

Initially, one of the scenarios included the use of an additional tool to perform traffic complexity assessment to support the choice of the rerouting scenarios.

During the project, it appeared that the tool that was intended for this purpose, a piece of software developed in the scope of SESAR project VP700, was mainly focused on the measurement of complexity of pure En route traffic.

The tool was not adapted to mixed en route/approach traffic such as the one in Paris ACC, and therefore could not be used for dDCB trials: no sufficient time and effort were available to allow the necessary complementary developments.

However, the use of a complexity tool was mainly to facilitate the decision making process when choosing the rerouting scenarios. It is reckoned that the non-availability of this tool did not severely impact the performance of the dDCB system.

5.4.2 Exercises Results

5.4.2.1 Summary of Exercises Results

Exercise ID	**Demonstration Objective Tittle**	**Demonstration Objective ID**	**Success Criterion**	**Exercise Results**	**Demonstration Objective Status**
EXE-01.02-D-055	Evaluate the impact on flight crew and OCC staff workload and safety.	OBJ-0102-001	No negative impact on flight crew and OCC staff workload and safety	No negative impact was observed on staff workload and safety due to the use of dDCB measures.	OK
EXE-01.02-D-055	Evaluate the impacts on ATM workload and safety (NM and ATCOs and/or FMP)	OBJ-0102-002	No negative impact on ATM operational staff (NM, ATCOs and/or FMP) workload and safety	The dDCB measures had a positive impact on ATM operational workload and safety.	OK
EXE-01.02-D-055	Evaluate the impact on flight efficiency.	OBJ-0102-430	The scenarios; by enhancing flight profiles and/or reducing ATFCM delays and/or reduced vectoring and/or reduced number of holdings; reduces the fuel burn compared to OFP data and/or baseline data.	The use of dDCB measures, with or without combination with the use of TT, helped reducing ATFCM (ground) delays. Most rerouted flights had a reduction of route length, but some suffered an increase of route length. Effects of the measure on ASMA delays have proved inconclusive.	OK

Exercise ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
EXE-01.02-D-055	Evaluate the impact on capacity use of airport and sectors (arrival / en-route).	OBJ-0102-440	The airport capacity and sectors (TMA/En-route) capacities are not reduced.	The use of dDCB measures, with or without combination with the use of TT, had a positive impact on the use of sector capacities and no negative impact on runway capacities	OK
EXE-01.02-D-055	Evaluate the impact of dDCB collaborative processes on hotspot or demand and capacity imbalance detection and resolution and on users operations.	OBJ-0102-610	The dDCB collaborative processes reduce hotspots and enhance demand and capacity imbalance detection and resolution efficiency, compared to baseline scenarios (no or less need for additional measures to reduce hotspots).	The dDCB collaborative process allowed to balance arrival flows, thus drastically improving matching between demand and capacity, and reducing ATFCM delays	OK

Fig. 9: Summary of Demonstration Exercises Results

5.4.2.1.1 Methodology

The traffic figures and flight details were loaded from NEST software using the relevant AIRAC cycles, days of ATC industrial action and significant airline strikes were not included in the statistics.

The regulation statistics were loaded from the Network Manager Interactive Reporting (NMIR) database. All the regulation data used below do not include regulations having reasons other than ATC Capacity or Aerodrome Capacity.

2015 Trials:

The baseline 1 (in red in the diagrams below) is based on a time period in 2014 similar to the 2015 trial. After having removed the days when the P2 peak was regulated for any other reason than ATC Capacity or Aerodrome Capacity, this represents 68 days of data.

The baseline 2 (in green in the diagrams below) is based on a time period in 2015 before the implementation of the ATFCM scenarios. This baseline lasts between the 29th of March 2015 and the 12th of April 2015. After having removed the days when the P2 peak was regulated for any other reason than ATC Capacity or Aerodrome Capacity, this represents 9 days of data.

The time period of the dDCB Paris 2015 trials was between the 13h of April 2015 and the 24th of June 2015 (in blue in the diagrams below). After having removed the days when the P2 peak was regulated for any other reason than ATC Capacity or Aerodrome Capacity, this represents 71 days of data.

When the document relates about peak hours figures, this data represents the average of every peak hour (with a sliding step of 10 mins) during every P2.

2016 Trials:

The baseline 2016 is based on a time period in 2016 before the implementation of the ATFCM scenarios. The baseline lasted between the 27th of March 2016 and the 8th of May 2016 (in orange in the diagrams below). After having removed the days when the P2 peak was regulated for any other reason other than ATC Capacity or Aerodrome Capacity, this represents 30 days of data.

The time period of the dDCB Paris 2016 trials was between the 9th of May 2016 and the 17th of July 2016 (in purple in the diagrams below). After having removed the days when the P2 peak was regulated for any other reason than ATC Capacity or Aerodrome Capacity, this represents 50 days of data.

The time period between the 18th of July 2016 and the 16th of September 2016 were not included in the statistics because of works on a southern runway in Paris-CDG which made the regulation strategies more cautious and less flexible. However, even more dDCB scenarios were activated during that time in order to cope with strong arrival traffic figures coming from the North to LFPG and to comply with MUAC request to add new scenarios to the dDCB strategy following the planned collaborative process with Paris FMP unit and MUAC FMP.

5.4.2.1.2 Results per KPA

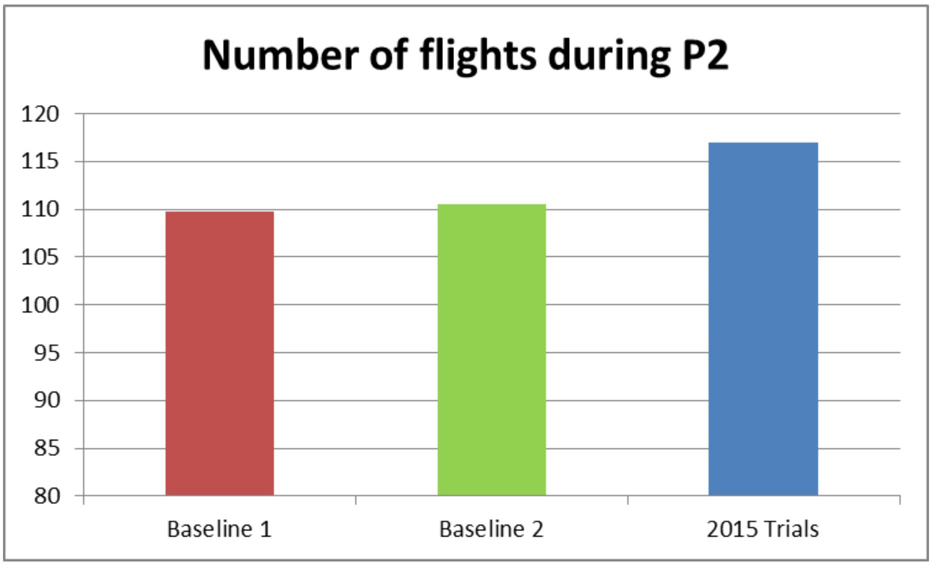
5.4.2.1.2.1 Traffic and capacity

5.4.2.1.2.1.1 Landing traffic into LFPG during the P2 peak

The total number of flights during the P2 peak is depicted below.

2015 Trials:

We can see the number of flights during the P2 peak is similar between baseline 1 and baseline 2, but during the 2015 trials we can notice an increase of 5% of the traffic demand compared to baseline 1 and 2.



2016 Trials:

We can see the number of flights during the P2 peak is similar between baseline 2016 and the 2016 trials.

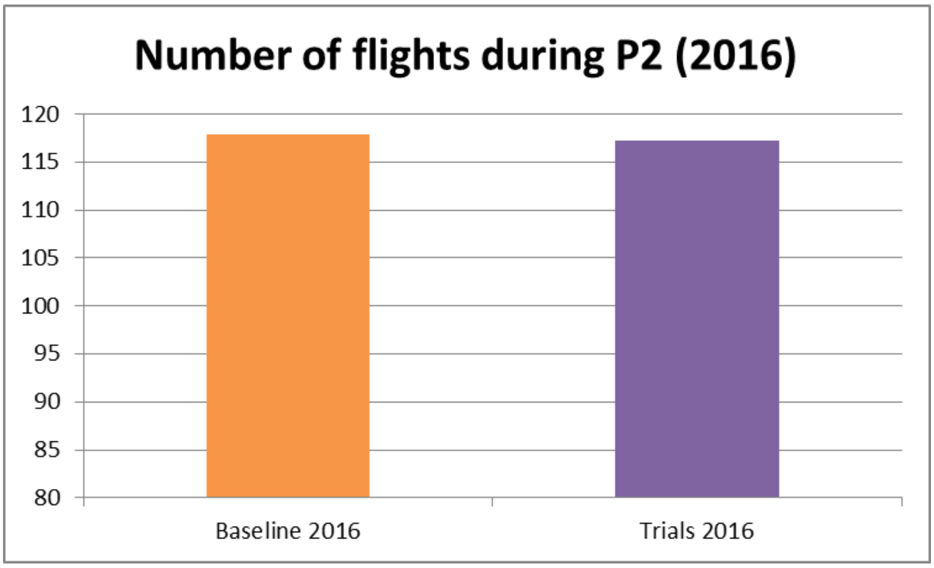


Fig. 10: Total average of flights during P2 peak

5.4.2.1.2.1.2 TV re-balancing/ Distribution of demand on P2 for LFPGARN/LFPGARS

The consequences on the distribution of the traffic demand during P2 on LFPG-based traffic volumes such as LFPGARN (capturing LFPG arrivals via the northern IAF) and LFPGARS (capturing LFPG arrivals via the southern IAF) are shown below.

2015 Trials:

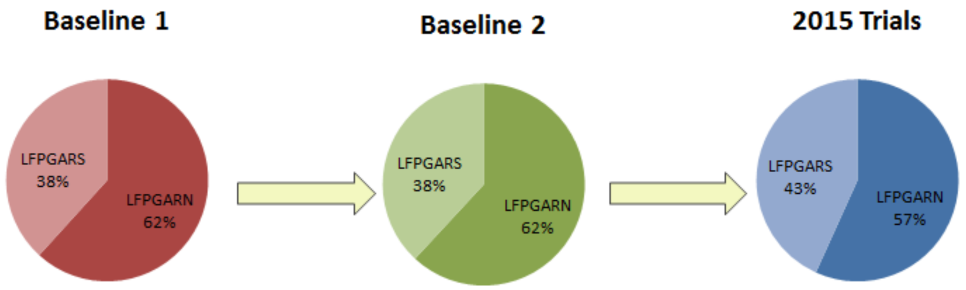
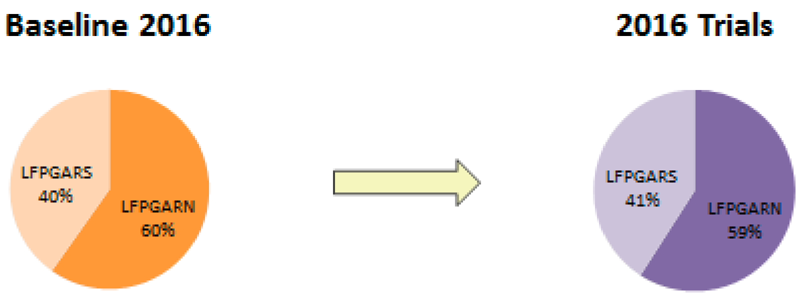


Fig. 11: TV re-balancing / Distribution of demand on P2 for LFPGARN/LFPGARS

We can notice an effective re-balancing between the North and South TVs for arrivals into LFPG during the 2015 trials:

- LFPG arrivals from the north decreased from 62% of the total during baseline 1 and 2 to 57% of the total of arrivals during the trial
- LFPG arrivals from the south increased from 38% of the total during baseline 1 and 2 to 43% of the total of arrivals during the trial

<u>2016 Trials:</u>



We are only able to notice a very slight re-balancing between the North and South TVs for arrivals into LFPG during the 2016 trials since fewer scenarios have been activated to avoid overloading the southern sectors.

5.4.2.1.2.1.3 TV re-balancing/ Distribution of demand on P2 for TE3 / AR3 / TP3 / RT3

On LFFF-sector based traffic volumes, the consequences on the traffic demand during P2 are he following:

- TE3 (capturing LFPG/LFPB/LFPO/LFPT/LFPN/LFOB/LFPV arrivals via TE sector in the northeast quadrant),
- AR3 (capturing LFPG/LFPB arrivals via AR sector in the southeast quadrant),
- TP3 (capturing LFPG/LFPB arrivals via TP sector in the northwest quadrant),
- RT3 (capturing LFPG/LFPB arrivals via RT sector in the southwest quadrant),

<u>2015 Trials:</u>

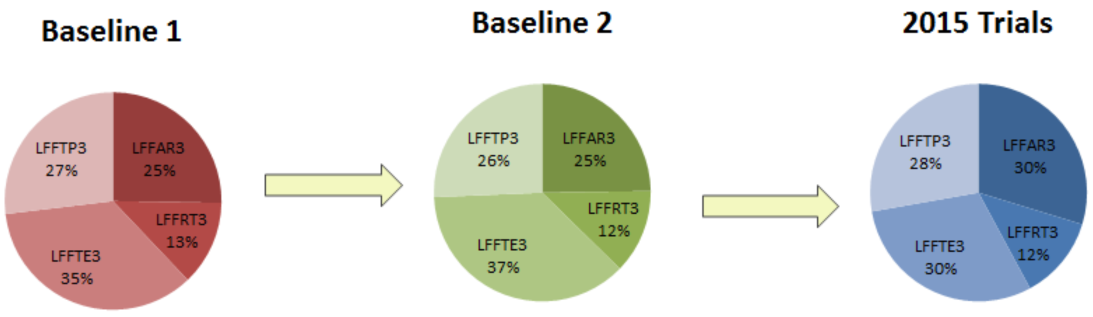


Fig. 12: TV re-balancing/ Distribution of demand on P2 for TE3 / AR3 / TP3 / RT3

We can notice an effective re-balancing between the LFFF-sector based TVs for arrivals into LFPG especially between:

- TE3 (which decreased from 35%-37% of the total during the baselines 1 and 2 to 30% during the trial),
- AR3 (which increased from 25% of the total during the baselines 1 and 2 to 30% during the trial).

<u>2016 Trials:</u>

We can notice a slight rebalancing between the TE3 (decreased from 33% to 31%) and the AR3 (increased from 26% to 28%) traffic volumes.

5.4.2.1.2.2 ATFCM regulations and delays

The ATFCM regulations used to compute the statistics didn't include

- The regulations having a reason other than ATC Capacity or Aerodrome Capacity
- The regulations cancelled before the starting time of the regulation

The most often regulated traffic volumes during the LFPG P2 morning peak are LFPGARR1, LFPGARN, LFFTE3 and LFFUJ.

5.4.2.1.2.2.1 Rate of occurrence of implemented traffic volume regulations

In this section we have analysed the rate of occurrence of the usual implemented traffic volume regulations during the P2 peak.

<u>2015 Trials:</u>

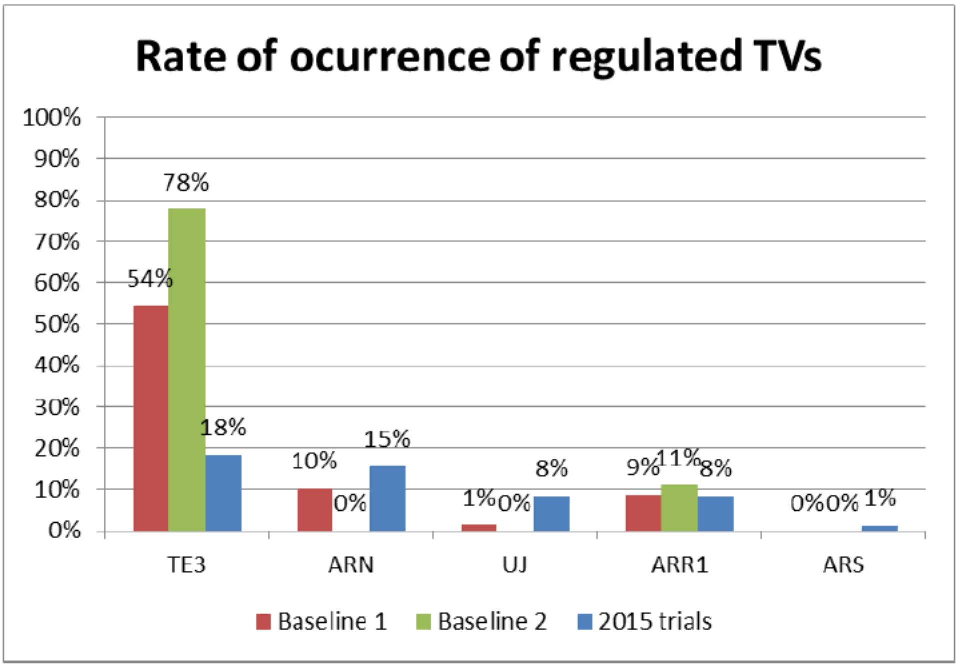


Fig. 13: Rate of occurrence of regulated TVs

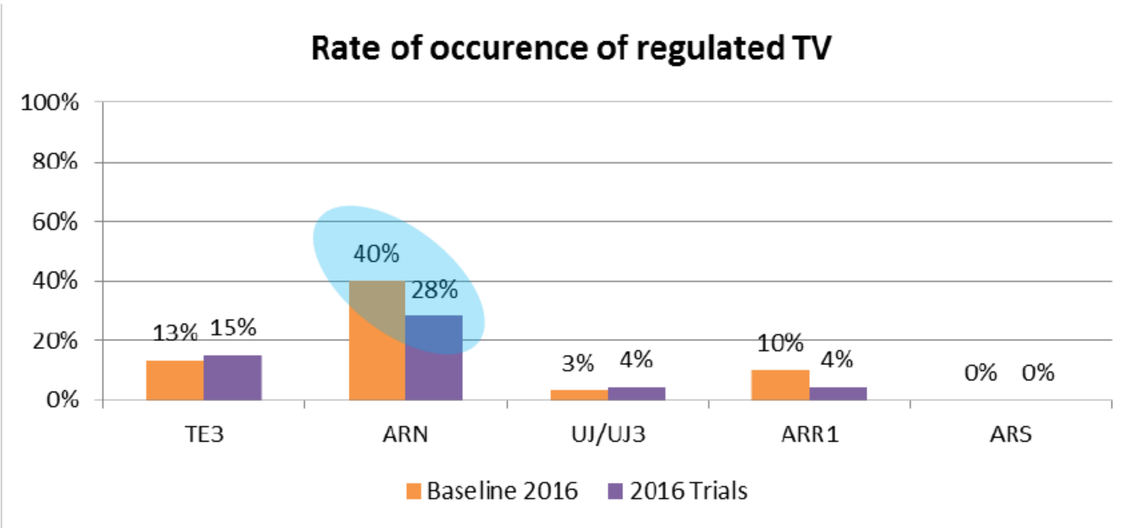
<u>TE3 regulations:</u>

- During baseline 1, the LFFTE3 TV was regulated 54% of the time. It increased to 78% of the time during baseline 2.
- During the 2015 trials, the rate of occurrence sharply decreased to 18% of the time thanks to the use of ATFCM scenarios which allowed moving traffic from the TE sector to the AR and UJ sectors.

<u>Other regulations:</u>

- There was no significant change for the other regulations except for the UJ sector that had a few more regulations (6)

<u>2016 Trials:</u>



<u>ARN regulations:</u>

- During baseline 2016, the LFPGARN TV was regulated 40% of the time. It decreased to 28% of the time during the 2016 trials thanks to the dDCB scenarios.

Other regulations:

- There was no significant change for the other regulations, even for the onloaded UJ sector.

5.4.2.1.2.2.2 Proportion of days having the P2 peak being regulated by at least one traffic volume

2015 Trials:

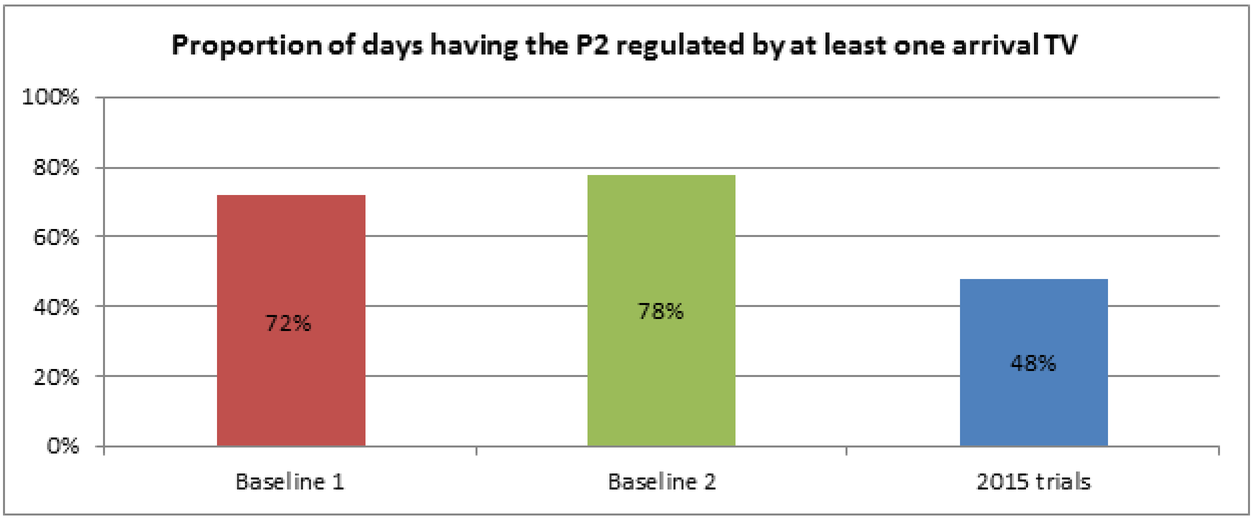
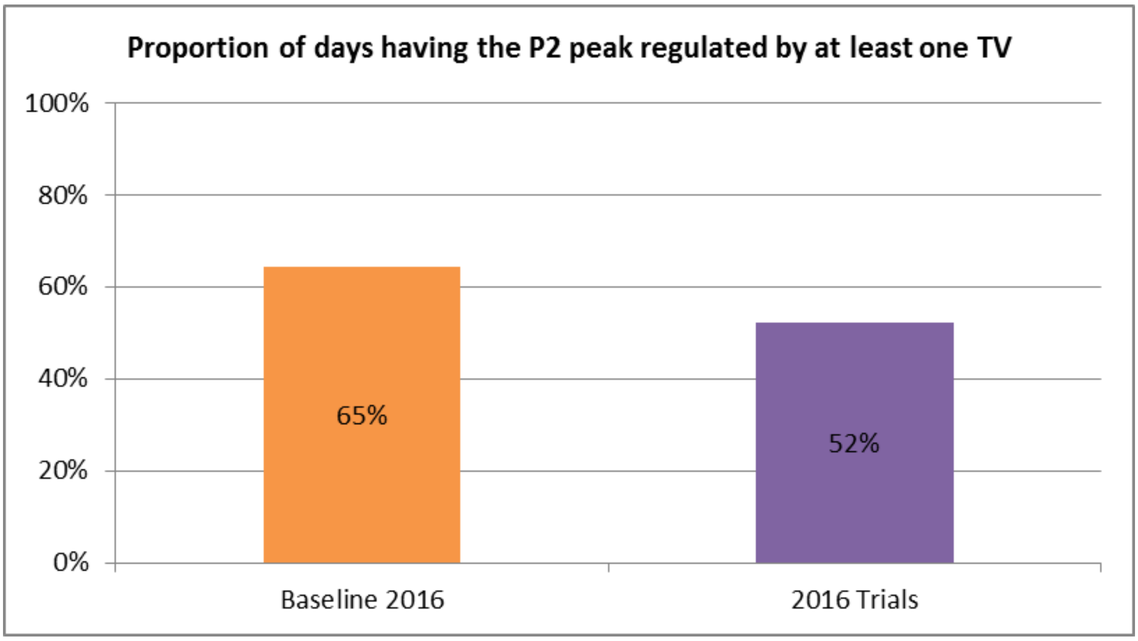


Fig. 14: Proportion of days having the P2 regulated by at least one arrival TV

During the 2015 trials, the proportion of days having their P2 peak being regulated by at least one TV decreased from 72% and 78% during baseline 1 and 2 to 48%.

This is a direct impact of the use of ATFCM rerouting scenarios to offload the most regulated sector during the P2 peak (TE sector).

2016 Trials:



During the 2016 trials, the proportion of days having their P2 peak being regulated by at least one TV decreased from 65% during baseline 2016 to 52%.

This is a direct impact of the use of ATFCM rerouting scenarios to offload the most regulated sector during the P2 peak (TE sector).

5.4.2.1.2.2.3 Average delay per regulated TV

The average delay per regulated TV was calculated and we can notice the direct impact of the use of the ATFCM rerouting scenarios:

2015 Trials:

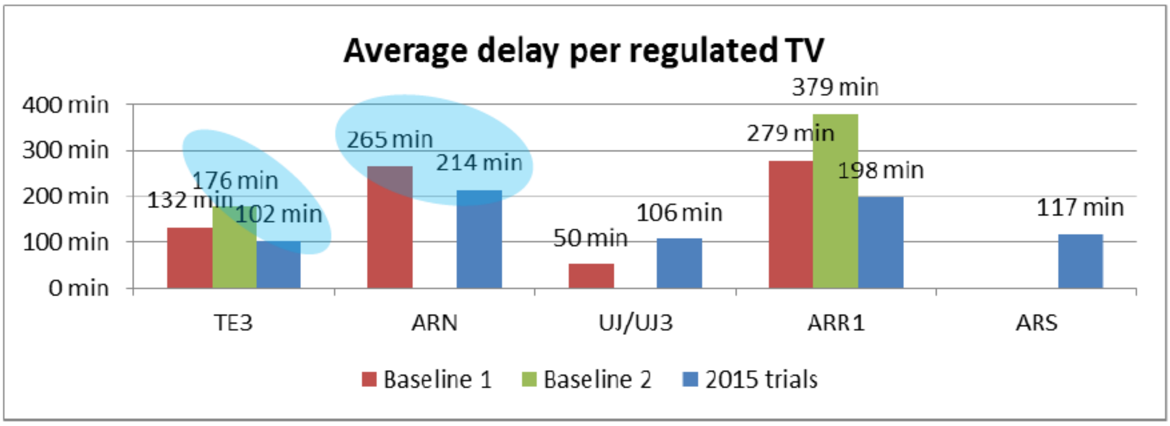
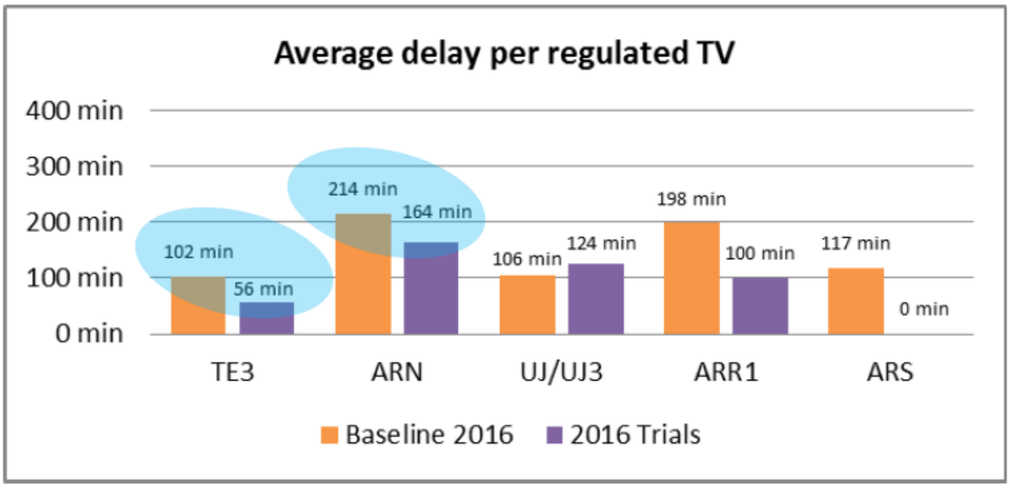


Fig. 15: Average delay per regulated TV

- Regarding LFFTE3 regulations, average generated delay by this regulation decreased by 42% between baseline 2 and 2015 trials, and by 23% between baseline 1 and 2015 trials.
- Regarding LFPGARN regulations, average generated delay by this regulation decreased by 19% between baseline 1 and 2015 trials.
- Regarding the LFPGARR1, LFPGARS and LFFUJ/UJ3 regulations, the average delays are not relevant because there were too few regulations.

2016 Trials:



- Regarding LFFTE3 regulations, average generated delay by this regulation decreased by 45% between baseline 2016 and 2016 trials.
- Regarding LFPGARN regulations, average generated delay by this regulation decreased by 23% between baseline 2016 and 2016 trials.

- Regarding the LFPGARR1, LFPGARS and LFFUJ/UJ3 regulations, the average delays are not relevant because there were too few regulations.

5.4.2.1.2.2.4 Average delay per regulated traffic

We can also notice to impact of the trials on the average delay per regulated traffic.

2015 Trials:

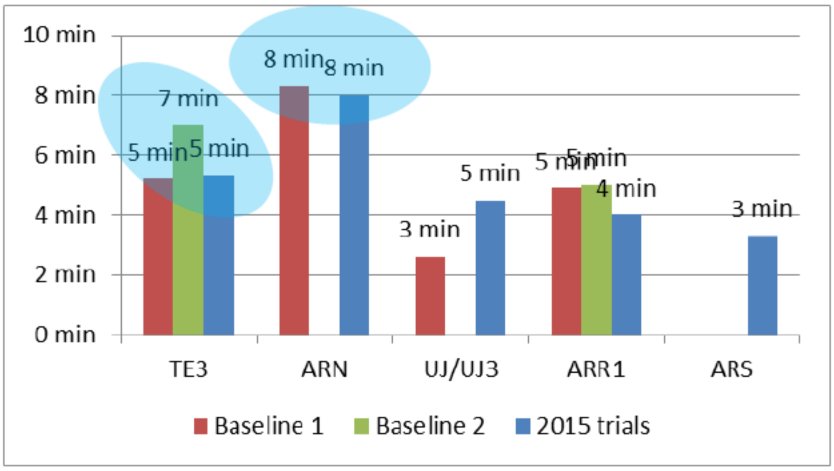
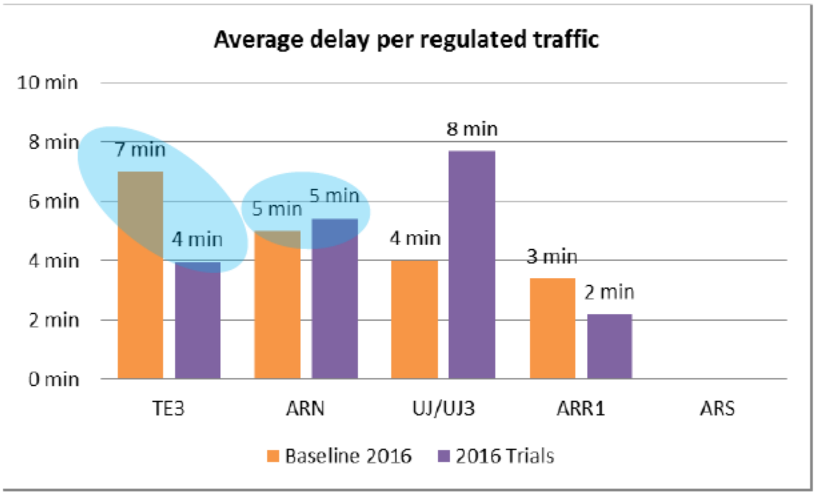


Fig. 16: Average delay per regulated traffic

- LFFTE3 regulations: average delay per regulated traffic was around 5 mins during baseline 1, increased to 7 mins during baseline 2 then decreased to 5 mins during the 2015 trials.
- LFPGARN regulations: average delay per regulated traffic remained at around 8 mins between baseline 1 and the 2015 trials.
- Regarding the LFPGARR1, LFPGARS and LFFUJ/UJ3 regulations, the average delays are not relevant because there were too few regulations.

2016 Trials:



- LFFTE3 regulations: average delay per regulated traffic decreased from 7 min during baseline 2016 to 5 min during 2016 trials.
- LFPGARN regulations: average delay per regulated traffic remained at around 5 mins between baseline 1 and the 2015 trials.
- Regarding the LFPGARR1, LFPGARS and LFFUJ/UJ3 regulations, the average delays are not relevant because there were too few regulations.

5.4.2.1.2.2.5 Global average delay on P2 per day

More globally, we can compute the global average delay generated during the P2 peak per day by adding all the generated ATFCM delays during the time periods and dividing this number by the number of days during the baselines or during the flight trials.

2015 Trials:

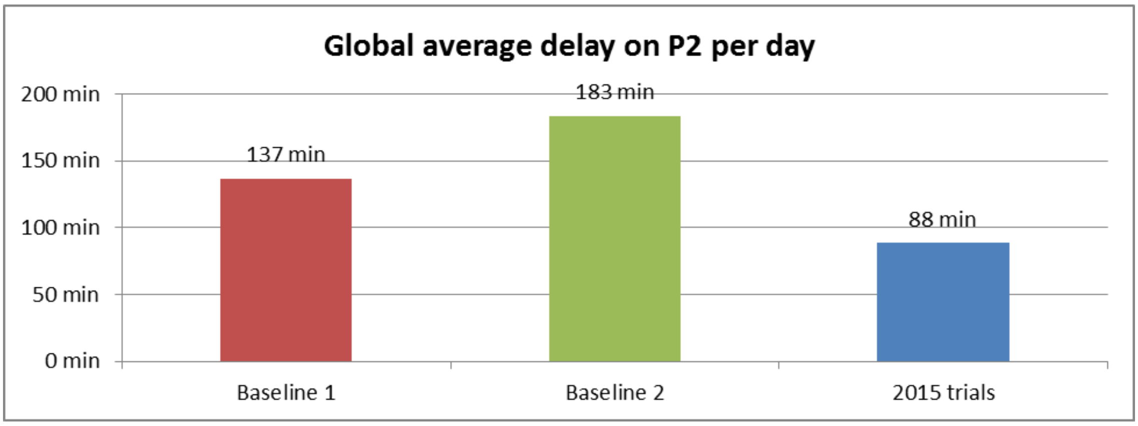
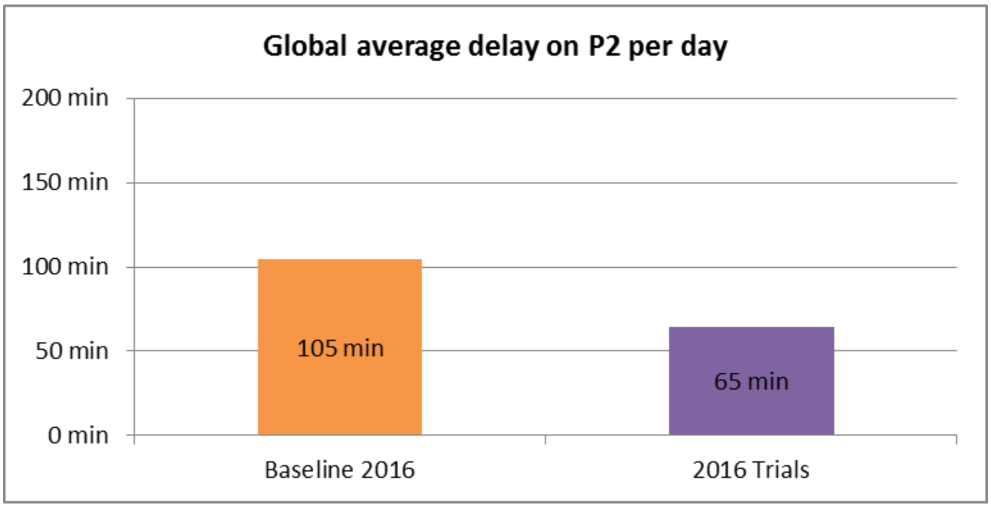


Fig. 17: Global average delay on P2 per day

We can finally observe:

- A 36% decrease of the global average delay during the P2 per day between baseline 1 and the 2015 trials
- A 52% decrease of the global average delay during the P2 per day between baseline 2 and the 2015 trials

2016 Trials:



We can finally observe:

- A 38% decrease of the global average delay during the P2 per day between baseline 2016 and the 2016 trials

5.4.2.1.2.3 ASMA additional time

ASMA (Arrival Sequencing and Metering Area) is the 40NM cylinder around the airport.

ASMA additional time is an indicator measuring additional duration in TMA and eTMA compared to unimpeded duration which is the elapsed duration without congestion.

5.4.2.1.2.3.1 ASMA additional time & ATFM delay relationship

This part presents the existing relationship between ASMA additional time and ATFM delay especially when an ATFM delay is cancelled for a flight (as a consequence of Re-routing), leading to place it in a forward position in the arrival sequence.

Figures below are based on these hypotheses:

- Minimal spacing between flight is 2min
- ATFM delay for target flight is 8min

All figures will be based on the following legend:

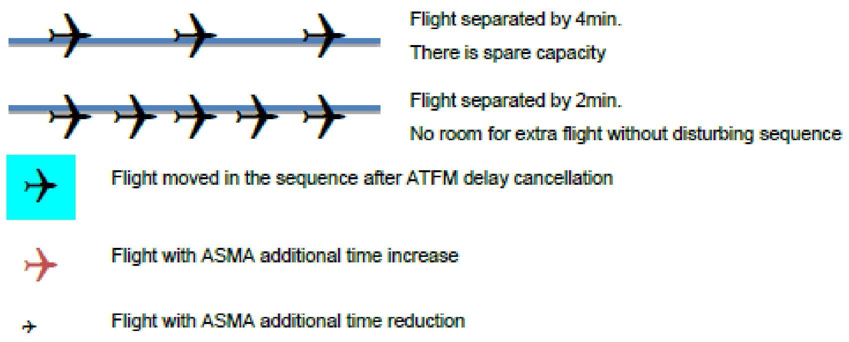


Fig. 18: Reading rules for ASMA figures

Low traffic sequence:

In this situation, TMA or the sequences are not saturated and there is room to insert a flight or to move a flight forward in the sequence.

ASMA additional time stays the same while ATFM delay is deleted.

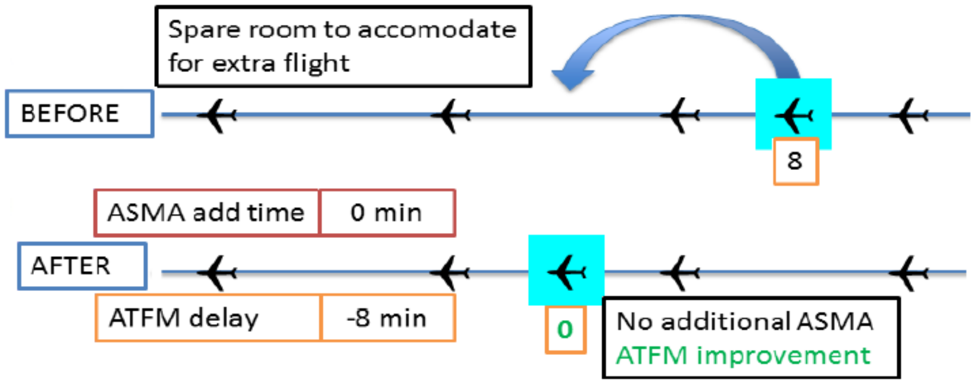


Fig. 19: ASMA additional time & ATFM delay relationship: Low traffic sequence

Saturated sequence:

In this case, the sequence is saturated and there is no room to move a flight forward in the sequence.

To do so, some flights must be shifted as it is illustrated below. As a consequence, ATFM delay is totally transferred to ASMA additional time which means that even if there is ATFM improvement, it is completely mixed into ASMA additional time.

The only advantage is the splitting of ASMA additional time between several flights while ATFM delay is carried by only one flight.

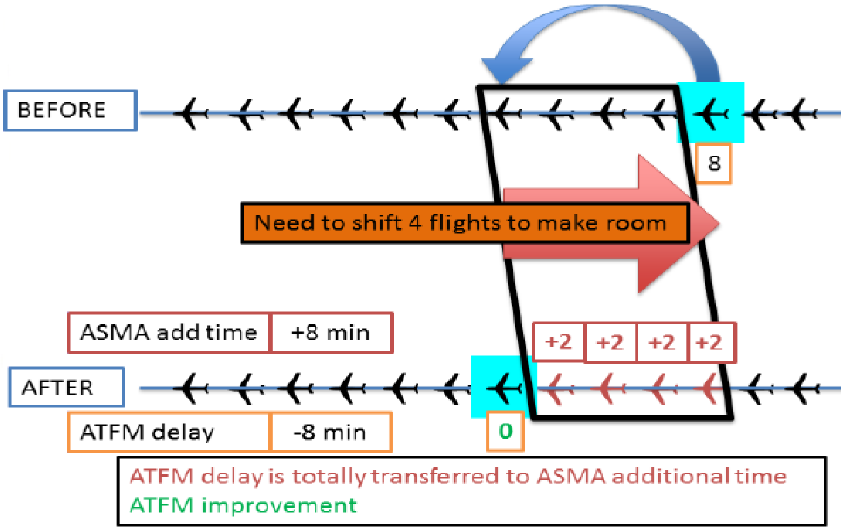


Fig. 20: ASMA additional time & ATFM delay relationship: Saturated sequence

Flight in the arrival peak moved before the arrival peak:

This is the most favourable situation because it enables to improve both ASMA additional time and ATFM delay. Indeed, the flight with ATFM delay is shifted forward, out of the arrival peak.

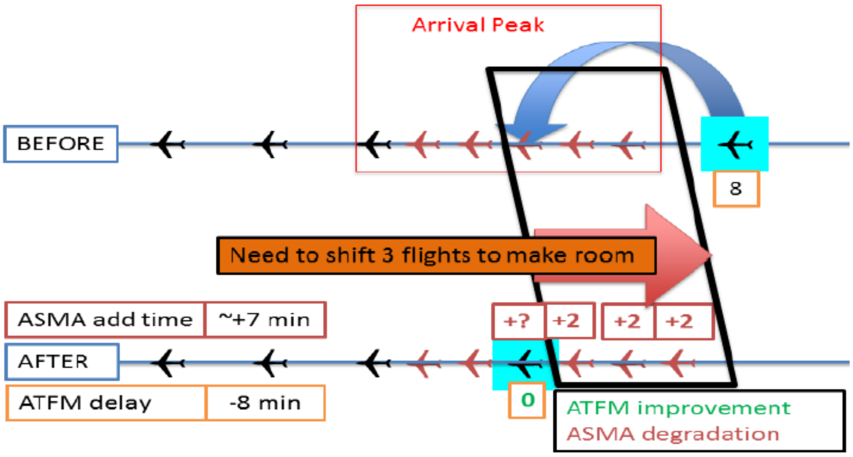


Fig. 21: ASMA additional time & ATFM delay relationship: Flight re-sequenced before the arrival peak

Later flight moved in the arrival peak:

Compared to the previous case, it is the opposite situation. As the flight is re-sequenced into the arrival peak which is saturated, many flights must be shifted to create extra room for the ATFM delayed flight. Consequently, ASMA additional time increases.

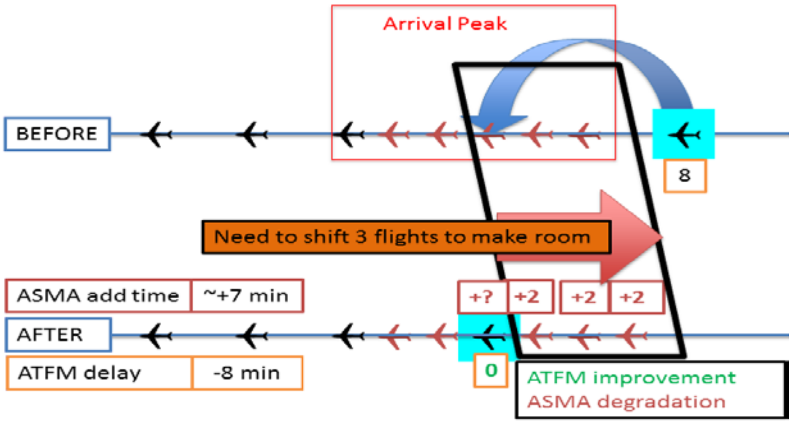


Fig. 22: ASMA additional time & ATFM delay relationship: Flight re-sequenced in the arrival peak

<u>Conclusions:</u>

The four cases illustrated show that there is a complete or partial transfer of ATFM delay into ASMA additional time.

However, when traffic is low, there is no significant increase in ASMA additional time. On the other hand, when the sequence is saturated, a complete transfer from ATFM delay to ASMA additional time happens.

Thus, arrival peak must be known to adapt re-sequencing, leading to improvement if the flight is moved off the peak or to degradation if the flight is added to the peak. Unfortunately, an additional flight into the peak is the most likely situation in the case of ATFM delay improvement.

5.4.2.1.2.3.2 ASMA+ indicator computing method

ASMA+ derives from the Eurocontrol's indictor called ASMA: it was tailored to Paris arrivals.

First, borders of eTMA and TMA were redefined.

- TMA for CDG airport is a cylinder of 55NM radius centred on CDG airport.
- eTMA for CDG airport is a cylinder of 110NM to 175NM depending on the arrival stream

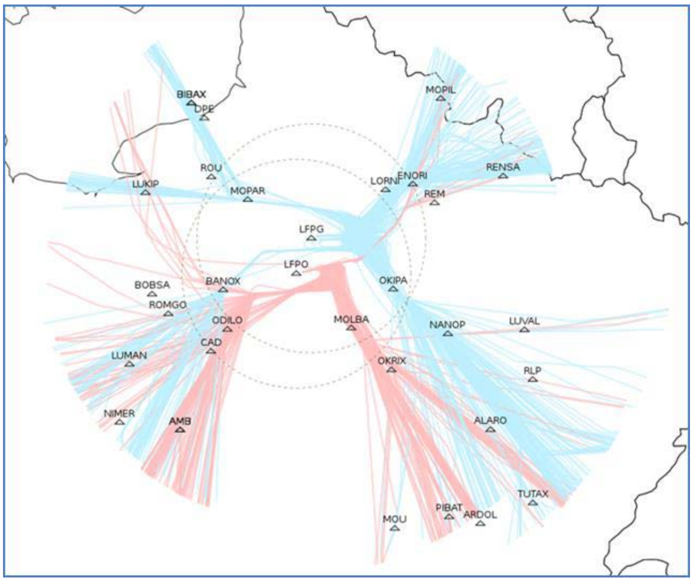


Fig. 23: ASMA area with LFPG (blue) and LFPO (red) streams

Then, unimpeded duration which is the elapsed duration in an area (in that case eTMA or TMA) without congestion is based on the duration of the 20th centile of the sample. Unimpeded duration is used to compute additional time produced by ASMA+ indicator.

ASMA+ indicator is the measure of additional time in CRNA and TMA for arrival flights.

All numerical results in this part are based on ASMA+ indicator.

Flight additional time = Flight duration –Unimpeded duration

5.4.2.1.2.3.3 Results

2015 Trials:

Results are based on the most saturated part of the P2 (08:00 - 09:30) in CDG.

2015 results (named Trials thereafter) when iStream dDCB trials occurs are compared to a reference period in 2014 (named Baseline thereafter).

Baseline results were made from 2014/04/14 to 2014/06/25, 7 inadequate days were removed. Trials results were made from 2015/04/13 to 2015/06/24, 3 inadequate days were removed.

It represents about 70 days and 6000 flights analysed for each sample.

Number of landings:

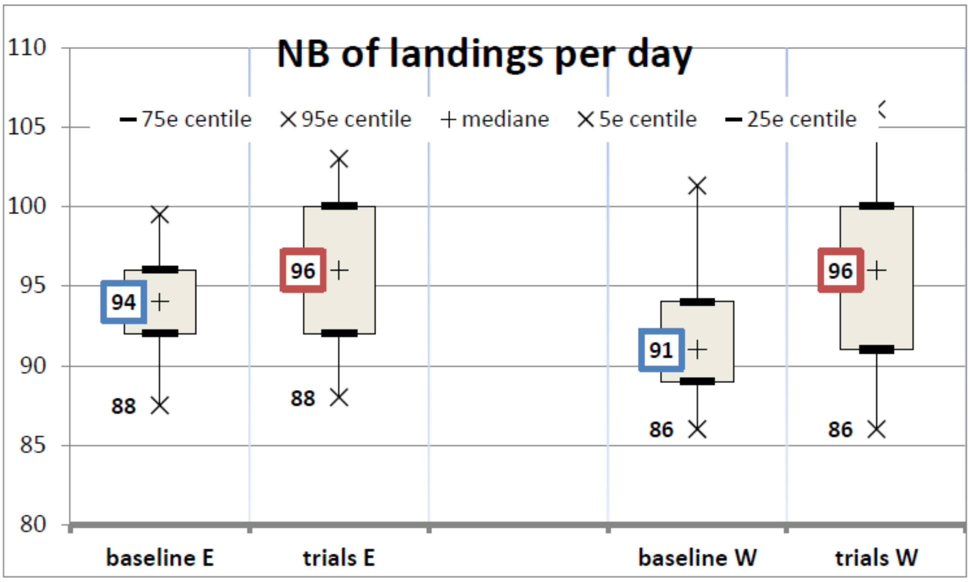


Fig. 24: ASMA+ results Number of landings per day per configuration

The graph above presents the number of landings per day which are split according to the configuration in use (E: East or W: West).

Boxes represent 50% of the flights and the ending crosses 90% of the flights. Thus, it appears that samples are quite different, there is much more traffic per day during trials. With a reduction of ATFM delay, more flights are re-scheduled in P2's arrival peak leading to more ASMA additional time.

Additional time in ASMA:

Between Baseline and Trials, additional time increases both on East and West configuration.

On the second graph, Trials boxes widened compared to Baseline.

This increase may be imputed to traffic growth and ATFM delay reduction.

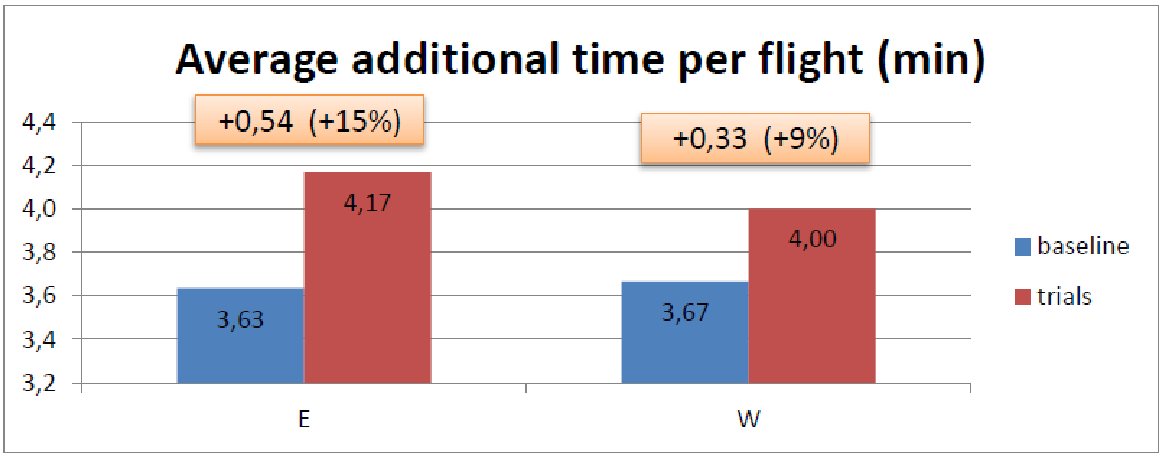


Fig. 25: ASMA+ results Average additional time per flight

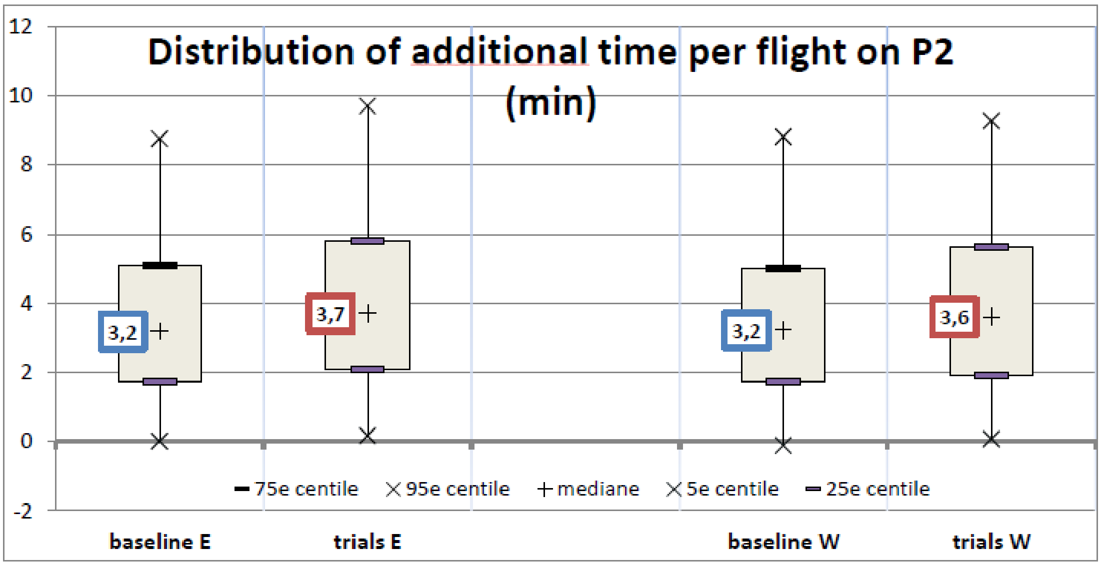


Fig. 26: ASMA+ results Distribution of additional time per flight

<u>Average additional in ASMA time per quarter:</u>

On the overall, during the P2 peak, there is more additional time in Trials than in Baseline (except during the last quarter which is not saturated). There are also more flights in Trials than in Baseline (about +0.4)

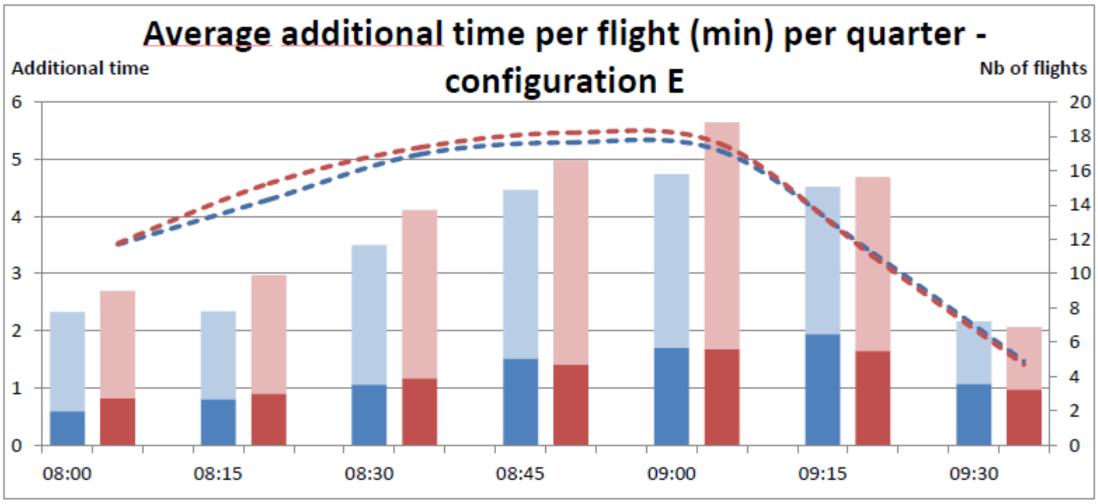


Fig. 27: ASMA+ results Average additional duration per flight per quarter per configuration

2016 Trials:

Results are based on the P2 peak (07:30 - 09:30) in CDG.

2016 results (named Trials thereafter) when iStream dDCB trials occurs are compared to a reference period in 2016 (named Baseline thereafter).

Baseline results were made from 2016/03/27 to 2016/05/08, 12 inadequate days were removed. It represents about 30 days and 3500 flights.

Trials results were made from 2016/05/09 to 2016/07/17, 26 inadequate days were removed.

It represents about 43 days and 5000 flights analysed.

Number of landings:

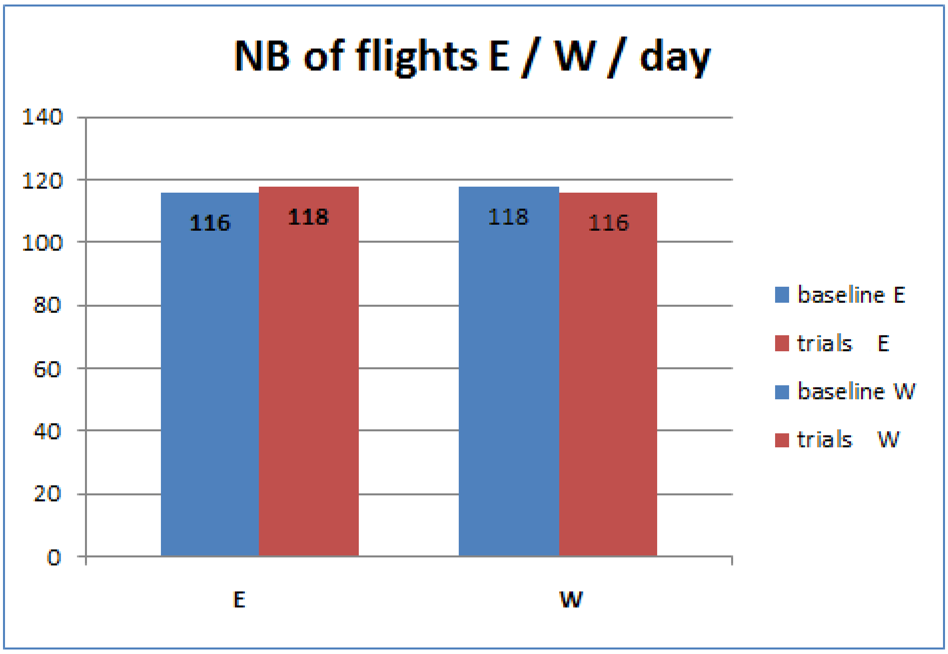


Fig. 28: Number of landings per day during the 2016 dDCB trials

The graph above presents the number of landings per day depending on West or East configuration. We can see the average number of flights is quite similar between the baseline and the trials during the 2016 dDCB trials.

Additional time in ASMA:

The graph below presents the average additional delay per flight during 2016.

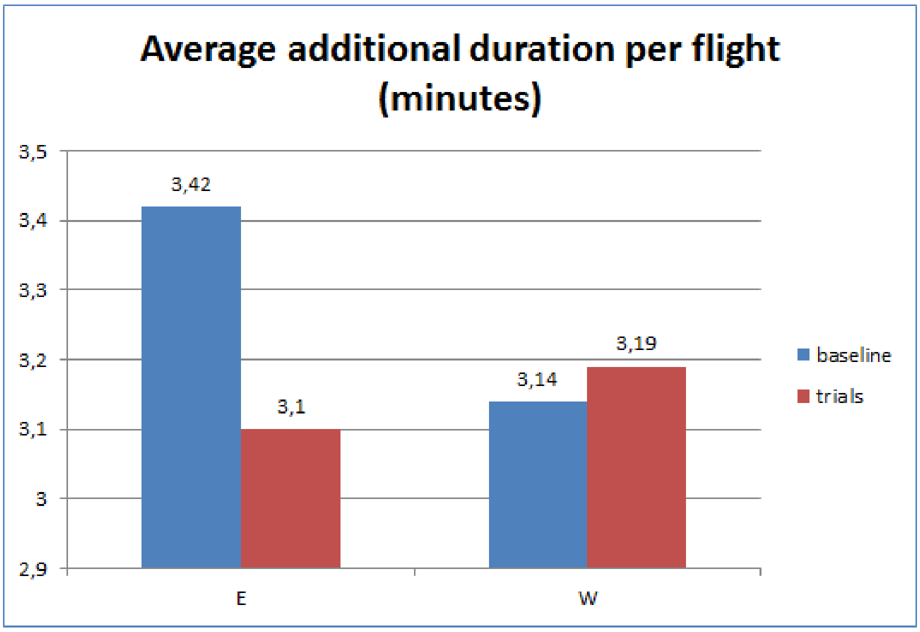


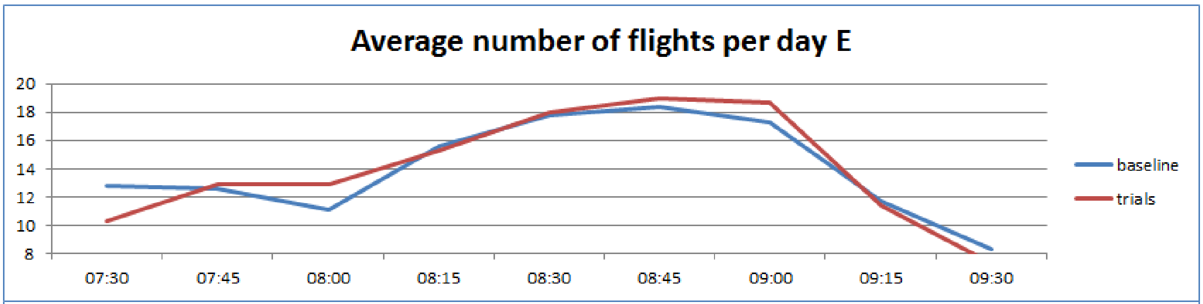
Fig. 29: Average additional delay per flight during 2016

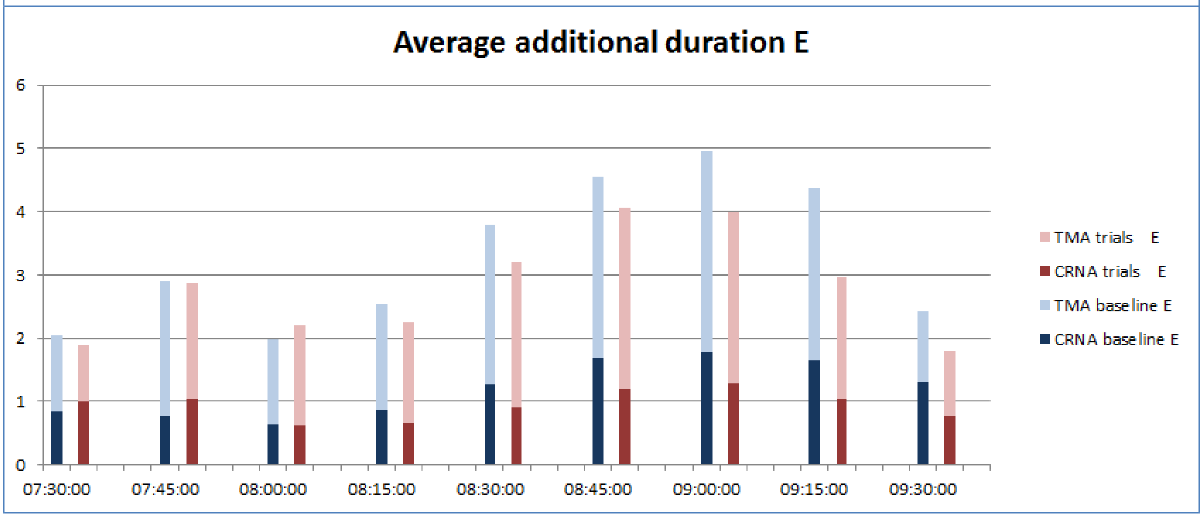
Between Baseline and Trials, we can notice a decrease by 10% of additional time in 2016 for ASMA+ delays when facing East and an increase by 2% when facing West.

As a whole, additional time during 2016 trials decreased by 4% compared to the 2016 baseline.

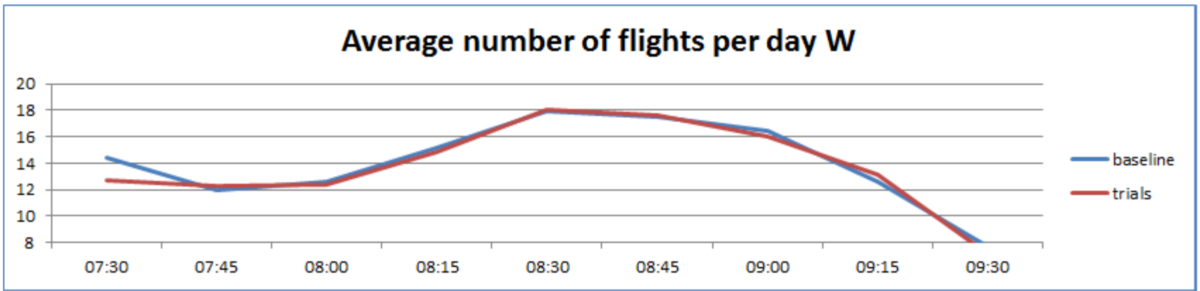
Average additional time in ASMA per quarter:

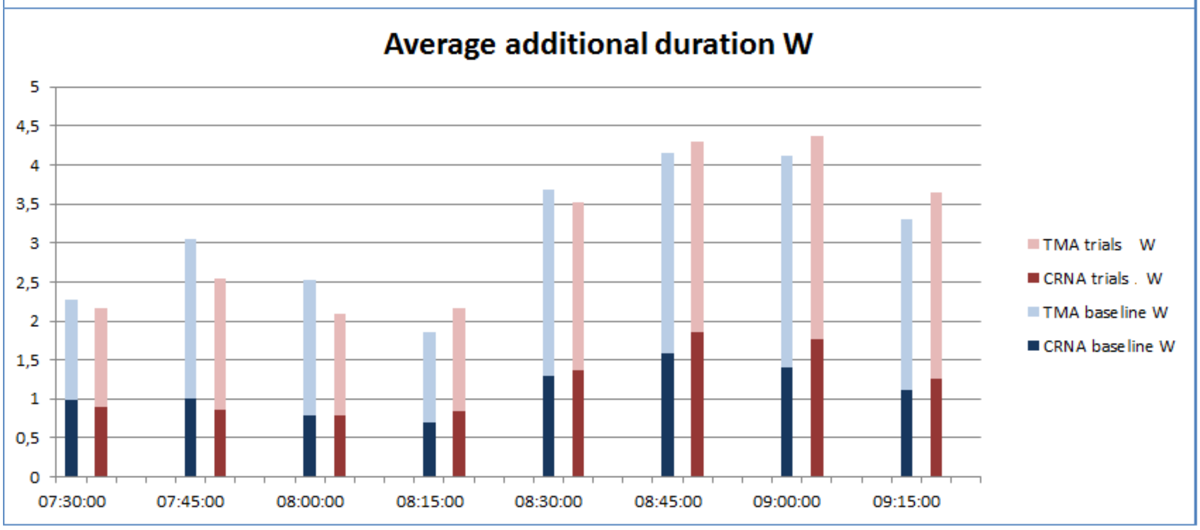
When facing East, during the P2 peak, there is less additional time in trials than in baseline. There are also more flights in Trials than in Baseline (about +2)





When facing West, during the P2 peak, there is more additional time in trials than in baseline. The number of flights in Trials is similar to the Baseline.





5.4.2.1.2.4 Average flight time for concerned flights

Below is a table showing the difference in flight time in 2016 between the trial period and the baseline for a few flights which had to change their flight plan to comply with the ATFCM rerouting scenarios. We can see most of the flights were not penalized, and a few of them even gained time over the baseline period.

	Facing E	Facing W
Flight #1	-4 mins	-4 mins
Flight #2	+1 min	-4 mins
Flight #3	-4 mins	0 min
Flight #4	0 min	+4 mins

Fig. 30: 2016 Flight time difference between the trial period & baseline for a few flights

5.4.2.2 Summary of Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
	Collaborative portal		A collaborative portal is available.		ER+ APP	All			DSNA	
	Common procedures		Common procedures/processes with AOC, airports and ATS Units and NMOC are implemented for the trials.		ER	All			DSNA	
	User preference.		A mean to collect user preferences is available for the trials.		ER+ APP	All			DSNA	

Fig. 31: Demonstration Assumptions

5.4.2.3 Analysis of Exercises Results

The trials showed that the dDCB measures (ATFCM rerouting scenarios on the Eastern side, and tactical rerouting on the Western side) helped to rebalance LFPG arrival flows between, on one side, the NE and the SE corners, and, on the other side, on the NW and on the SW corners.

The rebalancing of LFPG arrival traffic flows helped improving the matching between the traffic demand and the capacity of the terminal sectors.

In 2015, a 5% increase of the traffic demand was observed between the period of the 2015 exercise and the periods of the baselines, however we can see the ATFCM rerouting scenarios had the following positive impacts:

- Dramatically reducing the rate of occurrence of regulated TV in the North-Eastern corner, by a factor 3 or 4, depending on the baseline. In the meantime, no regulations were induced in the SE corner through the use of dDCB measures.
- A 48% decreasing the proportion of days having the P2 peak being regulated on at least one LFPG arrival TV. The P2 peak was regulated 3 days out of 4 during baseline 1, and it decreased to once every 2 days during the 2015 trials.
- Significantly reducing the average delay on NE LFPG arrival traffic volumes

A more detailed view per TV showed that:

- On the overall, the TE3 TV was regulated once every 2 days during baseline 1, and 3 days out of 4 during baseline 2. During the 2015 trials, this TV was only regulated once every 5 days.
- The ARN regulation pattern remained unchanged.
- The UJ sector was more regulated during the 2015 trials but the number of regulations was still very limited.

Due to the activation of the ATFCM rerouting scenarios, regulations generated less delays during the P2 arrival peak during the 2015 trials compared to baseline 1, even with an increase of the traffic demand into LFPG of 5,5% (peak hour increased also by 1,8%):

- The TE3 regulations generated 23% less delays during the 2015 trials compared to baseline 1,
- The ARN regulations generated 20% less delays during the 2015 trials compared to baseline 1,
- The UJ/UJ3 regulations generated 110% more delays during the 2015 trials compared to baseline 1 but only during very few occurrences (4 in 2015 , 1 in 2014),

- On the whole, the delays generated during the P2 peak decreased by 36% during the 2015 trials compared to baseline 1.
-
- In 2016, the positive impacts were very similar to the 2015 trials:
- Reducing the rate of occurrence of regulated TV for LFPG Northern arrivals from 40% to 29% of the days
- Significantly reducing the average delay on North LFPG arrival traffic volumes: by 45% on TE3 regulations and by 24% on LFPGARN regulations
- On the whole, the delays generated daily during the P2 peak decreased by 38% during the 2016 trials compared to baseline 2016, with a similar traffic structure

5.4.2.4 Confidence in Results of Demonstration Exercises

5.4.2.4.1 Quality of Demonstration Exercises Results

One of the main difficulties of the statistical analysis of the results has been to identify a proper baseline. For the most significant results, two baselines have been chosen, each having pros and cons:

- Baseline 1 allows a 2014-2015 comparison and its length is about the same as the trial period. However the structure of the traffic demand may be different than in 2015.
- The size and structure of Baseline 2 traffic demand are closer to the trial period. However, the period itself is significantly shorter than the trial period or Baseline 1 and did not cover some regulation scenarios (ARN, UJ/UJ3).
- Baseline 2016 allows a comparison with the trial 2016 as the structure and the volume of the traffic is similar

The comparison of these sets of results using each baseline does not show any discrepancy regarding the nature and the amplitude of observed qualitative benefits. However the quantitative benefits are highly dependent on the size and structure of the traffic demand.

5.4.2.4.2 Significance of Demonstration Exercise Results

In 2015, the dDCB trials were performed during a time period of more than two months covering the days of the year with the highest traffic demand. The presented results are based on indicators that have computed for each morning P2 peak during this period, meaning 71 days of data covering about 8000 flights.

For these reasons, the results are considered as statistically significant. In addition, no other causal factor than the dDCB measures have been identified that could explain the observed benefits.

The analysis of the additional time in ASMA through ASMA+ indicator show an increase of this additional time between the trial period and the 2014 baseline.

However, it has been difficult to conclude whether this increase of additional time is due to dDCB measures or to the observed changes of traffic growth and traffic mix change (more A380 and Heavy).

More traffic leads to more saturation and thus more ASMA additional time. More heavy traffic leads to runway capacity degradation due to upper regulatory spacing, which also reflects on ASMA additional time.

In 2016, however, traffic figures and structure was similar between the trial and the baseline, and we could see the ASMA+ indicator showed a decrease of additional time between the trial period and the 2016 baseline.

Due to the non-consistent evolution of additional time in ASMA during the trials (increase in 2015 and decrease in 2016), and because additional ASMA delays can be due to other factors (e.g. storms and increase of traffic), the results of dDCB trials regarding additional time in ASMA have proved inconclusive.

5.4.3 Conclusions and recommendations

5.4.3.1 Conclusions

The dDCB scenarios tested in LFPG between April and June 2015 and between May and July 2016 induced significant benefits for airspace users in terms of:

- Reducing the need to regulate the P2 peak,
- Decreasing the average ATFCM delay generated during the P2 arrival hub by at least 35% in 2015 and in 2016, compared to their respective baselines.
- Arrival capacity efficiency: absorbed a 5.5% traffic increase during the 2015 trial morning P2 peak compared to the 2014 baseline.

A collaborative process between the ANSP and the participating airspace users was put in place to select the flights (between 1 and 7 per day) that had to be transferred to another arrival flow.

A few of these flights were negatively impacted by the rerouting scenarios in terms of route length increase. However, several flights were positively impacted in terms of flight time. Moreover, the ASMA delays slightly increased during the 2015 live trials but decreased during the 2016 trials.

It also should be noted that this reduction of ATFCM delays allowed Paris ACC to fulfil its second reference period ("RP2") 2015 and 2016 objectives. Following the live trials, these ATFCM rerouting scenarios were put into operations on a daily basis, for further use during high traffic demand periods.

In 2016, an in-depth collaboration was set up between MUAC and Paris FMP to improve the coordination of the dDCB scenarios concerning LFPG arrivals via the North East. As a matter of fact, this led to the activation of 2 other scenarios (RR3FTE and RR4FTE) almost daily from the 19th of July 2016 until the 16th of September 2016 to reduce the pressure on LFPG North arrivals and on Maastricht Lux sector. This allowed to limit the increase of generated ATFCM delays due to the Paris-CDG airport runway works.

ASMA:

ASMA additional time and ATFM delay are strongly connected.

Results based on ASMA+ indicator (ASMA indicator tailored to Paris arrivals) show an increase in ASMA additional time during iStream dDCB 2015 Trials compared to Baseline 2014 period and a slight decrease during iStream dDCB 2016 Trials compared to Baseline 2016 period.

However, ASMA additional time differences between Baseline and 2015 Trials may be more linked to these observations such as traffic growth and traffic mix change (more Heavy traffic) than the iStream exercise itself.

Evaluation of a theoretical capacity based on these criteria and others such as wind compared to real stream could help identify iStream dDCB trials impacts more precisely.

Impacts on ANSP and AU :

- iStream participants considered that the trials showed successful collaborative process between ANSPs and ANSP and AUs,
- dDCB scenarios induced significant AU's benefits:
  - Reduced need to regulate P2
  - Reduced average P2 ATFM delay by 35%, with 5,5% trafic increase
- For further use of the dDCB scenarios, AU's ask not to increase the number of impacted flights

5.4.3.2 Recommendations

The concept is mature and is now implemented in day-to-day operations during the summer periods.

It could be enhanced by developing B2B services to ease/standardize the process.

5.5 Target Time management for Zurich arrivals

5.5.1 Execution of Demonstration Exercises

5.5.1.1 Exercises Preparation

The objective of the LSZH scenario AFlex (**EXE-01.02-D-06.3**) was to demonstrate that overall compliance to Target Times (TTs) can contribute to smoother arrival sequencing taking into account airspace users' preferences and providing a better service by integrating them.

The applicable operational context was current real-life operations at Zurich ACC/APP/TWR and Zurich Airport.

For Zurich arrivals, the framework of AFlex was to start from the current existing procedure developed during the GREENER WAVE project (Refer to document [R-11]), and to extend it to a larger timeframe involving more Airspace Users.

The demonstration adapted the procedure involving other affected Airspace Users than SWISS and computed an arrival sequence (assigned TT) to all inbound flights during the pre-defined timeframe at Zurich Airport.

Please note that the TTs considered in this chapter are **Target Times over LSZH IAF**, which can be either RILAX, AMIKI, GIPOL, DOPIL or KELIP.

Below is the sequence of events that occurred for the preparation of the LSZH Trials.

Event	Date & Place	Goal
Face-to-Face meeting #1	20/02/2015 @ Zurich	First meeting of the LSZH team members
Meeting with FMP	16/03/2015 @ Zurich	Refining procedure & working methods
Safety Assessment meeting	08/04/2015 @ Zurich	Ensure safety of iStream procedure
Face-to-Face meeting with LSZH Airlines Station Managers	30/04/2015 @ Zurich	Present iStream procedure
WebEx #1 with Airlines OPS staff (AOC + dispatch)	01/07/2015	Present iStream procedure
Face-to-Face meeting #2	15/12/2015 @ Zurich	Mid-Trials assessments
WebEx #2 with Airlines OPS staff (AOC + dispatch)	19/01/2016	Present iStream results
Face-to-Face meeting #3	04/04/2016 @ Zurich	Assess Trials
Face-to-Face meeting #4	08/07/2016 @ Zurich	End Trials assessment
Several internal meetings/WebEx	02/2015 – 07/2016	Briefings, preparation, information

5.5.1.2 Exercises Execution

Exercise ID	Exercise Title	Actual Exercise execution start date	Actual Exercise execution end date	Actual Exercise start analysis date	Actual Exercise end date
EXE-01.02-D-06.3	LSZH AFlex	15.06.2015	30.06.2016	15.06.2015	30.06.2016

Fig. 32: LSZH - Exercises execution/analysis dates

The LSZH Trials started on 15th of June 2015 and ended on 30th of June 2016.

The procedure for the Trials was based on the existing “LSZH Early Wave procedure” explained in iStream CONOPS ([R-14]) and enlarges its scope to ensure benefits for all the actors; Airspace Users and ATC.

LSZH airport has a night ban and the first landing is allowed at 06:04 LT. In order to enhance the awareness of the concerned incoming flights during the first hour (06:04 – 07:00 LT) as well as to enhance their adherence to Scheduled Times of Arrivals (STA), a Target Time allocation and distribution procedure has been put in place.

This procedure aimed to smooth the arrival sequence and prevent holdings and/or significant vectorings, by spacing the aircraft at the entry of the LSZH Approach sector.

The process involved the different partners at different points in time, which is detailed in the table below:

	WHEN	WHO	WHAT	MEAN / TOOL
Planning phase	EOBT -10:00	AOC[1]	Assign Strategic TTO when filling FPL	FPL
	EOBT -0:30	Crews	Manage Off-Block / TO in order to meet STTO	Crew
	After Take Off		Fly speed according company policy	Crew
	TOC[2]		Transmit ETO the designated IAF to AOC	ACARS
Coordination	01:00 - 01:30LT latest	AOCs	Analyse ETOs received for own flights and optimizes TTO assignments: -To ensure a maximum number of passenger connections, -To optimize CI (cost index) of flights involved. Transmit ETOs to FMP ZRH, incl. possible preferences	E-mail
	01:00 - 02:00LT*	FMP	Assign TTOs for flights based on analysis of ETO / STA / users preferences	Excel tool
			Assign TTOs for SH/MH[3]-flights based on ETOs from CHMI	Excel tool

[1] Airline Operation Centre
[2] Top of climb
[3] Short haul / medium haul

			Transmit confirmed TTOs for all flights to AOCs and fill in the feedback tab	E-mail
Execution	Upon TTO reception	AOCs	Transmit TTOs to flights	ACARS
	ASAP	Crews	Manage flight to reach designated IAF at TTO	FMS
		ATC	The flights are inserted into the Arrival Manager in their order of arrival	AMAN
Post OPS	06:00LT onwards	FMP	Input the ATO and ALDT of the flights in the Excel sheet and fill the feedback tab	Excel/ FDPZ

*Or earlier if the ETOs of the participating flights have been received.

Fig. 33: LSZH Trials - Global procedure

The tools, systems and communication channels used were:

- the **CHMI (CFMU Human-Machine Interface)** providing the LSZH arrival flight list 06:04 – 07:00 LT and the ETOs for short/medium hauls flights,
- the **ETO ACARS messages** of long-hauls' flight crews,
- the **Zurich Airport STA flight list** (Excel file provided by e-mail)
- the **SWISS company tool** providing the SWISS flights' sequence based on passenger connections and ETO messages,
- the **ETO e-mails from OCCs** (transmitting ETOs of long-hauls)
- the **FMP Excel tool** to generate the arrival sequence and the **FMP e-mail** to distribute the arrival sequence to AOCs and
- the possibility of the AOCs to send **ACARS messages** back to the crews with their designated TTOs.

The iStream procedure was implemented in 2 steps:

- The first phase (15.06.2015 – 24.07.2015) targeted week days (Monday to Friday) only, including all Zurich arrivals between 06:04 – 07:00 LT.
- The second step was effective since 25th of July 2015 and applicable to all days of the week with the same timeframe.

The FMP team were the central actors and points of contact in the process of optimizing the early wave. FMP generated the arrival sequence based on the Estimated Time Over (ETOs) received from the airlines (long-hauls) or taken from the CHMI (short/medium-hauls), resulting in a distribution of Target Times Over (TTO) the **IAF** to the aircraft operators (refer to chapter 5.1.4 for further details).

The process for the FMP could be decomposed into four main steps:

1. Preparation

FMP populated the Excel Tool with the whole flight information according flights expected within the LSZHARR flight list of the CHMI between 06:00-07:00 (all flights were included in the sequence calculation, even if they did not participate in the trial), and populated the Flight Crew Information part considering that:

- For participating flights, AOCs provided the ETO including an indication of their speed preference, this might even include short-haul flights. The AOCs having more than one flight in the sequence provided their swaps requests in case of operational needs
- If for the participating long-haul flights no ETO was received, FMP contacted the airline OCC to receive an accurate ETO;

- If for participating short haul flights no ETO was received, as they were not departed yet, the ETO over the IAF from the CHMI was used.
- For flights within the ECAC area, or if the airline was not participating, FMP gathered the ETO over the IAF from the CHMI: calculated or actual profile, whichever was more up to date.

The sequence was generated when all ETOs were available.

2. Generated sequence

FMP checked if the generated sequence assured a 2 minutes gap between each estimated landing time (ELDT). If not, the ELDT was adapted manually. In case of manual prioritization, flights closer to their STA were prioritized.

An amendment of +/- 5mins of the provided ETO was the limit for adaptions, if those exceed the +/- 5min range, the sequence became voluntary for the airlines but a sequence was still generated.

When the ELDTs fit accordingly, the sequence was published.

3. Publication

FMP published the whole sequence to all participating companies operating on that day.

Destination:	Sequence Number	Flight	IAF	TTO	Date:
LSZH / ZRH	1	SWR179	AMIKI	03:55	
	2	SWR139	RILAX	03:53	
	3	SWR155	AMIKI	03:59	
	4	SWR7K	GIPOL	04:02	
	5	SWR289	KELIP	04:00	
	6	ETD73	AMIKI	04:05	
	7	SWR87	GIPOL	04:08	
	8	SWR243	AMIKI	04:09	
	9	CPA383	AMIKI	04:13	
	10	SWR117R	AMIKI	04:15	
	11	SWR147	AMIKI	04:17	
	12	QTR093	AMIKI	04:20	
	13	SWR40KX	GIPOL	04:39	
	14	THA970	AMIKI	04:40	
	15	#N/A	#N/A	#N/A	
	16	#N/A	#N/A	#N/A	
	17	#N/A	#N/A	#N/A	
	18	#N/A	#N/A	#N/A	
	19	#N/A	#N/A	#N/A	
	20	#N/A	#N/A	#N/A	
	21	#N/A	#N/A	#N/A	
	22	#N/A	#N/A	#N/A	
	23	#N/A	#N/A	#N/A	

Fig. 34: FMP's e-mail with arrival sequence (example day in August 2015)

4. Monitoring / Post-OPS

FMP recorded the actual time over/ abeam the IAF and the actual landing time, to assure proper post operations analysis.

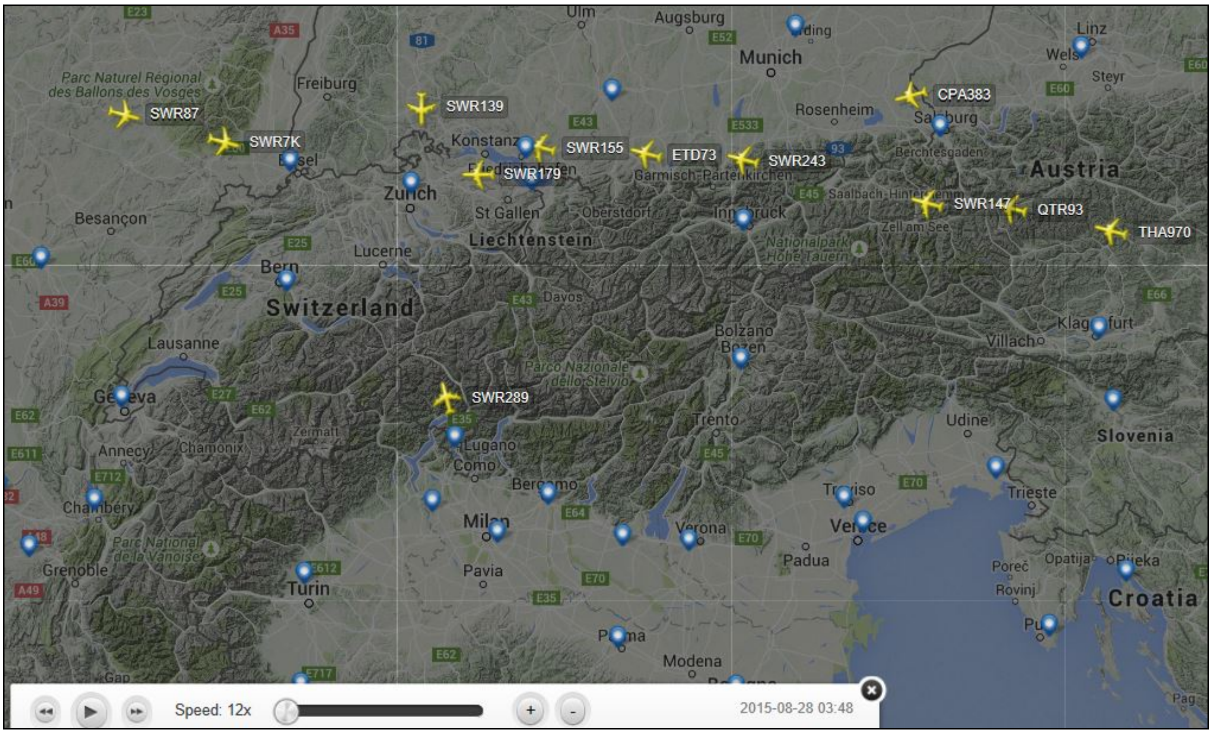


Fig. 35: iStream LSZH sequence execution (example day in August 2015 screen shot out of www.flightradar24.com)

Proposal of enhancement of the procedure:

In order to increase the short and medium hauls' ability to reach their assigned Target Times Over the IAF, a possibility could have consist in "cherry-picking" them, so the Network Manager can assign these flights a CTOT compatible with their TTs.

Once the whole sequence was generated, the FMP would have sent the TTs for the short/medium hauls flights to NM. NM would have then computed the CTOTs backwards from the provided TTs for the concerned flights and gather ETFMS. Keeping in mind that ideally the CTOT should be equal with their Estimated Take Off Time (zero minute delay).

5.5.1.3 Deviations from the planned activities

NMOC was not involved in the LSZH Trials as there was no capacity issue at the timeframe considered. The iStream procedure at LSZH was an optimization procedure designed to enhance predictability of flights' entry into the Approach sector while better taking into account the Airspace Users' preferences.

The sequence and Target Time computation was initially imagined to be taken over by NM, but due to traffic consideration (long-hauls flights) and systems limitations, the computation was not possible in the short-time needed for the implementation of the Trials. Therefore a local tool has been developed to support the Arrival sequence generation.

5.5.2 Exercises Results

5.5.2.1 Summary of Exercises Results

This chapter provides the outcomes of the iStream Trials EXE-01.02-D-06.3 concerning LSZH-Zurich Arrivals for the period 15.06.2015 – 30.06.2016.

Exercise ID	Demonstration Objective Tittle	Demonstration Objective ID	Success Criterion	Exercise Results	Demonstration Objective Status
EXE-01.02-D-06.3	Evaluate the impact on flight crew and OCC staff workload and safety	OBJ-0102-001	No negative impact on flight crew and OCC staff workload and safety	No negative impact was observed on staff workload and safety due to the use of iStream procedure.	OK
EXE-01.02-D-06.3	Evaluate the impact on ATM workload and safety (NM, ATCOs and/or FMP)	OBJ-0102-002	No negative impact on ATM operational staff (NM, ATCOs and/or FMP) workload and safety	No negative impact was observed on ATM operational workload and safety.	OK
EXE-01.02-D-06.3	Evaluate the impact on flight efficiency	OBJ-0102-430	The scenarios; by enhancing flight profiles and/or reducing ATFCM delays and/or reduced vectoring and/or reduced number of holdings; reduces the fuel burn compared to OFP data and/or baseline data.	The use of iStream procedure reduced the vectoring and number of holdings at LSZH airport.	OK
EXE-01.02-D-06.3	Evaluate the deviation to the initial TT	OBJ-0102-310	The variance of the TT adherence is improved compared to baseline.	There was no baseline available for the comparison, but the high results of adherence to the TT fix induced the reduction of tactical measures to	OK

				sequence the aircraft in the TMA (as vectoring).	
EXE-01.02-D-06.3	Evaluate the impact on capacity use of airport and sectors (arrival / en-route)	OBJ-0102-440	The airport capacity and sectors (TMA/En-route) capacities are not reduced.	The use of iStream procedure had no impact on the use of sector capacities and no negative impact on runway capacities	OK
EXE-01.02-D-06.3	Evaluate the possibility of swapping/modifying TTs based on airline's requests	OBJ-0102-710	Airlines are able to provide their TT modification requests and ATC is able to take Users Preferences into account and accommodate them.	The Airlines' requests were transmitted to ATC and taken into account in the arrival sequence computation.	OK

Please note that the adherence results are analyzed with FMP post-ops recorded data and the tracks flying time and distance in the LSZH TMA are analyzed with radar data (ARTAS).

5.5.2.1.1 Eligible flights and rate of participation

One recommendation from the previous FAIR-STREAM Trials pointed out that in order for the Target Time concept to be effective, complete flows have to be considered so non-TTA traffic does not disturb the computed sequence. Therefore it was a pre-requisite for these Trials that all flights in a define timeframe shall be involved.

Eligible flights for the Trials were all flights expected to arrive between the [06:00 – 07:00] LT timeframe at LSZH all days from 15.06.2015 until 30.06.2016. However the first five weekends were not included in the Trials (weekend days were included as from 25.07.2015).

All expected Airspace Users were informed by the Trials but only the airlines having regular flights participated actively in the Trials; i.e. SWISS International Airlines (SWISS), Cathay Pacific, Etihad Airways, Qatar Airways, Thaï Airways, Edelweiss Air, Belair Airlines and Germania. This involved long, medium and short haul flights.

Further in the report, we consider "Participating airlines" the eight airlines above.

Other Airspace Users having occasional flights were still considered in the arrival sequence but their Dispatch and Flight Crews were not aware of their Target Times.

The Trial period 15.06.2015 – 30.06.2016 led to a total of 4'866 eligible flights, with 4'577 from participating airlines: 94% of the flights actively participated in the Trials.

The participation to the Trials was on a voluntary basis, but emphasis was made that benefits can only be retrieved if all flights are playing the game. Still the flight crews were let the choice (mainly for operational reasons) to undergo the trials or not.

5.5.2.1.2 Results on Predictability

5.5.2.1.2.1 Adherence to TTO

For this part, we will not consider a baseline period as the adherence to a target time at the IAF cannot be compared to a previous period.

During the Trial period, 4'866 flights were listed.

On the 4'866 flights, 60 amongst them did not overfly the IAF → For the analysis, 4'806 flights were considered.

On the 4'806 flights, 4'577 were belonging to participating airlines (noted hereafter "participating flights").

	Adherence to TTO [-3;+3]	Adherence to TTO [-4;+4]
All flights	58%	68%
Participating flights	59%	69%
Long & Medium participating flights	63%	73%
Long-Haul participating flights (USA & Asia)	64%	74%
Middle-East participating flights	54%	67%

Fig. 36: LSZH Trials – Summary of adherence to TTO

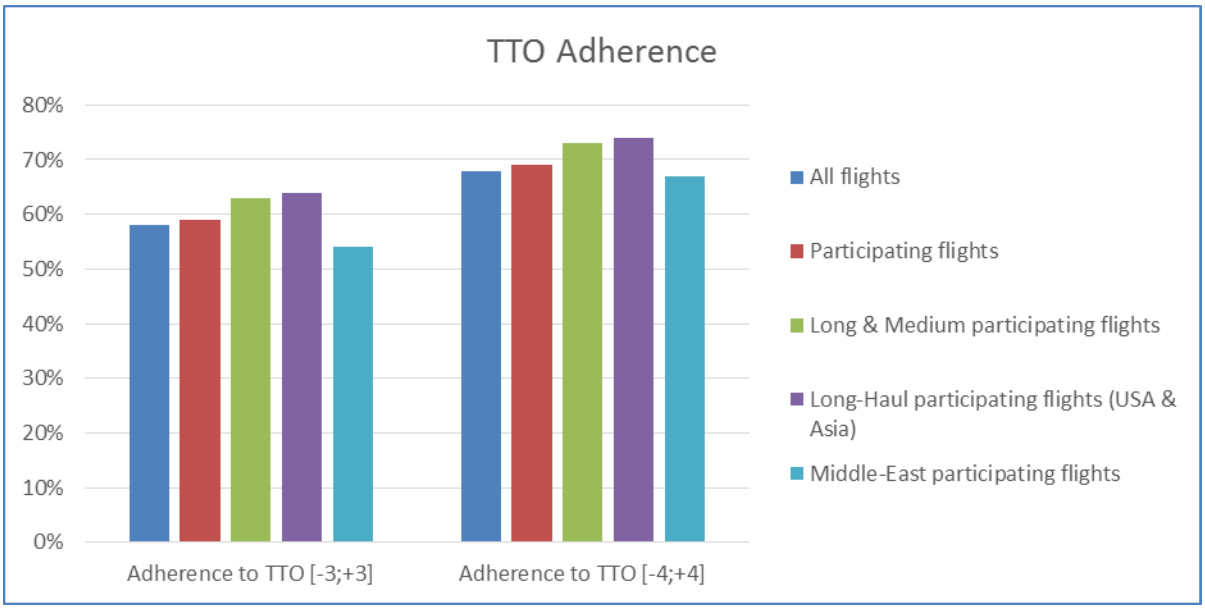


Fig. 37: LSZH Trials - Graph summary of adherence to TTO

TTO deviation = Actual Time Over (ATO) – TTO (in minutes)

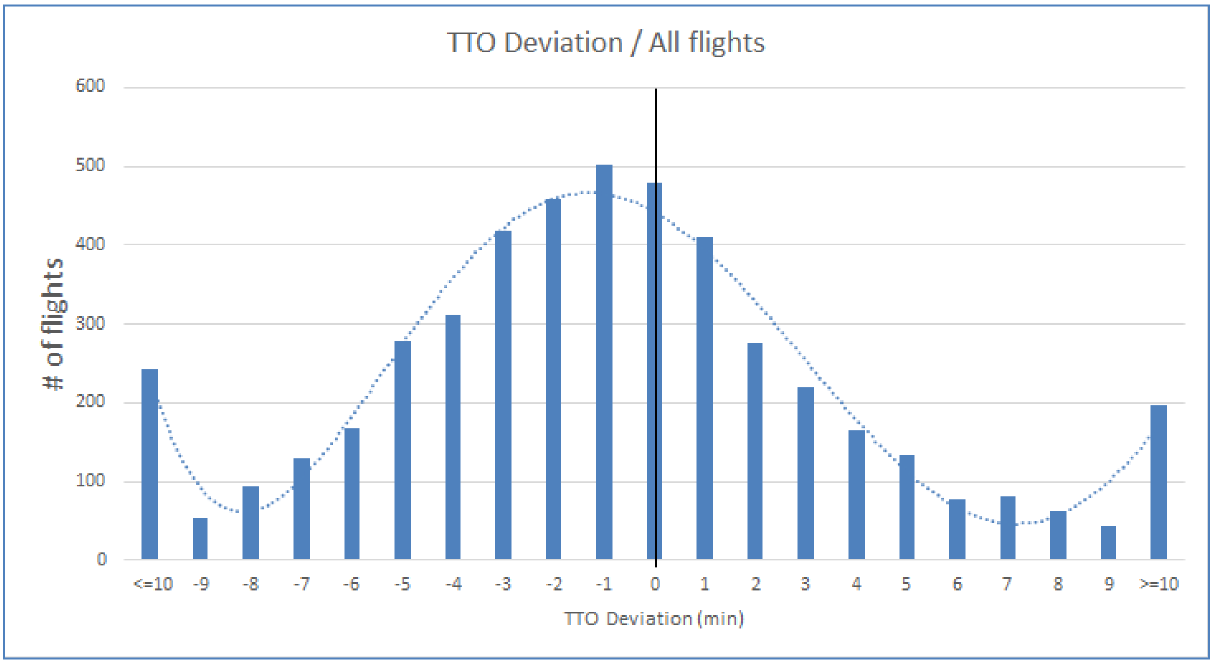


Fig. 38: LSZH Trials - TTO Deviation for all flights [06:00-07:00] LT

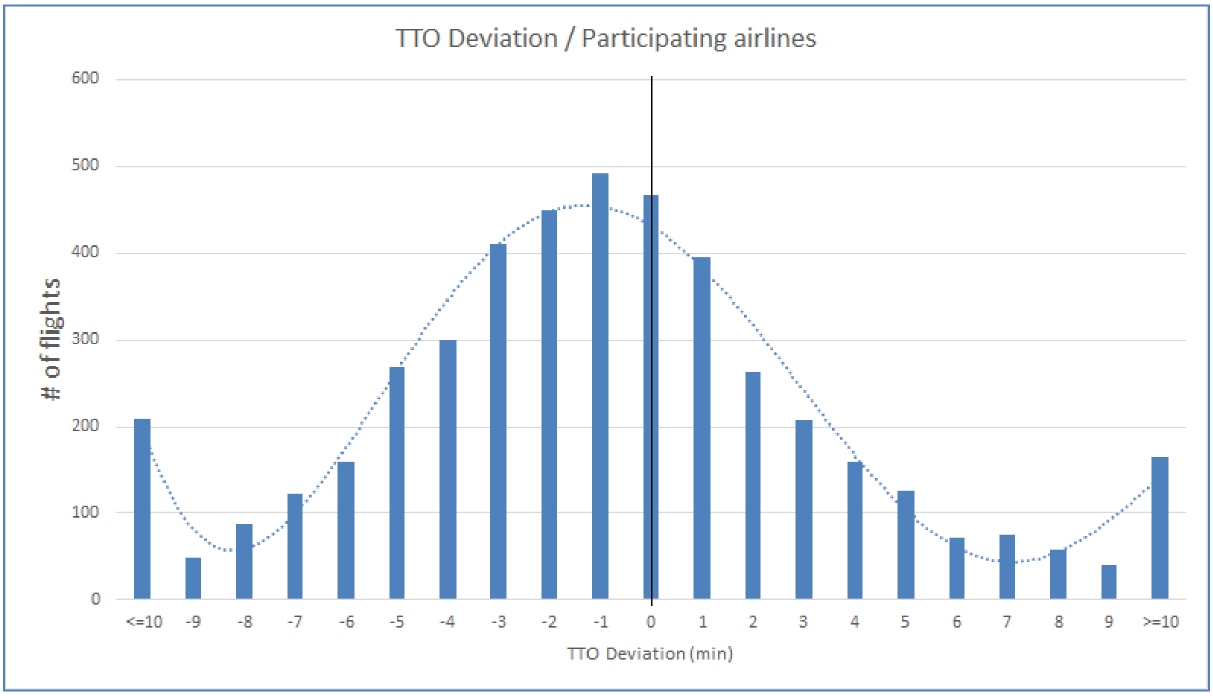


Fig. 39: LSZH Trials - TTO Deviation for participating flights

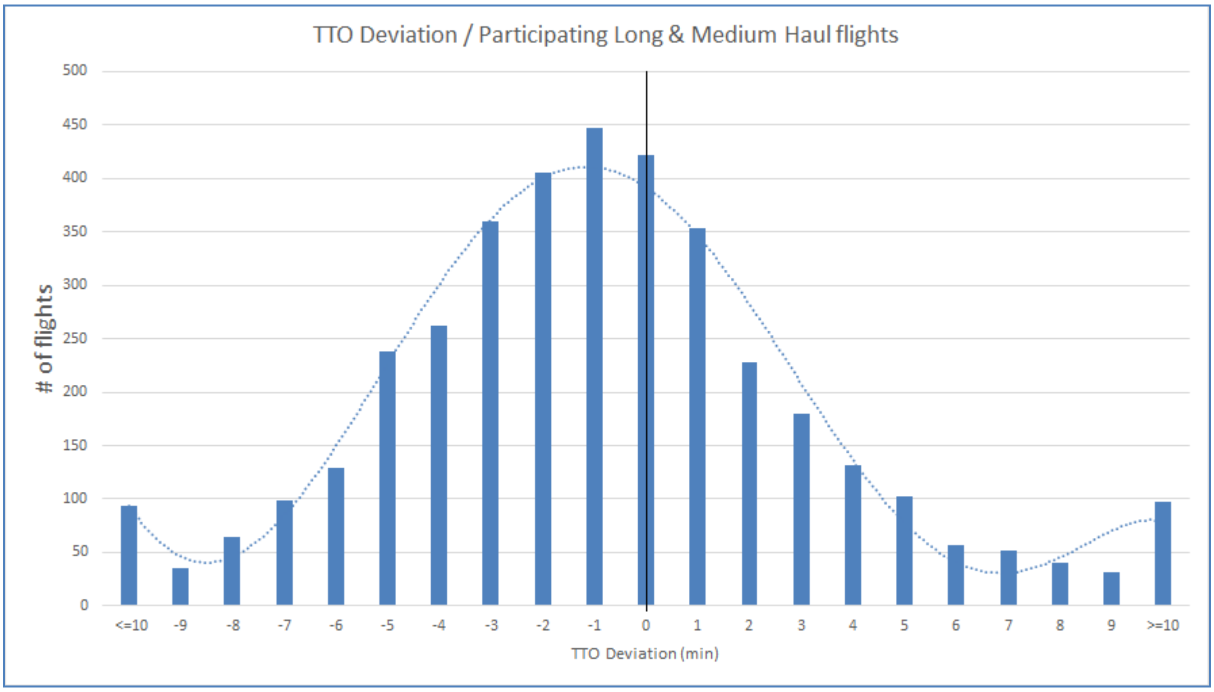


Fig. 40: LSZH Trials - TTO Deviation for Participating Long & Medium Haul flights

5.5.2.1.2.1.1 Impact of flight time on TTO adherence

In order to analyze the impact of flight time on TTO achievement, the following graphs subdivide the flights on the basis of their duration. It is expected that longer flights have better chances to reach a TTO as they have more time to adjust their flight profiles to reach the target (and compensate for an unpunctual departure if the case).

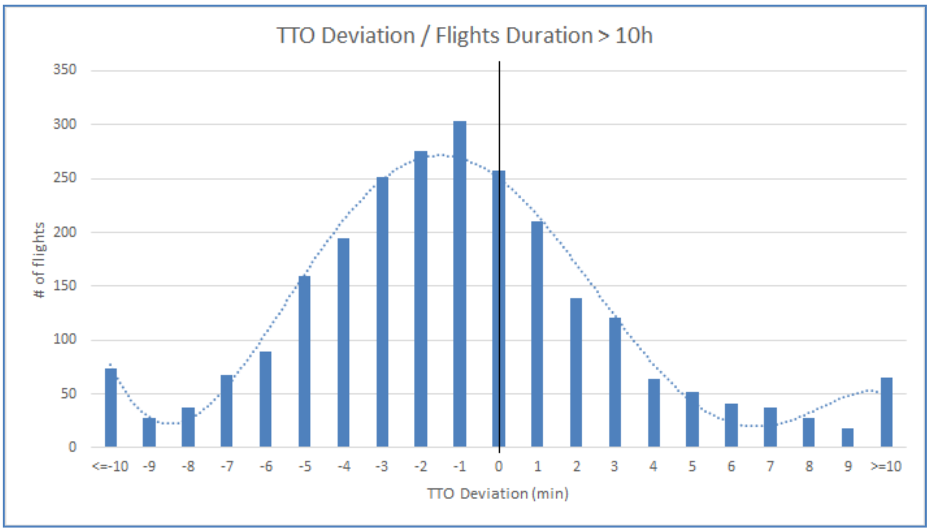


Fig. 41: LSZH Trials - TTO Deviation for very Long-Haul flights (North America+Asia)

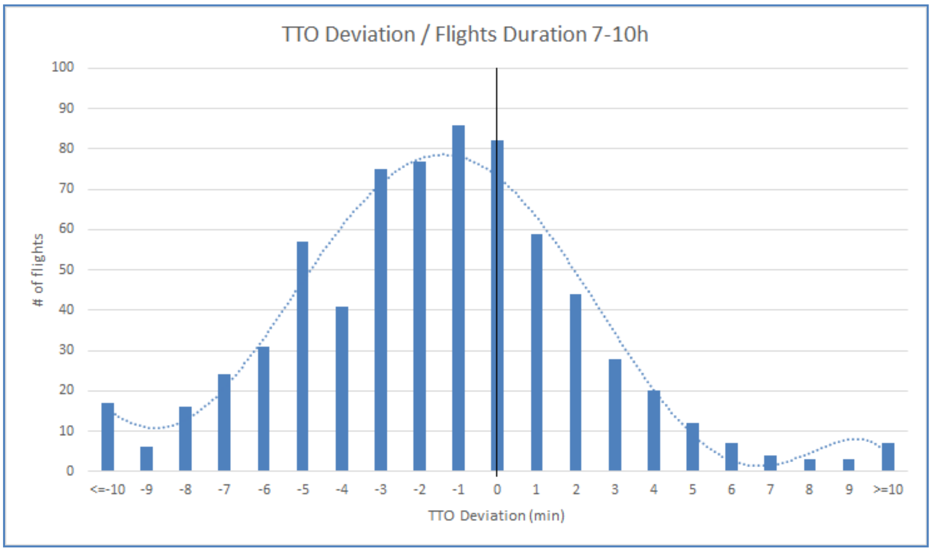


Fig. 42: LSZH Trials - TTO Deviation for Long-Haul flights (India)

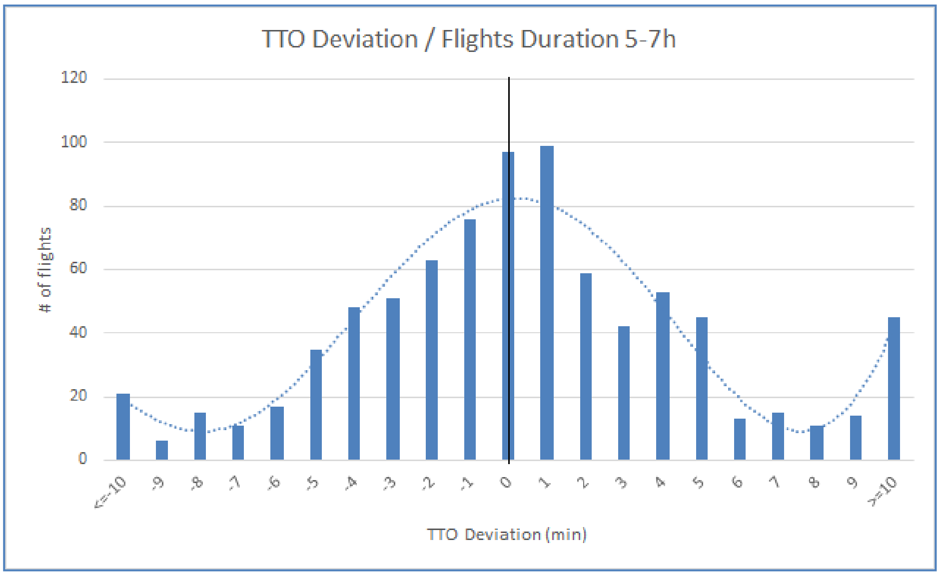


Fig. 43: LSZH Trials - TTO Deviation for Middle-East flights

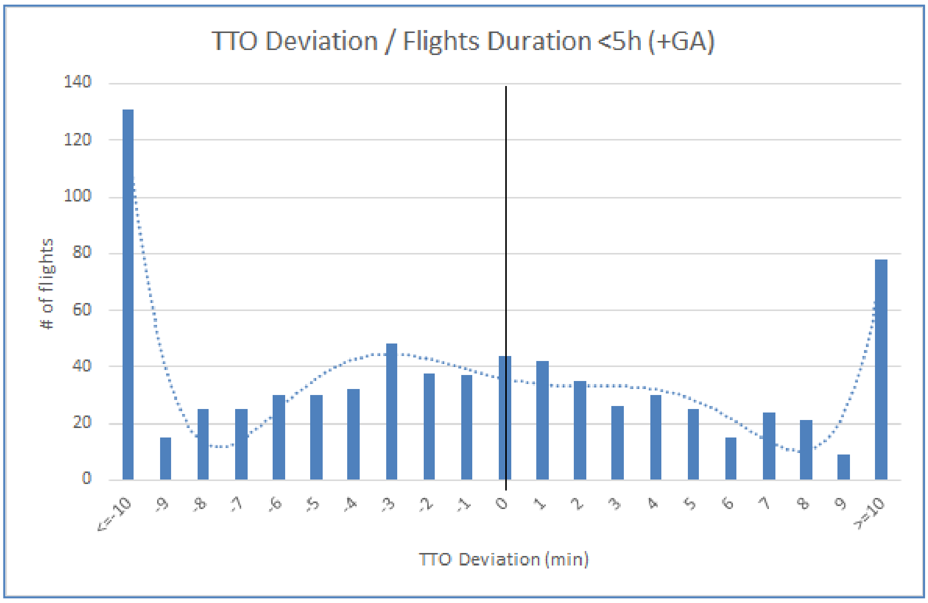


Fig. 44: LSZH Trials - TTO Deviation for Short Haul flights and General Aviation

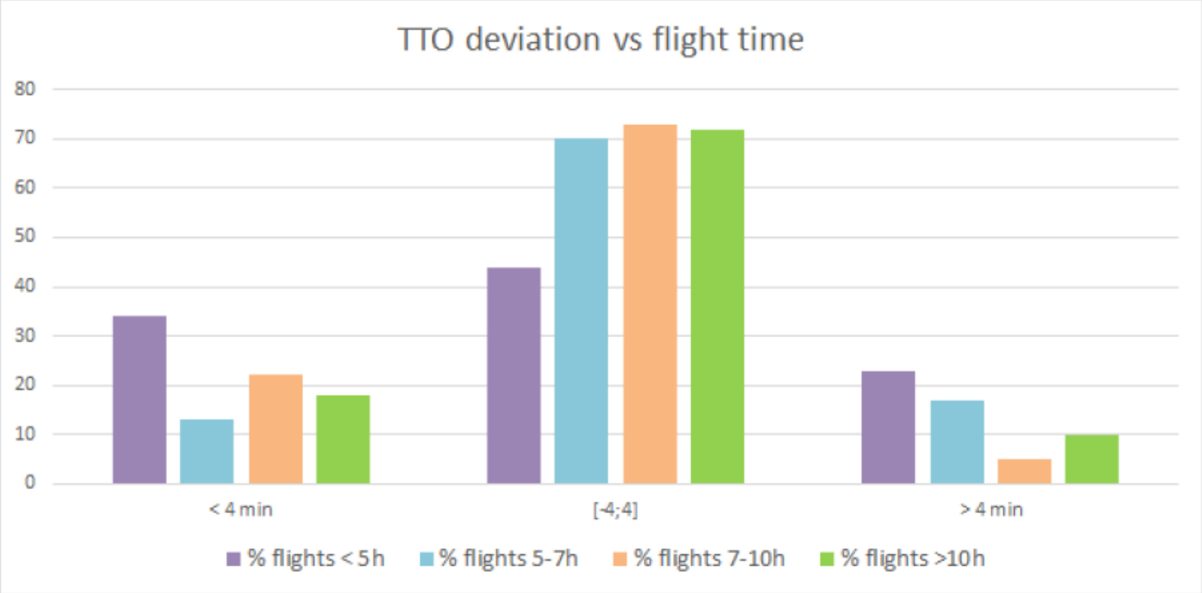


Fig. 45: LSZH Trials - Summary of TTO deviation vs Flight Time

We can see that adherence to TTO is not surprisingly better achieved with longer flights.
However, the General Aviation and private flights were not aware of the Trials and therefore did not consider their TTO, which contributes also to the result of their poor adherence.

Also, there was a timing issue with the Middle-East flights explaining they had more difficulty to adhere to provided TTO.
10-months long during the Trials, the deadline to provide the ETOs was 01:00 LT and their flights were just airborne at that time and did not reach their TOC. Sometimes they were even not departed.
Therefore inaccurate ETOs were considered (retrieved from the CHMI) which ended up in TTOs not being reachable. Please refer to the following chapter for further explanation.
To face this issue, mid of May the deadline was raised up to 01:30 LT for a better integration of the Middle East flights.

	Adherence to TTO [-3;+3]	Adherence to TTO [-4;+4]
Middle-East (QTR&ETD) outbound flights	54%	66%
USA/Asia outbound flights	64%	74%

Fig. 46: LSZH Trials – TTO adherence comparison for Long-Haul & Middle-East outbound flights

5.5.2.1.2.1.2 TTO Adherence relatively to ETO source (Flight Crew / CHMI)

During the trials, it appeared that estimated times retrieved from the CHMI were not accurate enough to provide realistic TTOs.
For many reasons, Flight Crews/Dispatch were not always able to send to skyguide their ETOs in time.
In this case the procedure was to retrieve the ETOs at the IAF from the CHMI estimated flight profiles. The sequence was then generated based on these ETOs. As a reminder, the TTOs were computed to be as close as possible to the provided ETOs (with a maximum of 5 minutes deviation to ETOs). However, many feedback from the Airspace Users were received indicating that the TTOs were not reachable for their flights.

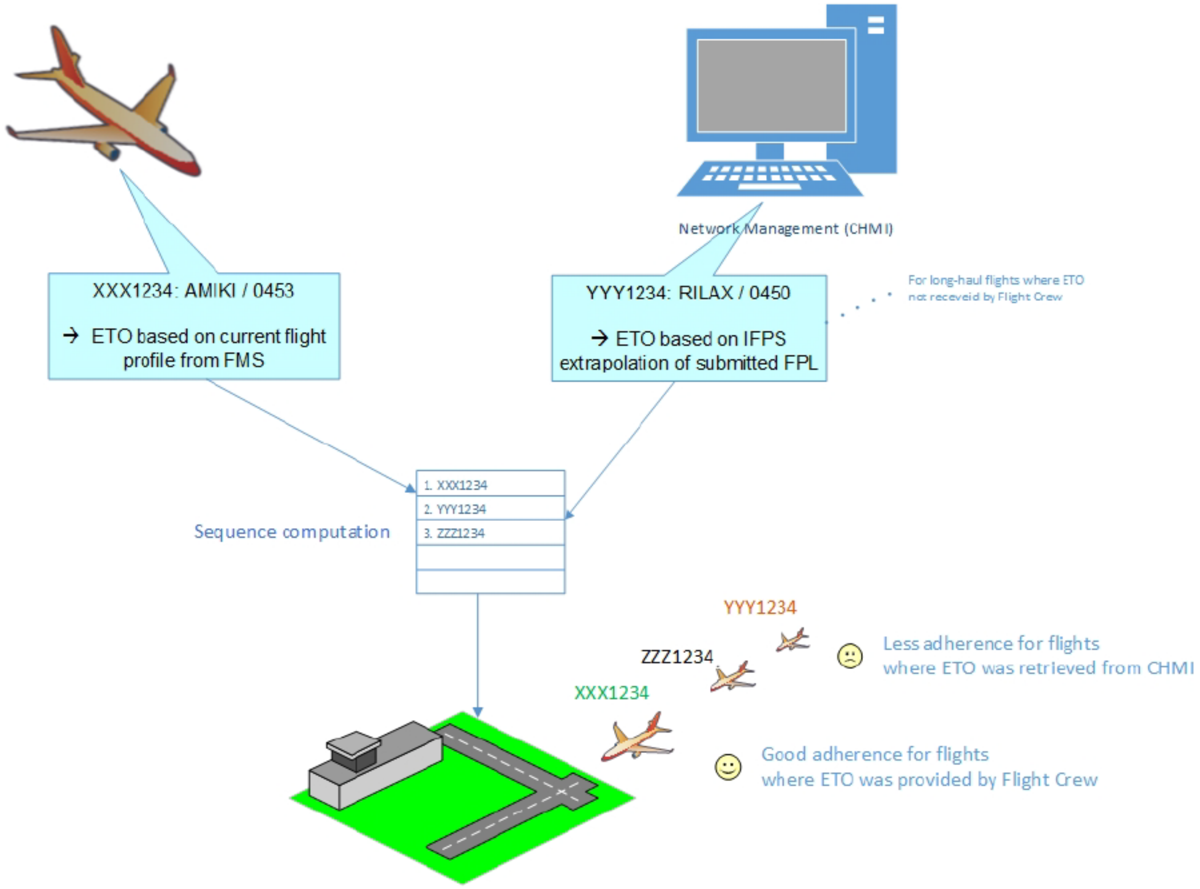


Fig. 47: LSZH Trials - ETO sources

So an analysis has been made on the participating long-hauls flights, to differentiate the TTO Adherence between flights where the ETO was provided by the Flight Crew and the ones where the ETO was taken out from the CHMI.

	Adherence to TTO [-3;+3]	Adherence to TTO [-4;+4]
Flights with ETOs retrieved from CHMI	35%	45%
Flights with ETOs provided by Flight Crews	67%	76%

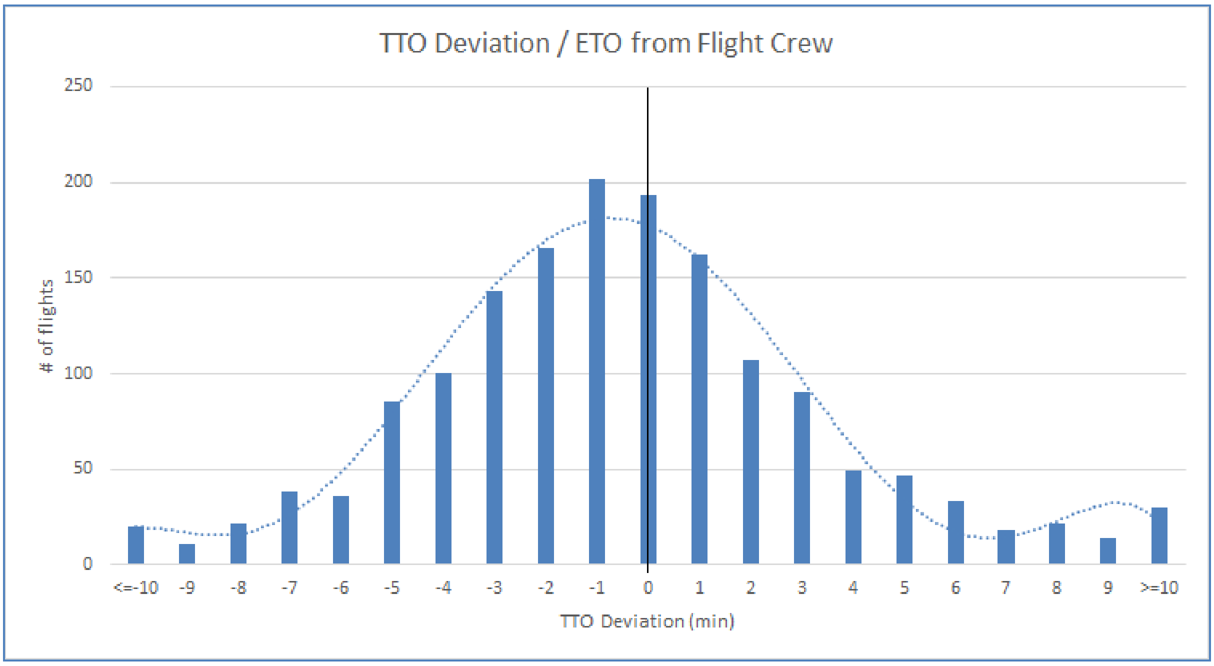


Fig. 48: LSZH Trials - TTO Deviation considering ETOs provided by Flight Crews

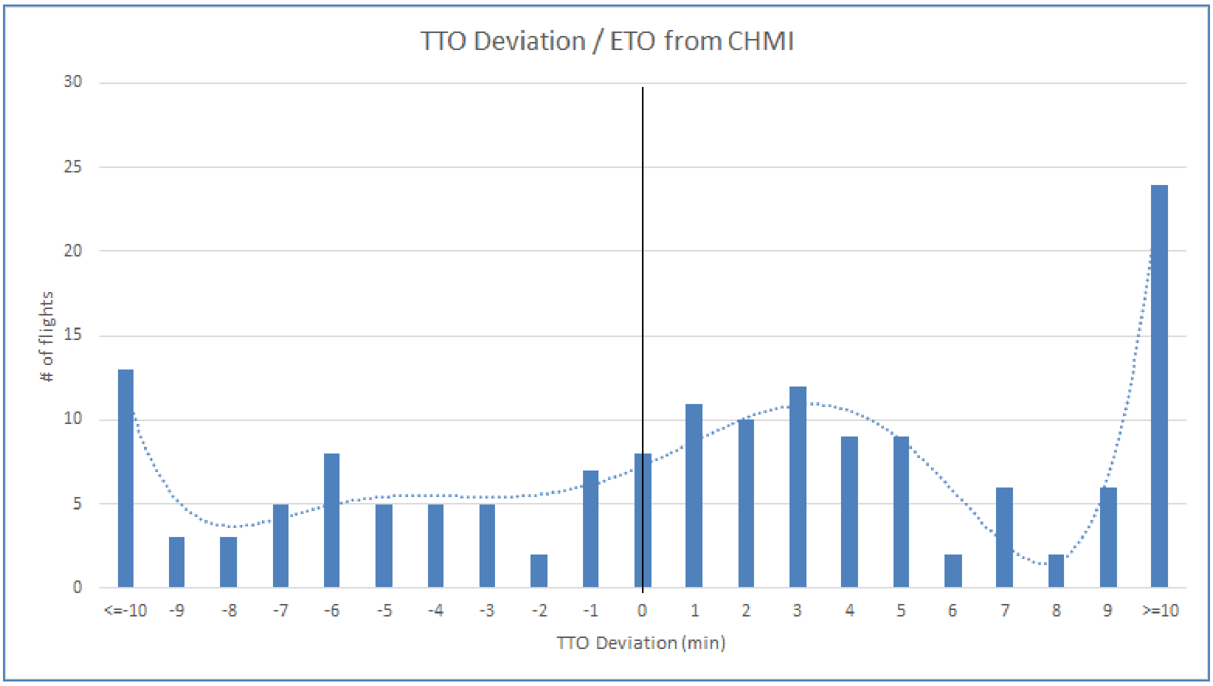


Fig. 49: LSZH Trials - TTO Deviation considering ETOs retrieved from the CHMI

We can observe a greater disparity in the TTO adherence for the flights where the ETO was provided by the CHMI. This implies that the ETOs were not sticking to the current flight profiles which engendered corrupted TTO values. This analysis points out the lack of accuracy of the ETO data from the CHMI tool; in particular taking into account, in the Network Management environment, long-haul flights which did not enter the IFPS zone yet.

5.5.2.1.2.1.3 Impact of take-off time deviations on TTO adherence

The two following graphs show the distribution of the flights' Actual Take Off Times (ATOT) compared to their Estimated Take Off Times (ETOT).

ETOT Deviation = ATOT – ETOT (in minute)

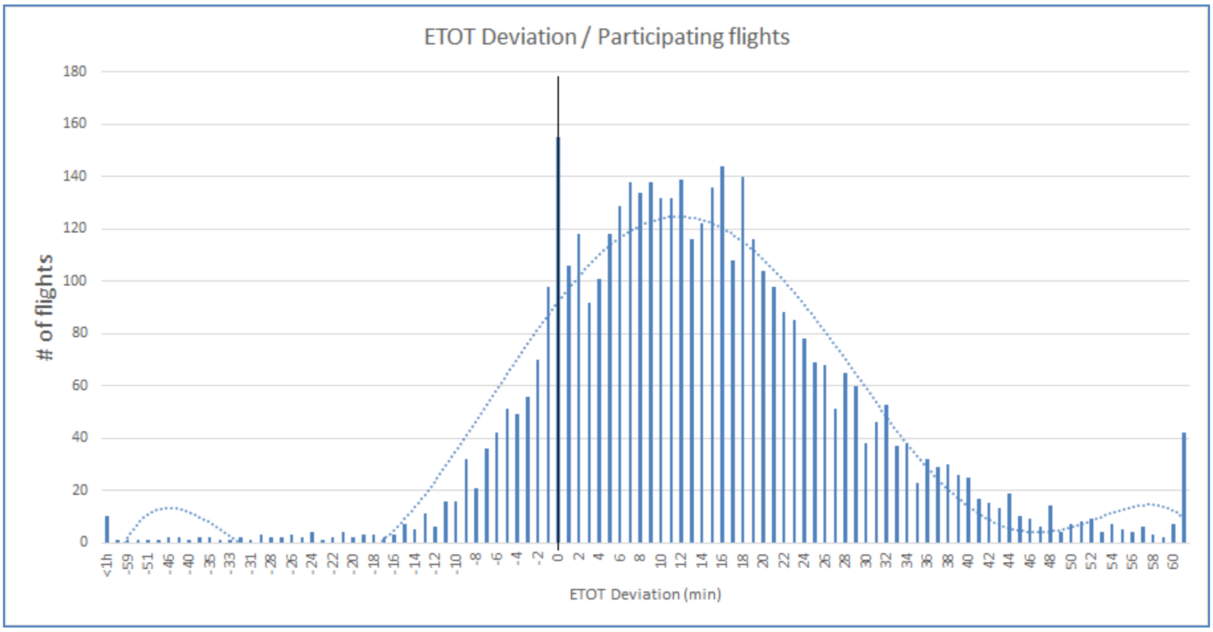


Fig. 50: LSZH Trials - ETOT Deviation for participating airlines

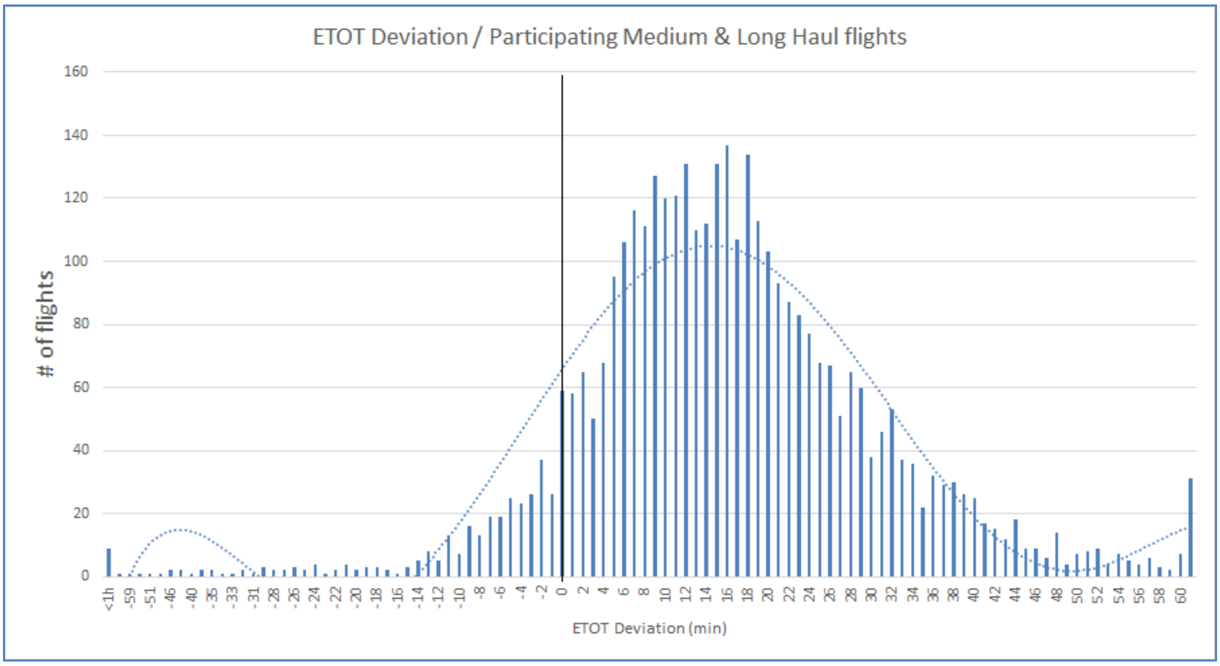


Fig. 51: LSZH Trials - ETOT Deviation for Long & Medium haul flights

The take-offs are largely spread with peaks on approximately +10 minutes, but the distribution windows over the TTs are much narrower with peaks in [-1;+1] of the TTs. This implies that the flight crews are able to manage the flights to reach the TT.

However, those results have to take into account the existing Strategic Steering phase for SWISS flights, as they already have a first TT taken into account for their take-off time in the Operational Flight Plan.

Long-haul flights have a tendency to wait at departure not to be too early at LSZH.

5.5.2.1.2.2 Results on Flight Efficiency

5.5.2.1.2.2.1 Impact of TTO on flight efficiency – Cruise phase (from TOC to IAF)

As the pilots had to adapt the aircraft speed in order to reach their TTO, some impact on fuel consumption was expected. The impact of TTO on cruise efficiency cannot be evaluated, as there was already a reduction of cruise speed with the former SWISS procedure. The adaptation during iStream trials with the integration of all airlines does not have an evaluable impact on the cruise efficiency.

5.5.2.1.2.2.2 Impact of TTO on flight efficiency – Approach & Arrival phase (from IAF to Touch-Down)

For the Approach phase, we will perform the analysis over 3 years to better apprehend the results of iStream procedure. In 2014, the "Early Wave procedure" was established, which already instituted Target Times for SWISS and Edelweiss flights. As benefits could be observed, it was aimed to extend the procedure to all flights in the arrival timeframe. This gave birth to FAIR-STREAM and later to iStream Trials.

- Comparison over 3 years:
  - 2013: No procedure
  - 2014: From April 2014: Early Wave procedure
    - with SWISS and Edelweiss airlines
    - between [06:00 – 06:30] LT
  - 2015: From June 2015: iStream procedure
    - with all airlines
    - between [06:00 – 07:00] LT

The graphs illustrate the benefits of the iStream procedure as the average flown distance and time per flight in the TMA decreased with iStream introduction in 2015, and even further decreased in 2016 thanks to the stabilization of the procedure.

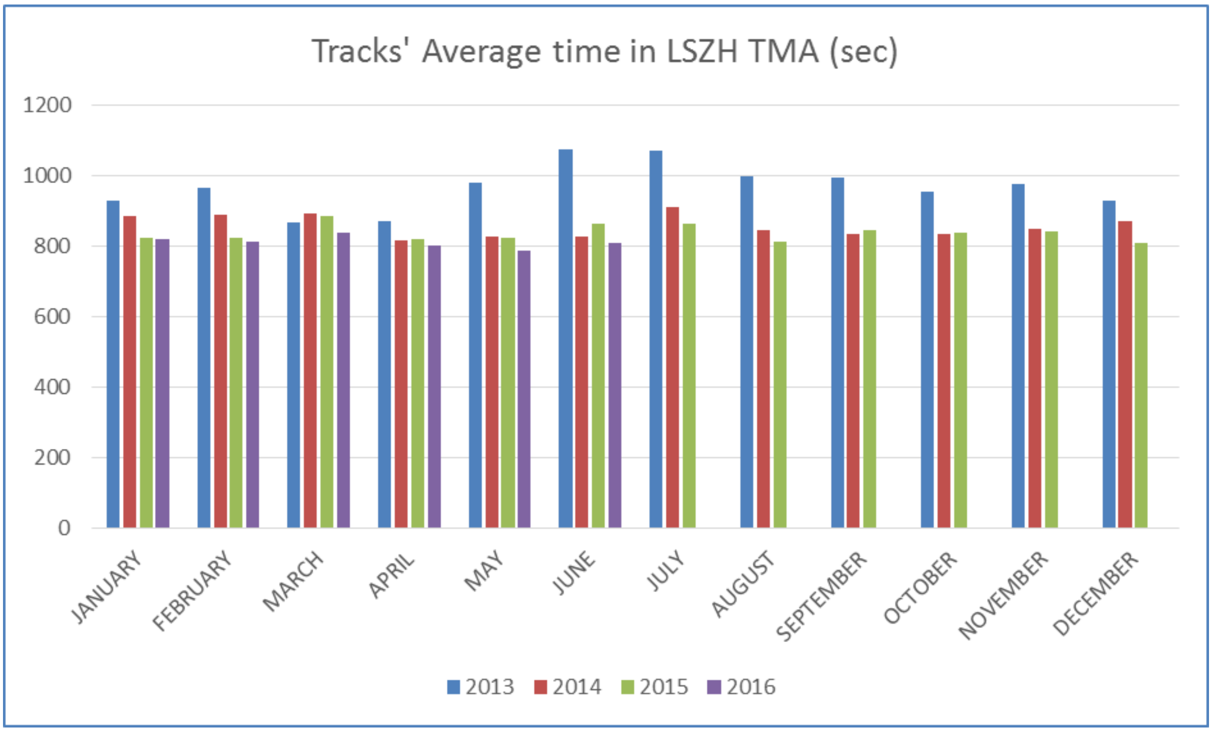


Fig. 52: LSZH Trials - Tracks Time in LSZH TMA (sec)

- Time: average flown time per flight from IAF until Touch-Down
- All flights arriving between [06:00 – 07:00] LT

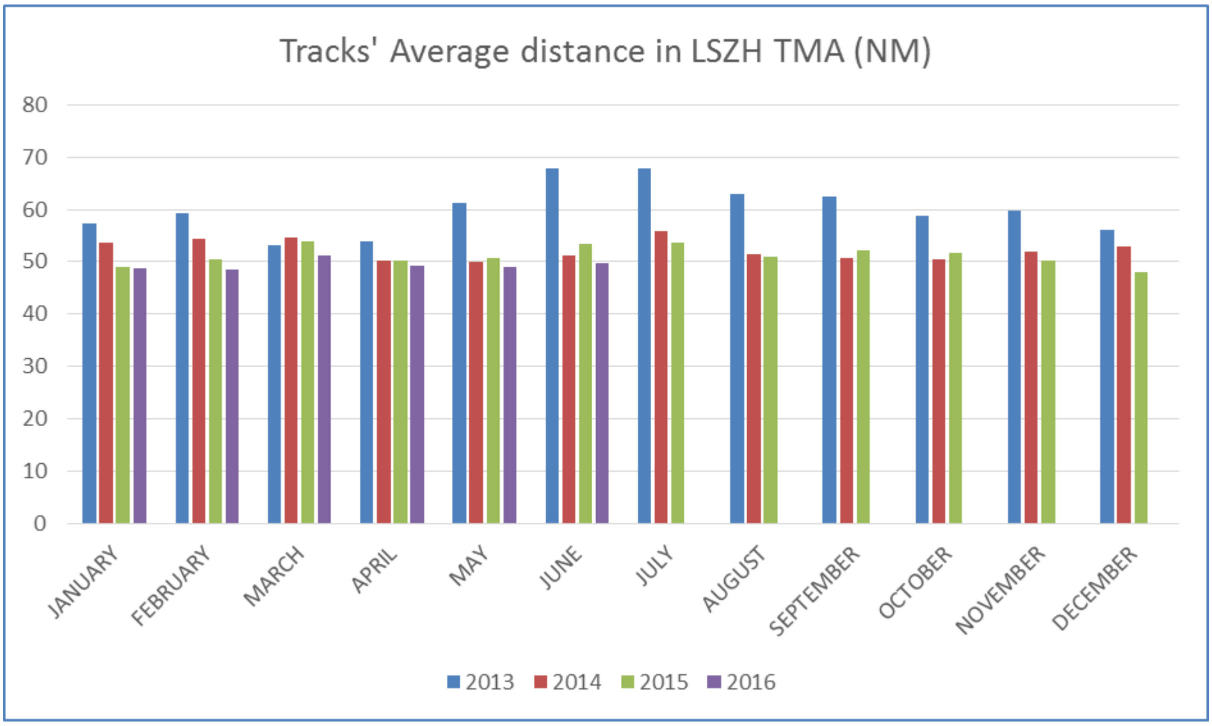


Fig. 53: LSZH Trials - Tracks Distance in LSZH TMA (NM)

- Distance: average distance in NM per flight from IAF until Touch-Down
- All flights arriving between [06:00 – 07:00] LT

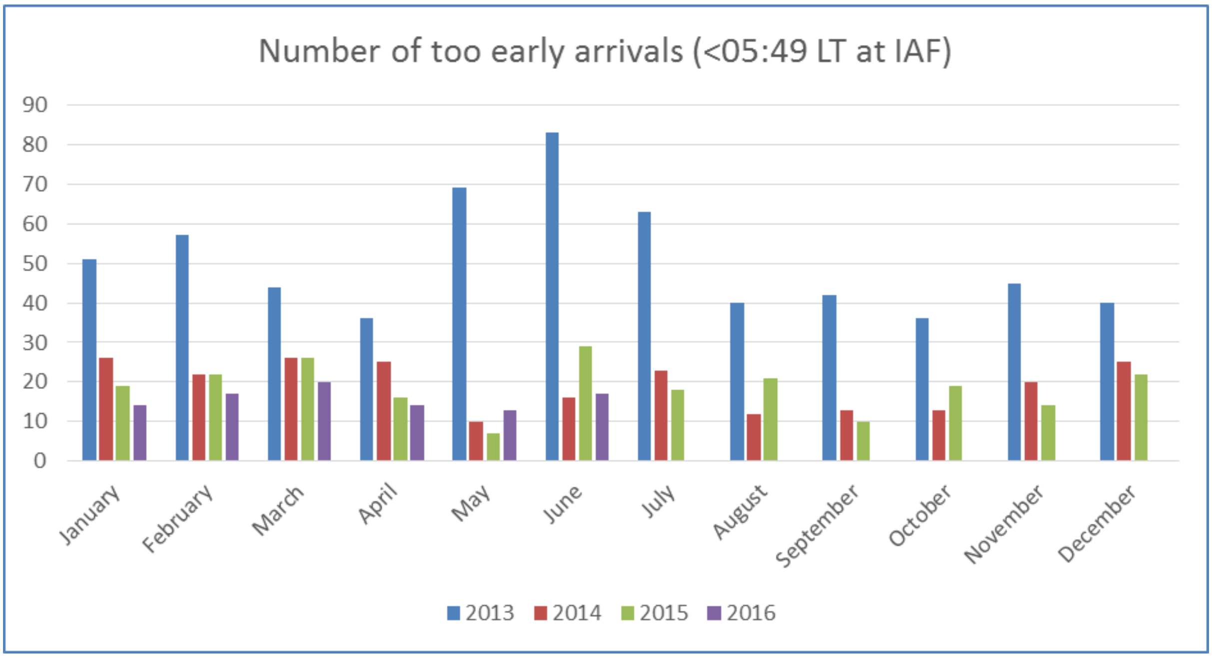


Fig. 54: LSZH Trials - Number of flights arriving too early

- All flights arriving before 05:49 LT in ZRH TMA

A flight arriving before 05:49LT at an IAF will necessary be put into holding, as it arrives before the opening of the airport.

Therefore number of flights arriving too early is useful to deduce the reduction of holdings before the opening of LSZH airport.

Before Fairstream, SWISS started in-house measures to optimize the arrival flow. From the very early beginning in the year 2008 with an average of 8.7 flights per day, SWISS had on 1220 out of 1716 flights holdings between 06:00 – 06:15 LT. The average arrival flown distance per flight was 122NM from a 50NM radius to touchdown. Between 06:15-06:30 LT SWISS had 489 holdings on 1470 flights with an average arrival distance of 99NM. If the iStream Trial time (June 2015 until June 2016) is compared to the baseline of 2008, a reduction of 96% in holdings and 30% of less arrival distance flown can be measured.

The next two graphs indicate only SWISS flight recorded data with the similar effect shown on the radar data.

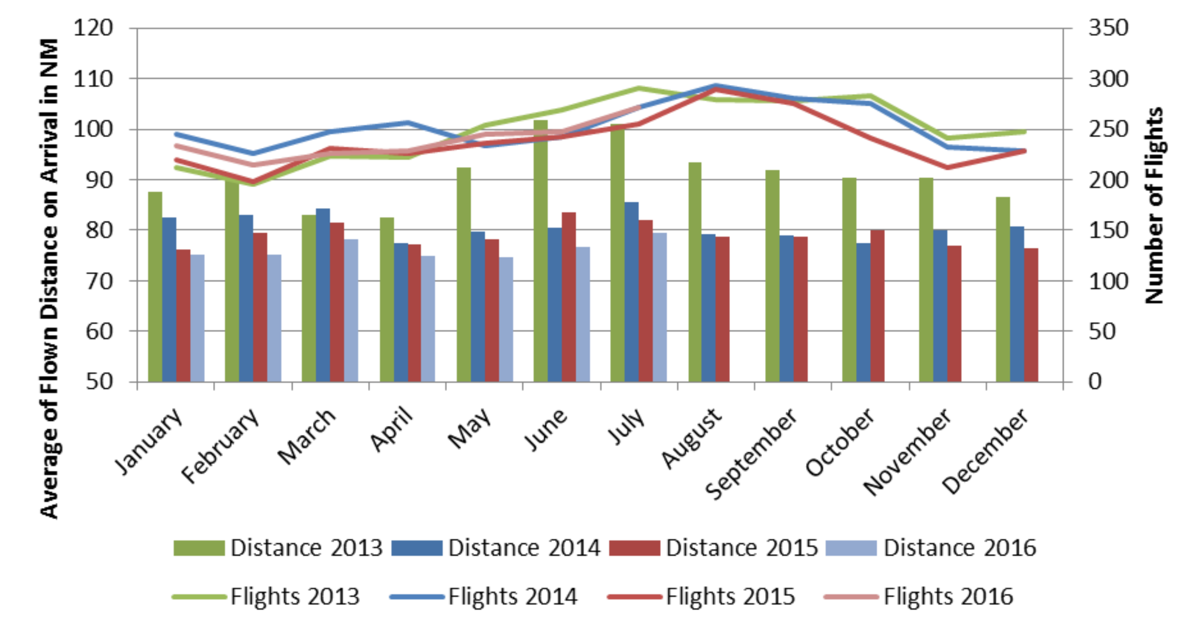


Fig. 55: LSZH Trials - Flown Arrival Distance of SWISS Flights

The flown distance on arrival is measured from a 50NM radius around the airport until touchdown. The number of landings of SWISS flights in the timeframe has also changed over the past year. Still, a major reduction is shown over the last months of the iStream trials.

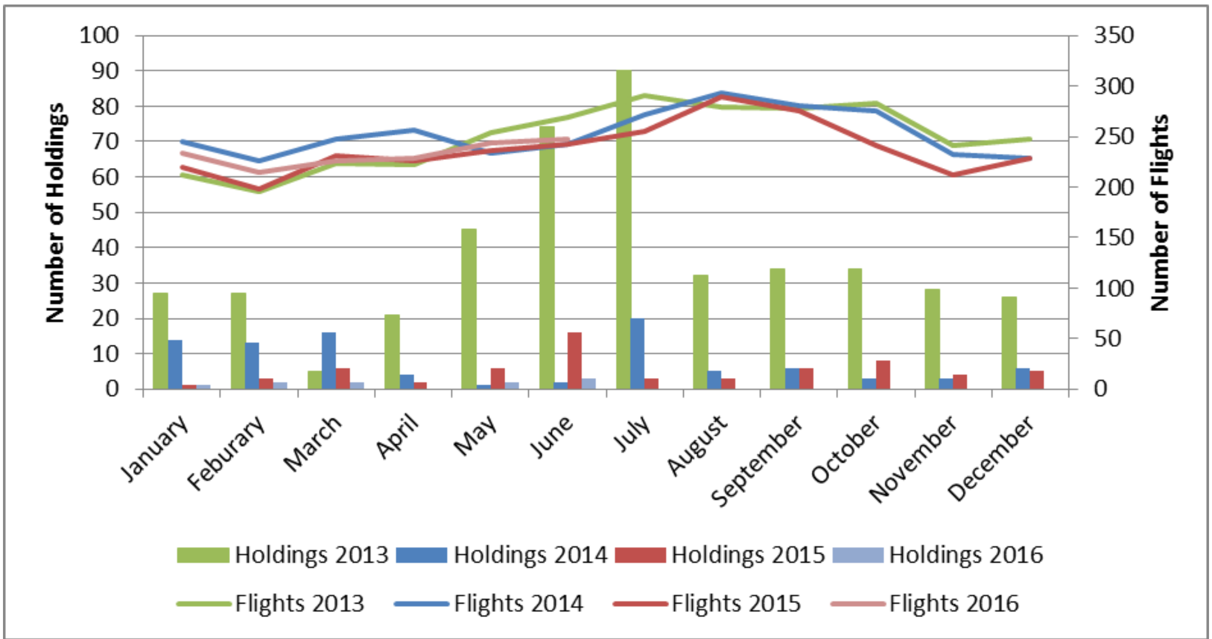


Fig. 56: LSZH Trials - Number of Holdings of SWISS Flights

The same result can be drawn from the SWISS recorded holdings over the IAFs, which are mostly flown in cases flights arrive too early in the LSZH TMA. In April 2016 not one single holding was recorded from SWISS flights landing between 06:00-07:00LT.

The reduction of holdings and less vectoring contributes to a better fuel consumption during the approach phase.

Based on the results of the flight crew questionnaires (see paragraph 5.5.2.1.2.3.3), optimized descents are more often carried out. This has also a positive impact on the flight efficiency of the approach and arrival.

5.5.2.1.2.2.3 Consideration of Airspace User's swap requests

SWISS is using a company tool, to provide the SWISS flight sequence based on the passenger connections and ETO messages to skyguide. There is a dynamic ranking for SWISS flights within the sequence, on average three SWISS flights get swapped per day compared to STA. These requests were provided to skyguide who took them into account in the sequence preparation.

With the swaps within the SWISS ranking, passenger connections are ensured and help to improve the passenger convenience with more time to walk to their connecting flight. This of course improves the punctuality of the first outbound flights with passenger connections as well. Therefore, a reduction of rotation delays (IR91) is also a qualitative result.

5.5.2.1.2.3 Results on Safety and Workload (qualitative feedbacks retrieved from questionnaires' analysis)

5.5.2.1.2.3.1 Impact on ATC

Zürich Approach ATCOs were informed of the Trials but were not actors. The Trials aimed to be transparent on the ATC side. No specific issues, neither on workload nor safety, were reported.

5.5.2.1.2.3.2 Impact on FMP

A total of 51 questionnaires filled from the FMP operators were collected. Please note that some of them were only partially filled. The global feedbacks and feelings regarding iStream procedure are highlighted below.

The FMP operators were confident working with iStream procedure. Although it was a whole new task, it did not affect their other duties as the night time is generally quiet and therefore was appropriate for the introduction of new duty.

64% think iStream did not compromise safety. However, after consultation we could see that there was a misunderstanding in the sense of the question and most answered in the way that iStream did not compromise safety. Furthermore no incident has been reported.

Although for 48% the workload feeling was increased, 82% disagree that iStream affected their overall performance / other duties.

Frequently some ETOs were not received: 63% of the time there were at least one ETO missing (either not received at all either not received in time), which conducted the FMP to e-mail the duty dispatch or look for the ETOs on the CHMI.

A few of them, 9%, directly called the dispatch to retrieve the information. 52% of missing ETOs were collected on CHMI and 68% via e–mail.

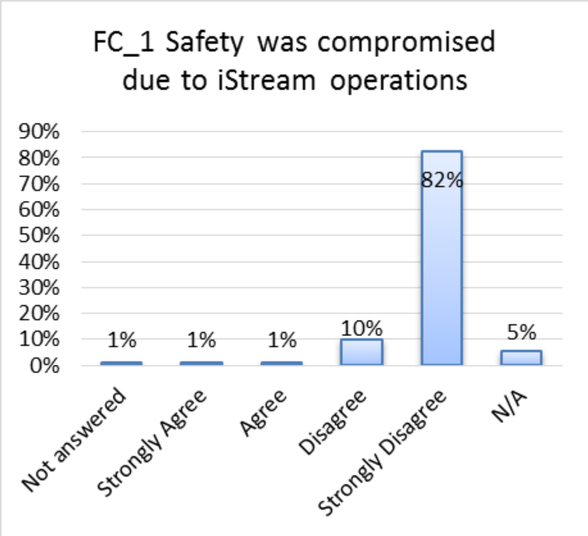
36% agreed iStream increased the amount of coordination with the Airlines Operation Centers.

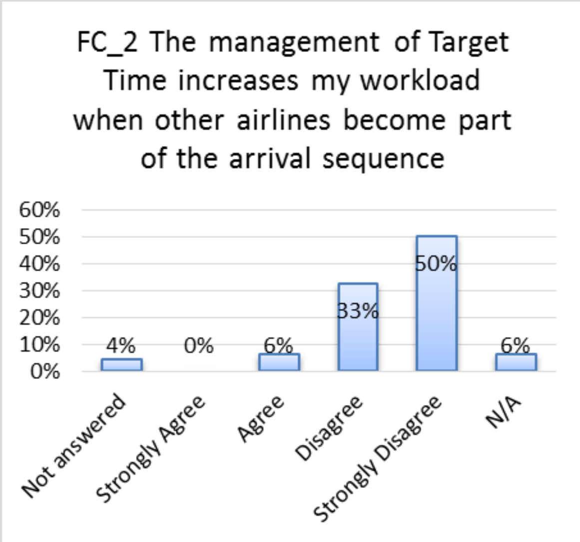
Most of the FMP thought iStream did not affect capacity neither traffic complexity.

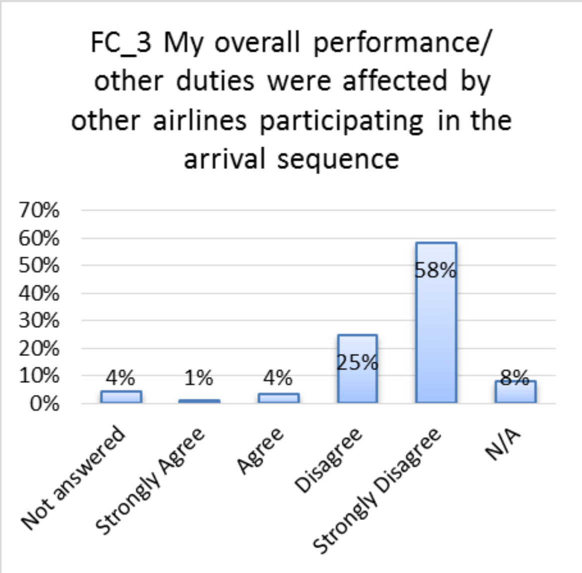
95% were confident working with iStream procedure. However the fact that there were often unexpected flights in the iStream timeframe did not comfort the FMP into the benefits of the current procedure.

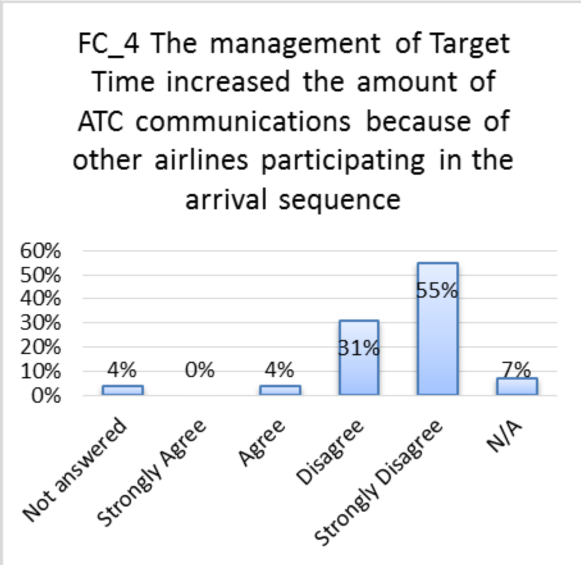
5.5.2.1.2.3.3 Impact on Flight Crews

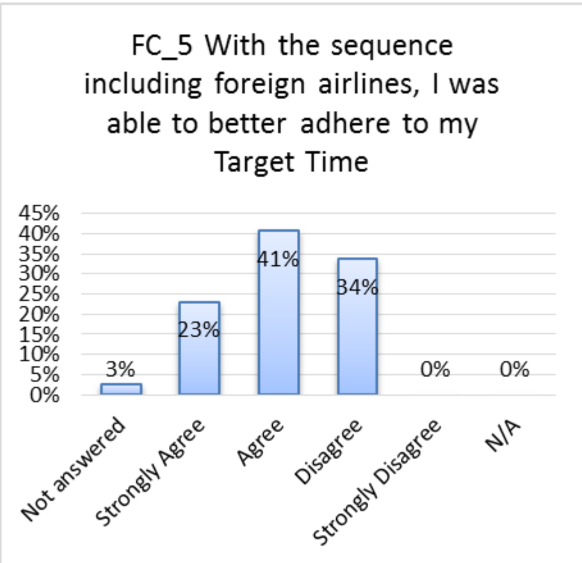
A total of 113 questionnaires filled from the flight crews participating in iStream were collected. The answered questions show a very good result from the perspective of the flight crews. Safety was never compromised during the iStream operation for 92%. As well as the workload did not increase for 83%. All single results are shown in the graphs below.

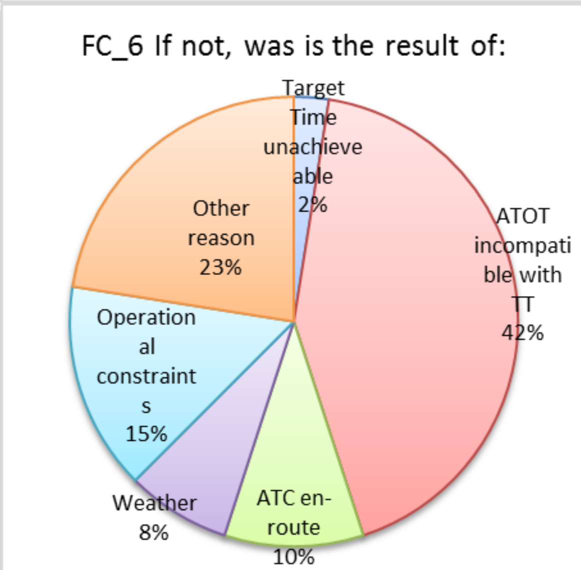

FC_1 Safety was compromised due to iStream operations
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1%
1%
1%
10%
82%
5%
Not answered
Strongly Agree
Agree
Disagree
Strongly Disagree
N/A


FC_2 The management of Target Time increases my workload when other airlines become part of the arrival sequence
60%
50%
40%
30%
20%
10%
0%
4%
0%
6%
33%
50%
6%
Not answered
Strongly Agree
Agree
Disagree
Strongly Disagree
N/A


FC_3 My overall performance/ other duties were affected by other airlines participating in the arrival sequence
70%
60%
50%
40%
30%
20%
10%
0%
4%
1%
4%
25%
58%
8%
Not answered
Strongly Agree
Agree
Disagree
Strongly Disagree
N/A


FC_4 The management of Target Time increased the amount of ATC communications because of other airlines participating in the arrival sequence
60%
50%
40%
30%
20%
10%
0%
4%
0%
4%
31%
55%
7%
Not answered
Strongly Agree
Agree
Disagree
Strongly Disagree
N/A


FC_5 With the sequence including foreign airlines, I was able to better adhere to my Target Time
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
3%
23%
41%
34%
0%
0%
Not answered
Strongly Agree
Agree
Disagree
Strongly Disagree
N/A


FC_6 If not, was is the result of:
Target Time unachieve able 2%
ATOT incompati ble with TT 42%
ATC en-route 10%
Weather 8%
Operation al constraint s 15%
Other reason 23%

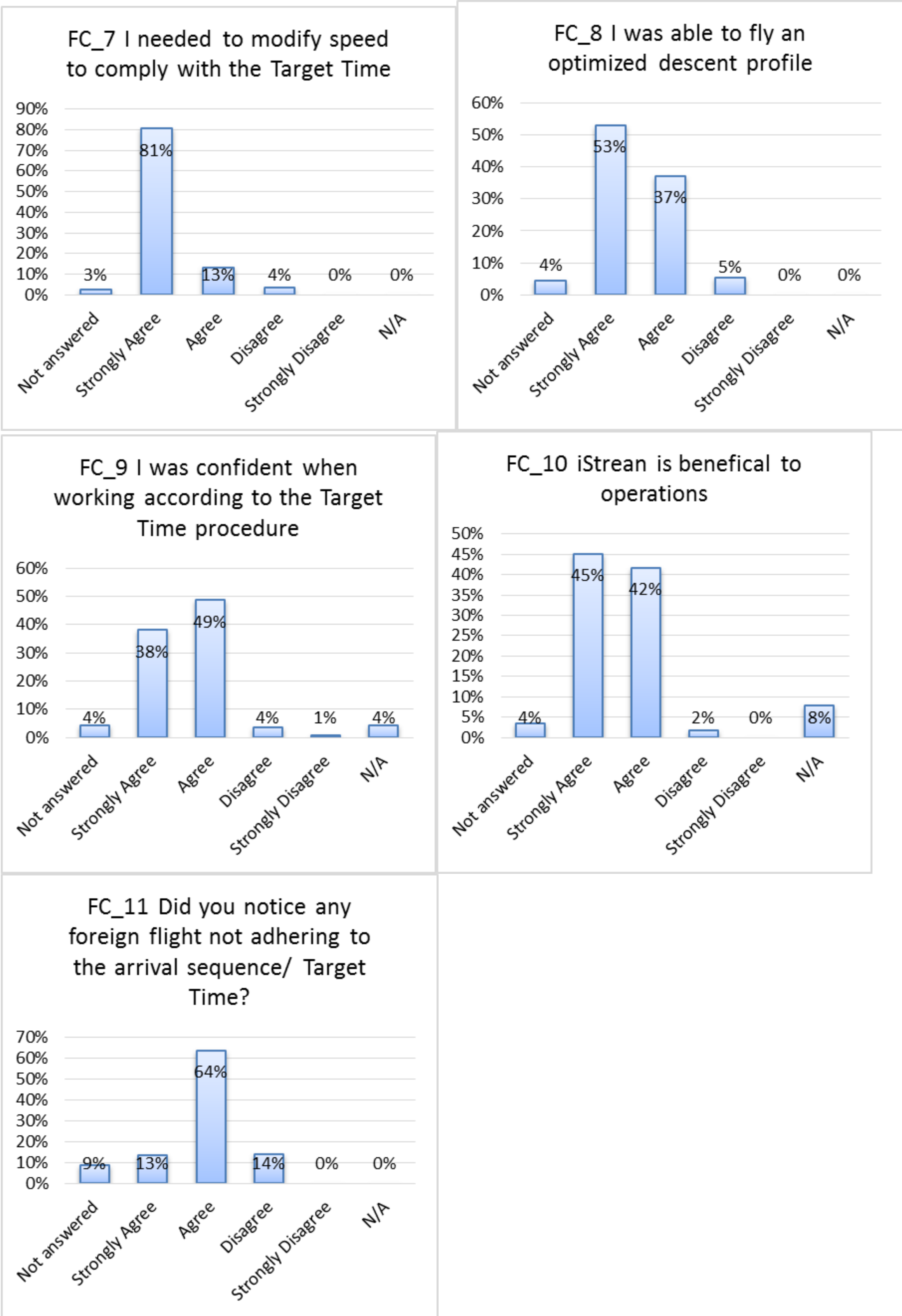


Fig. 57: LSZH Trials - Flight Crew Questionnaire Results

5.5.2.1.2.3.4 Impact on AOC

The Network Operation Center (SWISS AOC) was affected by the work of the TT management during their daily nightshifts. Several questionnaires were returned answering questions about safety, workload and benefits.

TTs for the trial flights were safely managed. Also the management between trial and standard flights were not disturbed in concerns of safety. Safety was never compromised due to iStream operations. The workload was slightly higher compared to routine operations. But the other duties were not affected. Still, the communication with flight crews compared to routine operations increased. Also the amount of coordination with ATC, in trial case skyguide FMP, compared to routine operations increased.

The iStream operational information before the trial was exhaustive. The Cost Index of most participating flights needed to be adapted towards the new swapped TT based also on the passenger connections (AFlex). The overall flight's costs are reduced as the speed adjustment result in fewer holdings and less vectoring and therefore saving fuel. Not only through speed adjustments, but also through ATC short-cuts the TTs can be achieved.

During the trial different time points of sending the TT information by skyguide to the AOCs were trialed. For the flight crew it is important to receive the TT information as early as possible in order to make their best in achieving the given TT.

Every day, savings are possible with a more efficient arrival flow and irregularly costs of missed connections are reduced. All returned questionnaires agreed that iStream is beneficial to the operations.

5.5.2.1.2.4 Issues encountered

- **Participation & motivation of non-Consortium airlines**

  As it was essential that **all** flights in the concerned timeframe were participating to ensure the benefits of the whole process, it required a noticeable amount of communication and coordination work to convince the Airspace Users of their involvement in the Trials and their knowledge of the process.

  It was necessary that all actors were aware that TT adherence is not only a tactical task, but is already prepared during whole flight and even at flight panning phase.

  In future developments, it has to be considered that KPI departure punctuality is part of labor agreements. Any delayed departure might have a direct impact on airline staff salaries. This shall be addressed and thoroughly discussed in future developments.

- **Communication/ data retrieval workload**

For this current operating method, the "chain of information" was rather complex, and enablers relied on numbers of actors and systems (ACARS, e-mails, CHMI, etc.).

The operators had to handle many different systems and tools to retrieve and distribute the information, which, further to an increase of workload, led to inconsistent data and manual errors.

- **NMOC long-haul flights' profiles**

  The NMOC estimated times over the IAF were retrieved when the operators did not receive the ETOs directly from the airlines. However, these estimated times were inaccurate and led to unachievable TTOs (please refer to the following chapter for the analysis). The reason for this is that NMOC can only provide more accurate data if the aircraft entered the IFPS Zone. As most aircraft are still outside the IFPS-Zone at the time of establishing the sequence, the data on the CHMI is not accurate enough for operational use.

- **Short-haul flights integration into sequence**

Short haul flights should be more efficiently integrated into the arrival sequence. The involvement of NM to better consider the IFPS flights within the long-haul inbound flow would be an added value.

Currently the long-hauls are able to manage TTs as far as the information is provided with sufficient time margins (4 hours in advance in our case, considering that TTs do not deviate more than 5 min of their ETOs).

However, the situation is different for the short/medium hauls within the ECAC area, which have less than 3 hours of flying-time and are therefore unable to gain or lose 5 minutes on such distances. Furthermore, the uncertainty of their Take Off Time – as these flights can also be subject to regulations; i.e. CTOT window of [-5;+10] minutes - affects the reliability of the ETO information extracted from the flight plan profiles.

A recommendation would be to link the arrival constraints to departure constraints (CDM, SWIM?) and ensure the departures within a restricted timeframe.

The proposal for the Cherry Picking procedure as described previously aimed to alleviate this limitation.

5.5.2.1.3 Results per KPA

Exercise	Object Identifier	Success Criterion	Result of the demonstration
EXE-01.02-D-06.3	SAFETY OBJ-0102-001	The usage of TTs does not have a negative impact on flight crew workload and OCC Staff and safety	Flight crews and OCC staff questionnaires results show that no critical impact on workload nor safety has been recorded.
EXE-01.02-D-06.3	SAFETY OBJ-0102-002	The usage of TTs does not have a negative impact on ATM operational staff (NM, ATCOs and/or FMP) workload and safety	FMP staff questionnaires results show that no impact on workload neither safety have been observed.
EXE-01.02-D-06.3	SAFETY OBJ-0102-110 (Verification Objective)	The calculated TTs ensure reduced vectoring and reduced number of holdings.	The Trials reduced the average flight time in TMA, reduced vectorings and number of holdings
EXE-01.02-D-06.3	Verification Objective OBJ-0102-120	The exchange of TTs information is efficient and done in a timely manner so that all partners are aware of TTs and able to act on it if necessary, to ensure that flights receive their TTs early enough to be reachable (so the flight crews are able to manage their flight accordingly without impacting negatively on cost index of flight).	The deadline to provide TTs had to be updated to better integrate middle-east flights. Therefore, other long-haul flights received the TTs very late and had fewer possibilities to adhere to their TT.
EXE-01.02-D-06.3	PREDICTABILITY OBJ-0102-310	The variance of the TT adherence is improved compared to baseline	Not applicable
EXE-01.02-D-06.3	Verification OBJ-0102-320	Same as OBJ-0102-120 for revised TT	Not applicable as no TT

			revision.
EXE-01.02-D-06.3	SAFETY OBJ-0102-810	The usage of TT and potential inherent speed changes should not induce safety concerns for ATC	Not applicable
EXE-01.02-D-06.3	PREDICTABILITY OBJ-0102-330	Same as OBJ-0102-310 for revised TT	Not applicable as no TT revision.
EXE-01.02-D-06.3	PREDICTABILITY OBJ-0102-340	The variance of the (revised) TT adherence is improved compared to baseline, and the estimated arrival sequence (flights' arrival order) is better adhered compare to baseline.	Not applicable as no TT revision.
EXE-01.02-D-06.3	PREDICTABILITY OBJ-0102-410	The variance of the TT adherence is improved compared to baseline without negative impacts on the flight's cost index.	Not applicable
EXE-01.02-D-06.3	PREDICTABILITY OBJ-0102-420	The usage of TT enhances the adherence of the estimated times (entry times into a sector / arrival times), compared to baseline scenario.	The Trials reduced the average flight time in TMA
EXE-01.02-D-06.3	FLIGHT EFFICIENCY OBJ-0102-430	The usage of TT; by enhancing flight profiles and/or reducing ATFCM delays and/or reduced vectorings and/or reduced number of holdings; reduces the fuel burn compared to OFP data and/or baseline data.	The Trials reduced number of holdings and vectorings. Furthermore trial flights were able to perform an optimized descent to LSZH.
EXE-01.02-D-06.3	CAPACITY OBJ-0102-440	The usage of TT does not reduce airport capacity neither sectors (TMA/En-route) capacities.	Not applicable as no capacity issue at LSZH during Trials timeframe considered
EXE-01.02-D-06.3	PREDICTABILITY OBJ-0102-540	The usage of TT does not impact negatively the CTOT adherence	Not applicable as no regulation during Trials timeframe considered
EXE-01.02-D-06.3	CAPACITY, EFFICIENCY OBJ-0102-611	The new information processing (TT, AMAN with extended time horizon…) enhance the hotspot and demand/capacity imbalance detection and resolution efficiency, compared to baseline scenarios.	Not applicable as no capacity issue at LSZH during Trials timeframe considered
EXE-01.02-D-06.3	FLEXIBILITY OBJ-0102-710	Airlines are able to provide their TT	TT swaps requested by AUs were taken into

		modification requests and ATC is able to take Users Preferences into account and accommodate them.	account for the arrival sequence computation

5.5.2.2 Summary of Assumptions

Identifier	Title		Description		Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
ASS-0201-101	Participation of pilots and OCCs/Dispatch from project member airlines		Participation of AUs may be encouraged by official documentation (e.g. NOTAMs).		All	NA			Airlines, ANSP	Impact on all objectives.
ASS-0201-002	No technical evolution		The iStream scenarios shall be designed and implemented with the existing technical systems capabilities (including prototypes) existing at the time the trials will be conducted.		All	NA			All	Impact on OBJ-0102-110 and on OBJ-0102-710.
ASS-0201-102	Availability of NMOC support tools to communicate TT information				All	NA			ECTL	No involvement of NMOC
ASS-0202-601	Support tool to communicate arrival sequence		At LFPG, a tool (web based) shall be at disposal of OCC to allow TT swapping between flights.		Pre-departure	Flexibility			TBD	Impact on OBJ-0102-710.
ASS-0201-	Specific procedur		For TWR and ATC En-route units, the		All	NA			ANSPs	Impact on OBJ-0102-

602	es for FMP, based on the existing "GREENER WAVE" one		flight trials will not require specific procedures application. Specific procedure will be designed for FMP.							110 and on OBJ-0102-710.
ASS-0201-005	No change in standard operating procedures for flight crews		No revision of operating manuals (like OM-A and –B) is necessary. Special crew task will be briefed separately. No release of NSA necessary.		All	NA			Airlines	Impact on OBJ-0102-110 and on OBJ-0102-710.
ASS-0201-603	More predictability implies more capacity		When the traffic predictability is improved, the margins taken by ATC services to control the sectors workload will be reduced and the real ATC sectors capacity increased.		Arrival	Capacity			ANSPs	Impact on OBJ-0102-120.

Fig. 58: Demonstration Assumptions

5.5.2.3 Analysis of Exercises Results

5.5.2.4 Confidence in Results of Demonstration Exercises

5.5.2.4.1 Quality of Demonstration Exercises Results

5.5.2.4.2 Significance of Demonstration Exercise Results

The results are relevant from a statistical point of view considering the large number of flights for the Trials (more than 4'800 flights). The Trials were conducted almost one year long, involving all the flights in the timeframe 06:00-07:00 LT. The iStream procedure was assessed on a complete flow of traffic involving all the Airspace Users.

The results are also relevant from an operational point of view as the trials took place in normal operations, with the existing technical systems capabilities, without any new or added specific procedures for ATC.
The trials had a major impact on the arrival flow. Flight crews are now also aware of other flights' TTs if the full list is sent to them, this helps creating a bigger situational awareness on arrival.

5.5.3 Conclusions and recommendations

5.5.3.1 Conclusions

The benefits of the iStream procedure support the will of skyguide and Zurich Airport to perform sustainable and as much as possible greener traffic management. As in addition, the iStream procedure enables an optimized service to our Aispace Users (offering them the opportunity to prioritize specific flights and enhance passengers' connections), skyguide decided to put into operations this target time concept for the early arrival wave at Zurich; i.e. between 06:00 – 07:00 LT.

The implementation is made possible thanks to the introduction of a new collaborative automated tool, developed by skyguide, which aim is to gather all necessary data (via B2B connection with the Network Management and via e-mail for the Airspace Users data), to compute the arrival sequence and to distribute it to the involved Airspace Users.

The implementation followed the Trials without interruption and will be official as on the 13th of October 2016, date of publication of the AIP.

These Trials allowed to optimize step by step a target time concept to reach an operationally sustainable and profitable procedure to all aviation stakeholders in the Zurich environment.

5.5.3.2 Recommendations

In order to enhance benefits for the arrival flow through the Target Time concept, the main recommendations coming out the LSZH trials are:

- NMOC to optimize flights profiles' updates in order to have accurate flight time profiles, especially for long-hauls.
- To be able to integrate the TT information into the AMAN, and to distribute these TT information or speed / time constraints at other point to the adjacent centres, so the ATC can manage the flights with full knowledge of their time targets.
- TTs known to en-route ATC and departure airport / ATC would be in favour.
- Arrival sequence / TT to be communicated to NMOC and taken into account in the flights' profiles. The TTs of the short and medium haul flights shall be integrated into the TT/CTOT distribution process by NMOC.
- Performant data exchange between Airspace Users, ATC and NMOC is desirable (SWIM?).

The main recommendation for more convenient operations and being able to enhance and extend the procedure, would be to benefit from a **single and relevant source of information**, available to all actors – FMP, AOCs and NM.

This single source of information should ideally be the NM System, as further evolutions of the iStream Solution will make use of the available NM Web Services.

This would help for easier retrieval and publication of TT information, as well as for transparency of information (mainly the arrival sequence there). Improved visibility of the arrival sequence to all the actors would lead to better situation awareness: ATC with improved predictability for both LSZH and adjacent centers, and AOCs/Flight Crews would be able to plan and execute their flights accordingly.

This improved visibility would lead to improved flight plan adherence and therefore to smoother arrival flows.

Also on the Airspace Users' side, the possibility for the AOCs to benefit from a tool (or an easier process) to transmit the TTOs to their flight crews would be of relevance.

In a nutshell, a single source of accurate data and a supporting tool to transmit TT information to airborne flights crews will reduce significantly the workload of the concerned actors.

6 Summary of the Communication Activities

The table below summarizes all the communications performed within the iStream project.

Media	Lead	Target audience	Status	Topic	Ref
Press	DSNA/SWISS	ATM community	June 03, 2015	"iStream: optimising the arrival management at congested airports" date June 03, 2015	[R-17]
Press	ECTL	ATM community	September 2015	EUROCONTROL communication on TT-STAM" dated September 2015	[R-18]
Press	SKYGUIDE	ATM community	August 2015	SKYGUIDE communication on AFLEX in Zurich (Refer to the 3 articles on the extranet)" dated August 2015,	[R-19]
Letter	EUROCONTROL	Head of ACCs	March 23, 2016	NM letter to Head of ACCs dated March 23, 2016,	[R-20]
Press	DSNA/SWISS	ATM community	April 04, 2016	Second iStream Press release (PR) dated April 04, 2016.	[R-21]
Article	DSNA/SWISS	ATM community	April 06, 2016	"iStream: SESAR funded Flow Management project shows promising trial results" at http://www.atc-network.com/atc-news/dsna/istream-sesar-funded-flow-management-project-shows-promising-trial-results dated April 06, 2016	[R-22]
Media	DSNA	ATM community	May 24, 2016	iStream poster for SESAR Closure Event dated May 24, 2016	[R-23]
Event	DSNA/SWISS	ATM community	June 14, 2016	iStream presentation at the SESAR1 closure event (Amsterdam) on June 14, 2016	[R-24]
Press	DSNA	ATM community	October 03, 2016	Article proposed to ATM magazine by DSNA on June 27, 2016:	[R-25]
Video	DSNA	ATM community	October 03, 2016	iStream and VP749 Visitor Day at CDG airport on October 03, 2016	[R-26]
Video	DSNA	ATM community	October 03,	iStream video concerning Target Time and predictability of	[R-27]

Media	Lead	Target audience	Status	Topic	Ref
			2016	flights/Live trials on Paris CDG-Arrivals (WP04/WP05/WP08-CDG)	
Video	SWISS	ATM community	September 30, 2016	iStream video concerning "AFLEX" trials at Zurich Airport (WP08-ZH)	[R-28]
Article	SWISS	Customers (Passengers)	October 2016	iStream article concerning AFLEX in Zurich in the on board SWISS Magazine dated October 2016	[R-29]
Press	SWISS	ATM community	September 30, 2016	SWISS communication on AFLEX in Zurich and publication of video dated September 30, 2016	[R-30]
Video	DSNA	ATM community	October 03, 2016	iStream video concerning Demand and Capacity Balancing and Rerouting//Live trials on Paris CDG-Arrivals (WP07) to improve punctuality during peak hours dated October 03, 2016	[R-31]
Letter	DSNA	Large audience	October 03, 2016	Article proposed to the "Magazine Aviation Civile" by DGAC	[R-32]
e-Prez	Air France	Pilots / Management	March 2016	Presentation of iStream and expected benefits	PT16_F01 iStream
e-letter	Air France	Pilots	March 2016	General presentation of Target Time information	e-letter of March
Presentation	Air France	IATA/AEA	April 2016	General presentation of iStream and expected benefits	PT16_F02 iStream_IATA
e-letter	Air France	OCC	July 2016	Presentation of iStream and AFLEX	I-Stream - Arrivée CDG P2 - Scenario 2

Media	Lead	Target audience	Status	Topic	Ref
e-Prez	Air France	Pilots / Management	October 2016	General presentation of iStream and actual benefits	iStream AFR internal prez_TT Management
Presentation	HOP!	Pilots	April 2016	Presentation of iStream and expected benefits	Tutorial istream
Presentation	HOP!	Pilots / Management	June 2016	general presentation of iStream and expected benefits	Memo operation Istream juin 2016

7 Next Steps

7.1 Conclusions

The FAIR STREAM project proved the feasibility of the use of Target Time for a few flights, and the improvement in the predictability of flights.

The iStream project aimed at demonstrating the feasibility and operational benefits of Target Time on complete flows.

The exercises performed in iStream have shown the benefits of Target Time on complete arrival flows to Zurich and Paris-CDG airports during peak and off-peak hours in the current environment:

- **Target Times have been safely trialled on complete arrivals flows** inbound Paris-CDG and Zurich. Over 1,400 flights inbound Paris-CDG (60% of the morning arrival peak, from May 2nd to September 16th 2016) and 4,600 flights inbound Zurich airport (94% of the early morning arrival peak, from June 15th 2015 to June 30th 2016) participated in the Target Time evaluation, without reported safety incidents to all actors (ATC, airlines, NM).
- **Target Time adherence of participating flights has been improved,** taking into account learning effect from dispatch, FMPs and flight crews. Target Time adherence was achieved with almost 70% of trial flights to Zurich in a window of [-4;+4] around their Target Time. The reduced flight time in TMA and the reduction of flights arriving too early (before the opening of Zurich airport) led to and optimized flight arrival management in the TMA. Target Time adherence for trial flights inbound Paris-CDG was also improved.
- **Flight efficiency has been improved during iStream trials.** Holdings have been drastically reduced for Zurich arrivals (SWISS was able to measure a reduction of 96%), along with radar vectoring, with positive impact on fuel. Delay in the terminal sectors (additional time in ASMA – Arrival Sequencing and Metering Area) for Paris-CDG arrivals have been reduced by 30 seconds per flight.
- **The Target Time information allowed to better manage the flight before departure.** In LFPG exercise, the pilot could calculate a Target Take-Off Time optimising the flight profile, reducing the fuel burn and improving departure punctuality. Depending on the situation, aircrews could leave the gate earlier, which improved departure punctuality and fuel efficiency.
- **The Target Time enabled to take Airspace Users' preferences into account.** The procedures developed in iStream allowed taking into account the Airspace Users' preferences and providing arrival flexibility (AFLEX) to flights.
  - Prioritized flights could have their delay reduced by 5 to 15 minutes in Paris trial, on the 5 occurrences. Flights can also be advanced in order to solve an ATFCM hotspot.
  - With the swaps within SWISS ranking, passenger connections are ensured and help to improve passenger convenience with more time to walk to their connecting flight. This of course improves the punctuality of the first outbound flights with passenger connections as well. Therefore, a reduction of rotation delays (IR91) is also a qualitative result.
- Although there is less variability during the trials, **the adherence to Target Time is influenced by the Take-Off Time.** The Take-Off Time is influenced by departure clearance and taxi time, which are not fully manageable by the flight crew.

Furthermore, iStream demonstrated the added value of local and collaborative tools and processes to solve hotspots:

- The **local Target Time assignment allows further improving the available capacity, thanks to more accurate data**. With a new local ATFM tool, delays of regulated flights were reduced by around 20% on Paris-CDG arrivals.
- **The collaborative processes developed in iStream provided efficiency benefits for all stakeholders.** The rerouting scenarios implemented at Paris-ACC, in collaboration with Maastricht UAC, allowed to drastically reduce ATFM delay in for Paris-CDG arrivals, while providing benefits for MUAC (moving away some flights from the busy MUAC Luxembourg sector compared to baseline scenarios)

7.2 Recommendations

The inclusion of the Target Time calculated by the Network Manager in the slot messages has proved its usefulness for airspace users and is ready for deployment.

Target Time calculated by a local tool brings additional benefits (better optimisation, flexibility for airspace users). It is recommended, for the development of local CDM procedures and tools related to Target Time that:

- NM should be involved in the output of the local CDM processes, in order to assess network impact and share information at network level. An automatic exchange between local calculation of Target Time and Network Manager is an additional value to ease the dissemination of Target Time.
- The information of arrival Target Time sequence should be provided to relevant stakeholders

It is recommended to pursue work toward the maturity increase for the Adherence Feature of Target Time Management:

- The exercises have shown that the Target Time adherence is influenced by the departure clearance and the taxi time, which are not fully manageable by the flight crew. Additional work should be devoted to better integrate the Target Time with ATC departure procedures.

The Target Time concept opens the possibility to achieve seamless integration of ATFCM and ATC (e.g. integration with XMAN concept): this needs to be investigated.

Concerning live trials organization, it is recommended that:

- The process of trial is kept as simple and pragmatic as possible. It is preferable to extend the Demonstration period with a stepwise approach rather than launching complex preliminary studies leading to blocking points.
- The live trials are implemented in a step by step approach. This allows a better buy-in and involvement of stakeholders. It also allows focusing on real issues and risks. It is thus a more efficient way to set up a concept.

8 References

8.1 Applicable Documents

[A-1] EUROCONTROL ATM Lexicon (https://extranet.eurocontrol.int/http://atmlexicon.eurocontrol.int/en/index.php/SESAR)

[A-2] Technical Proposal in response to call ref. SJU/LC/0102-CFP (Integrated SESAR TRials for Enhanced Arrival Management (iStream) step 1) referenced Stream_Tech_V1.0

[A-3] Consortium Agreement relating to iStream Project

[A-4] SESAR LSD communication Guidelines

[A-5] iStream Demonstration Plan issue 3.0 dated June 2016

8.2 Reference Documents

The following documents provide input/guidance/further information/other:

[R-1] ATM Master Plan (https://www.atmmasterplan.eu)

[R-2] SESAR Performance Framework (D41)

[R-3] SJU Communication Guidelines

[R-4] B04.02 SESAR Concept of Operations (D66) v02.00.00

[R-5] B 05-D85-Guidance on KPIs and Data Collection Version 01.01

[R-6] 04.02 Step 1 DOD (D98)

[R-7] 05.02 Step1 DOD (D84)

[R-8] 06.02 Step 1 DOD (D122)

[R-9] 07.02 Step 1 Release 4 DOD (D28)

[R-10] OFA05.01.01 OSED (D16)

[R-11] A Greener Wave final report V2.0 - SJU/LC/0129

[R-12] 13.02.03 VP749 Validation Plan (D342)

[R-13] 13.02.03 Step 1 OSED (D302)

9 Additional data and references per Work Package

9.1 WP01 CONOPS

[R-14] CONOPS version 1.2 dated April 07, 2016

9.2 WP02 systems

9.3 WP03 Performance

[R-1] iStream Performance Assessment Document version 1.1 dated April 12, 2016

9.4 WP04/05 Target Time management for Paris arrivals

[R-2] Note 16NI064 dated April 14, 2016 for iStream trials and sent to ATCO and CDS

[R-3] WP04/WP05 Exercise schedule (refer to figure below)

2016 Week	18							19							20							21							22						
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Scenario 1	X		X	X						X	X	X	X				X		X			X	X	X		X	X	X	X		X		X	X	X
Scenario 2																																			

2016 Weeks	23							24							25							26							27						
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Scenario 1	X		X		X	X					X					X	X			X				X				X	X		X				
Scenario 2																																			

2016 Weeks	28							29							30							31							32						
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Scenario 1	X			X	X	X			X									X							X	X	X			X		X	X		X
Scenario 2		X	X					X								X												X	X						

2016 Week	33							34							35							36							37						
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
Scenario 1	X																																		
Scenario 2		X										X				X													X				X		

[R-4] SESAR iStream Project - iStream Trial Safety Plan Ed. 00.01.01, 09/03/2016

[R-5] SESAR iStream Project – iStream LSD Overall Safety Case Ed. 00.01.05, 16/06/2016

[R-6] NM, Operational Instruction, iStream Live Trial EXE01 - Paris Arrivals Phase 1A, OI/16-057

[R-7] NM, Letter to Heads of ACCs via ODSG (Target Time information in the ATFM Slot messages and support to iStream exercises), initial letter sent 23rd March 2016, clarification e-mail sent 25th April 2016

[R-8] SESAR iStream, TTO-Management practices in iStream, Powerpoint package to be sent to participating airlines, V2 circulated 8th April 2016

[R-9] NM, Operational Instruction, iStream Live Trial EXE01 - Paris Arrivals Phase 1B, OI/16-090

[R-10] DSNA, LFFF, Experimenter Instructions booklet (Livret expérimentateur Expérimentations iStream : scénario 2), PDF, June 2016

[R-11] DSNA, LFPG, ATCO briefing, iStream, PDF, May 2016

[R-12] MUAC, iSTREAM operational trial for LFPG morning peak – ATCO briefing, 21st April 2016

[R-13] iStream Airlines communications to Pilots - Air France presentation entitled “iStream: CTOT & Target Time - Communication Pilotes” 31st March 2016, Air France Report “A320_FAIRSTREAM / iStream, Sécurité des Vols” v1.0, 30/03/2016, Air France Document “Direction du développement technique, iStream” /Avril 2016 and Swiss Briefing Note “iStream STAM Trials Briefing Sheet”, 14th April 2016

9.5 WP06 Target Time-based STAM

9.6 WP07 Dynamic Demand and Capacity Balancing

[R-14] AIM

[R-15] OI

[R-16] Operational Instruction n°11/C/15, dDCB evaluation

9.7 WP08 Target Time management for Zurich arrivals

9.8 WP09 Communication

9.8.1 Communication summary

[R-17] “iStream: optimising the arrival management at congested airports” date June 03, 2015

[R-18] EUROCONTROL communication on TT-STAM” dated September 2015

[R-19] SKYGUIDE communication on AFLEX in Zurich (Refer to the 3 articles on the extranet)” dated August 2015,

[R-20] NM letter to Head of ACCs dated March 23, 2016,

[R-21] Second iStream Press release (PR) dated April 04, 2016.

[R-22] “iStream: SESAR funded Flow Management project shows promising trial results” at http://www.atc-network.com/atc-news/dsna/istream-sesar-funded-flow-management-project-shows-promising-trial-results dated April 06, 2016

[R-23] iStream poster for SESAR Closure Event dated May 24, 2016

[R-24] iStream presentation at the SESAR1 closure event (Amsterdam) on June 14, 2016

[R-25] Article proposed to ATM magazine by DSNA on June 27, 2016:

[R-26] iStream and VP749 Visitor Day at CDG airport on October 03, 2016

[R-27] iStream video concerning Target Time and predictability of flights/Live trials on Paris CDG-Arrivals (WP04/WP05/WP08-CDG) to improve punctuality during peak hours (Presented at iStream/VP749 visitor day on October 03, 2016)

https://www.youtube.com/watch?v=YujFLmkRSak

[R-28] iStream video concerning "AFLEX" trials at Zurich Airport (WP08-ZH) presented at iStream/VP749 visitor day on October 03, 2016

https://www.youtube.com/watch?v=HLOZkxvkupY

[R-29] iStream article concerning AFLEX in Zurich in the on board SWISS Magazine dated October 2016

[R-30] SWISS communication on AFLEX in Zurich and publication of video dated September 30, 2016

[R-31] iStream video concerning Demand and Capacity Balancing and Rerouting//Live trials on Paris CDG-Arrivals (WP07) to improve punctuality during peak hours dated October 03, 2016

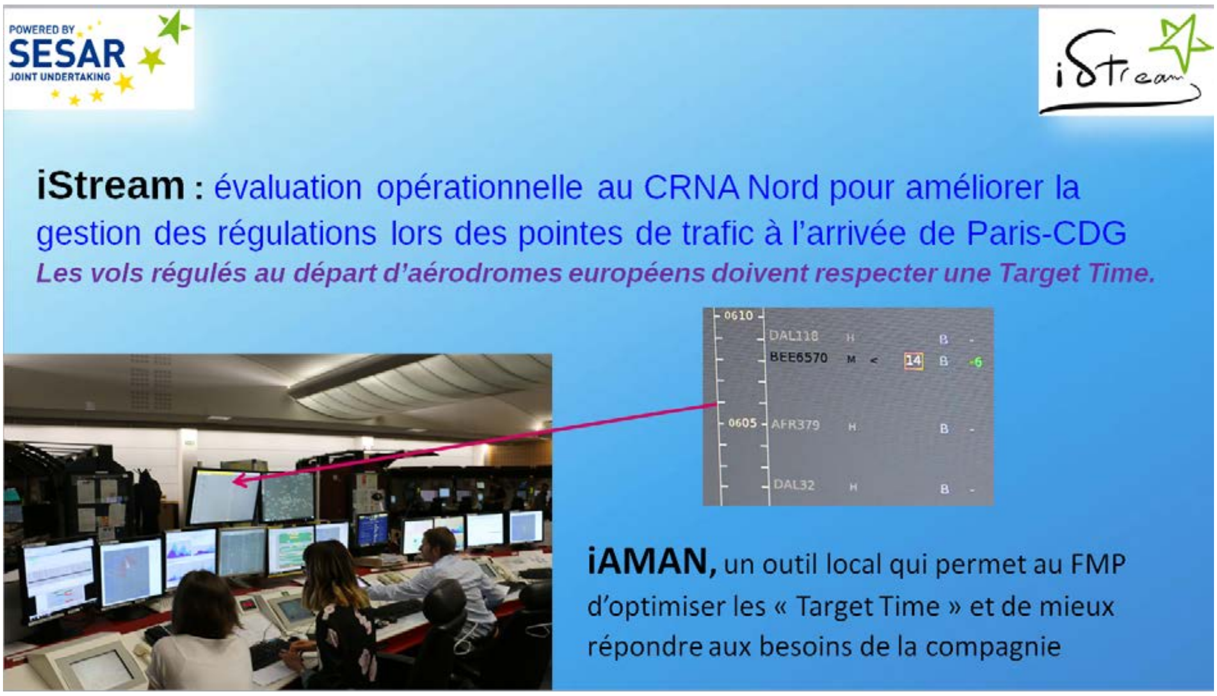
[R-32] Article proposed to the "Magazine Aviation Civile" by DGAC

[R-33] iStream video concerning Demand and Capacity Balancing and Rerouting//Live trials on Paris CDG-Arrivals (WP07) to improve punctuality during peak hours dated October 03, 2016

9.8.2 Supplement: Communication material

DSNA « journal vidéo » / October 2016

DSNA « journal vidéo » / September 2016



DSNA « journal vidéo » / July 2016


SESAR 1 [2008, 2016] :
clôture du programme
SESAR SOLUTIONS CATALOGUE
First Edition
Plusieurs solutions SESAR ont été identifiées par la SESAR Deployment Alliance pour être déployées dans le cadre du Pilot Common Project (PCP)
FIGURE 2 — SESAR 1 performance results
+33% airspace capacity in TMA
-2.3% fuel consumption and emission per flight
-4% air navigation service costs
+34% airspace capacity en-route
-30% flight time variance*
+11% airport capacity
safety
No increase in accidents despite increase in traffic


Les 4 sujets présentés par la DSNA
Improving Airport Traffic Management and Enhancing Airport Safety for Pilots, Vehicle Drivers and Controllers
9 SESAR Solutions
Point Merge in Paris Area
A new, more efficient arrival procedure at high altitude in high density airspace
Testing civil RPAS insertion on a regional airport
Enhancing the arrival management through the use of target times

iStream poster for the SESAR Closure event / June 2016

Enhancing the arrival management through the use of target times

POWERED BY SESAR JOINT UNDERTAKING

Paris-CDG Airport

Target times

- Since May 2016
- Improving the efficiency of ATFCM measures and providing more arrival flexibility to airlines (AFLEX)
- iAMAN: local ATFCM tool to optimise target times

EXPECTED BENEFITS

- Airport capacity
- Airspace capacity in TMA
- Environment
- Cost-efficiency

Dynamic demand and capacity balancing (dDCB)

- April to June 2015
- Improving the North/South balancing on morning arrival peak with ATFCM rerouting scenarios and airborne reroutings

BENEFITS

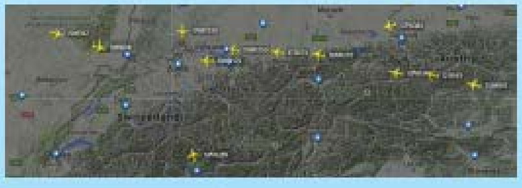
- Airport capacity
- Airspace capacity in TMA

Traffic: + 5%
ATFCM delays: - 36%

Zurich Airport

Target times

- Trials since 15th June 2015: on way to implementation
- More than 2,000 flights involved: Belair Airlines, Cathay Pacific, Edelweiss Air, Etihad Airways, Germania, Qatar Airways, SWISS, Thai Airways
- Optimising inbound traffic flows between 06 and 07 LT and providing more arrival flexibility to airlines (AFLEX)



BENEFITS

- Airport capacity
- Environment
- Cost-efficiency

Important fuel and time savings (15 minutes to 11 minutes in average in TMA: less vectoring, drastically reduced holdings, reduction of cost index)

Maastricht and Reims UACs

Target time-based short term ATFCM measures

- Since April 2016
- Improving the efficiency of mandatory cherry picking procedure with target times

EXPECTED BENEFITS Airport capacity | Airspace capacity en-route

DSNA | EUROCONTROL | skyguide | GROUPE ADP | ZURICH AIRPORT
AIRFRANCE | HOP! | Lufthansa | SWISS

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