Appendix K Demonstration Exercise EXE-VLD-07-003 (Improved Arrival Planning Management and Airspace User Preferences) Report

This appendix is a report concerning the execution of the Demonstration Exercise EXE-VLD-07-003.

This exercise had been implemented with five different configurations and each configuration executed one or more times as depicted in the figure below:

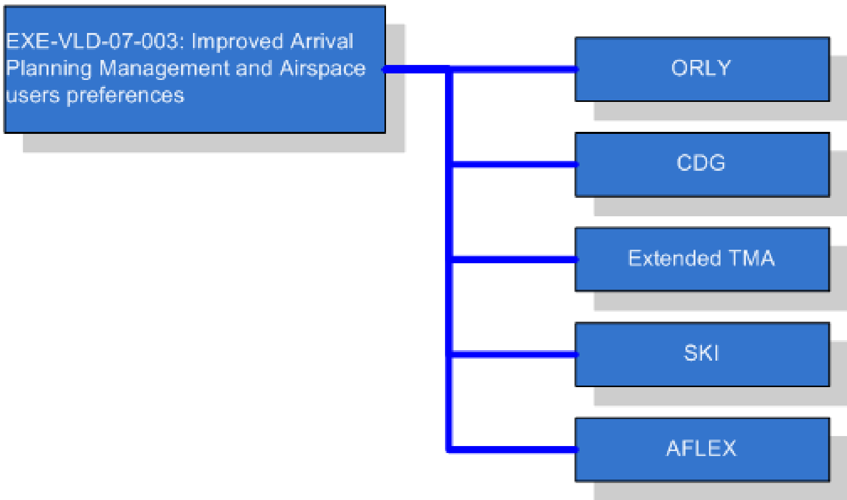


Figure 1: Summary of all implementations of Improved Arrival Planning Management and Airspace User Preferences scenario

K.1 Summary of the Demonstration Exercise EXE-VLD-07-003 Plan

K.1.1 Exercise Description and Scope

The « Improved Arrival Planning Management and Airspace User Preferences » trial consists of giving pre-departure “Target Time of Arrival” to optimize Paris-Orly, Paris-CDG and Lyon arrivals and exploring how to take Airspace Users (AU) preferences into account.

This exercise is complementary with EXE-VLD-07-001 and EXE-VLD-07-002 as shown in the figure below. It aims at demonstrating how TTA and AUs preferences can be combined with extended arrival management, for increased cost efficiency and flexibility in the management of an arrival peak.

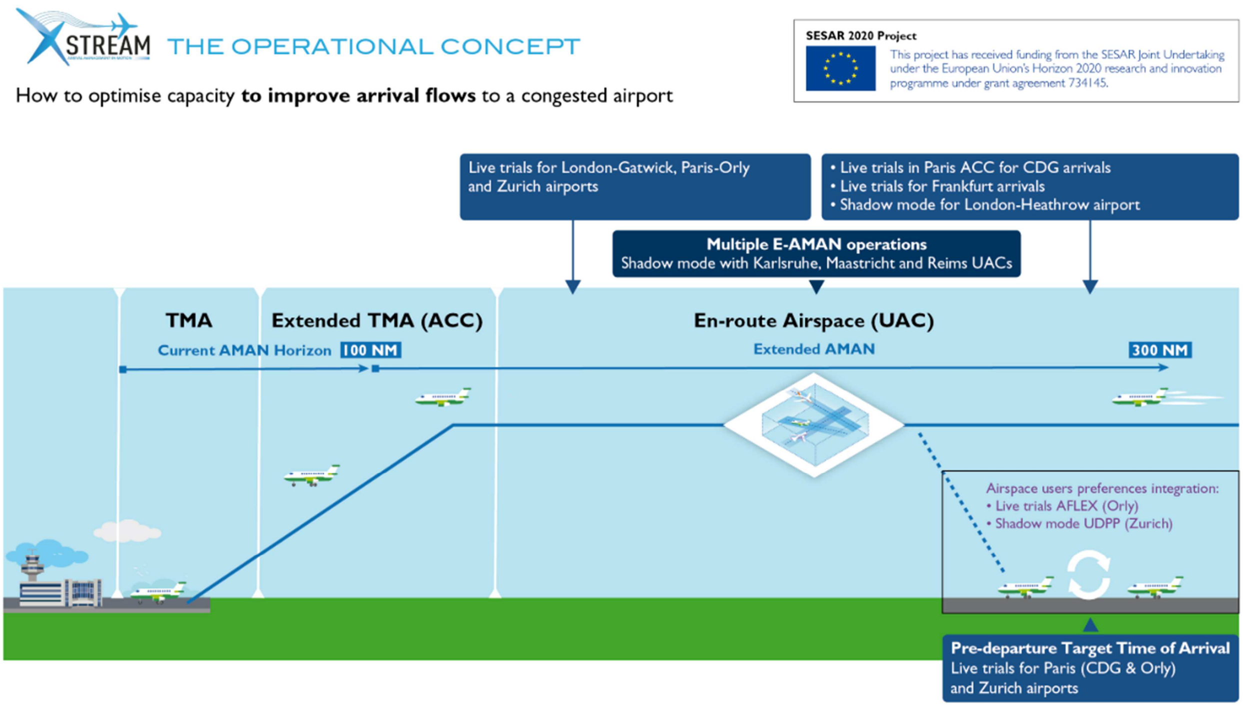


Figure 2: Overview of Paris area arrival management concept and links between WP7 trials

Therefore, the objectives were to:

- Reduce ATFCM constraints, by better targeting flights;
- Optimise the available capacity at the runway or in the Extended TMA;
- Provide flexibility to airspace users.

The process consists of the following steps, with a time horizon of one to three hours before the arrival peak:

- 2-3 hours before an arrival hotspot, when most the flights are still on the ground, Paris FMP operator analyses the incoming arrival sequence on iAMAN, which shows the planned arrival sequence on the concerned runway on E-TMA entry (Metering Fixes)
- He decides whether to implement an ATFCM or Mandatory Cherry Picking (MCP) regulation.
- Once the regulation is activated by NM, Paris FMP can move a flight in the arrival sequence to optimise the arrival flow in ATC sector or at the runway, by manually selecting a new Target Time of Arrival and sending it to NM, if Paris ATFCM regulations are the most penalizing ones. The objective is to optimise the ATFCM regulation strategy taking into account local constraints and available capacity.
- The newly generated TTAs sent electronically by Paris FMP to NM generate the corresponding CTOT and send a SRM (or a SAM in case of a MCP regulation) to the AU.

- In case the requested TTA is not compatible with network parameters (i.e. A-DPI already sent, flight already taxiing, slot list full…) the TTA is rejected, and Paris FMP is automatically notified via iAMAN.

The sending of Target Times of Arrival is done via iAMAN tool using NM B2B services using the “TargetTakeOff” API service. According to NM, the requested TTA can be sent:

- Only to flights arriving to CDM airports;
- inside the “Slot Zone”, fixed by NM as an interval of [-5;+10] around the CTO, then the TTA is automatically implemented (for sending revised TTA);
- outside the “Slot Zone”, then NM is assessing the situation and a slot in the regulation slot list needs to be available to implement the requested TTA (for sending revised TTA).

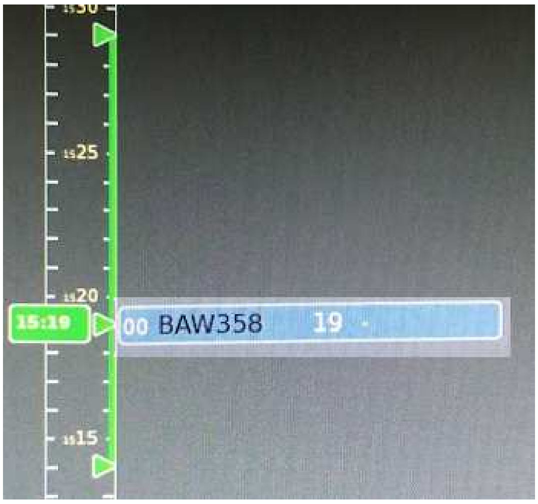


Figure 3: Example of a “Slot Zone” displayed on iAMAN in green (here around BAW358 that has 19 mins of ATFCM delays)

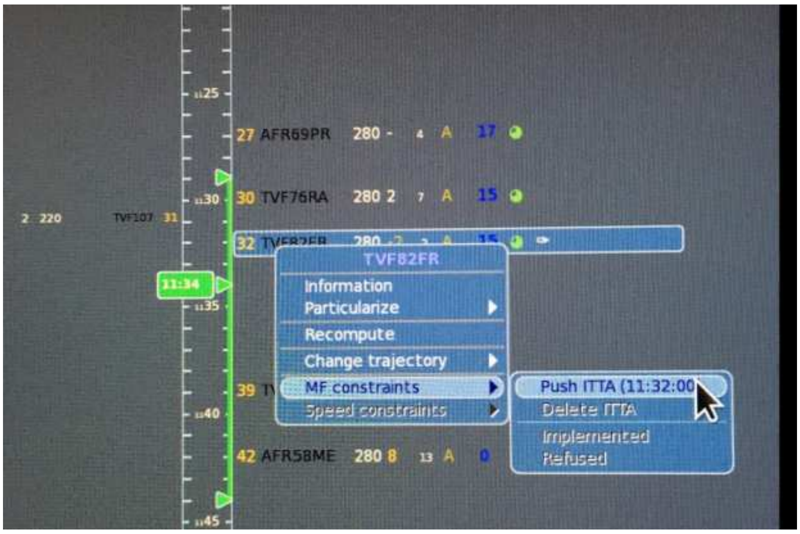


Figure 4: Example of iAMAN menu to send a Target Time to NM (here for TVF82FR)

The process is described in the diagram below:

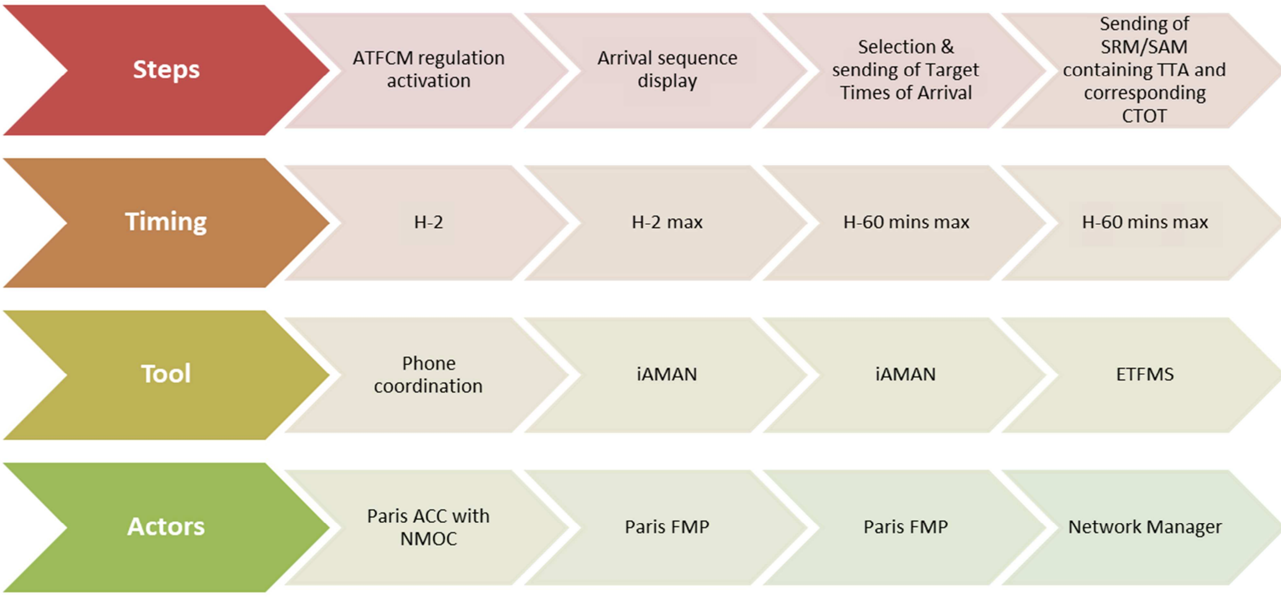


Figure 5: EXE-VLD-07-003 Improved Arrival Planning process

In addition, when AU preferences scenario called “AFLEX” is activated, AU can send to Paris FMP the following requests:

- Reduce to the minimum the impact of a flight,
- Exchange the priority between 2 regulated flights.

Depending on the current ATFCM situation, Paris FMP decides if these requests can be granted.

To achieve the above objectives, the exercise has been supported by:

- A prototype of Extended AMAN tool (called iAMAN). Based on computations on NM's B2B data, the tool is presenting to Paris FMP the planned arrival sequence in appropriate sector or runway. FMP operator can then send automatically TTO requests to NM (using NM B2B "Arrival Planning Information Service"),

Depending on the scenario and configuration, iAMAN tool shows the planned arrival sequence

- At the entry of the Extended TMA (ETO at the Metering Fix)
- At the runway

- A collaborative portal with AUs (dsna.fr), to share arrival priorities and sequence,

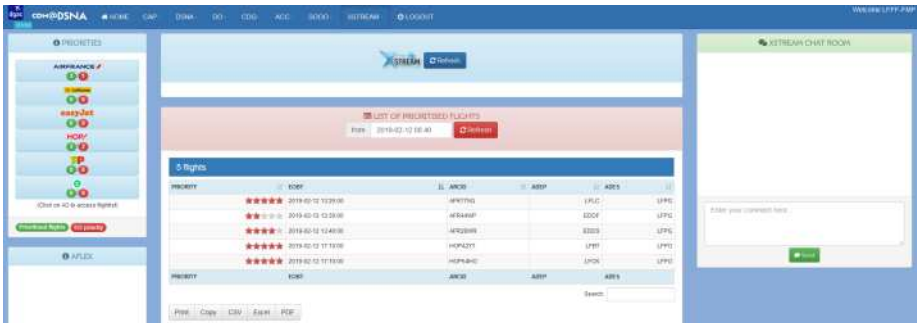


Figure 6: DSNA.fr portal showing flight priorities received from AUs

- AU prototype decision support systems to help in choosing how different flights should be treated in the AU preference mechanisms.

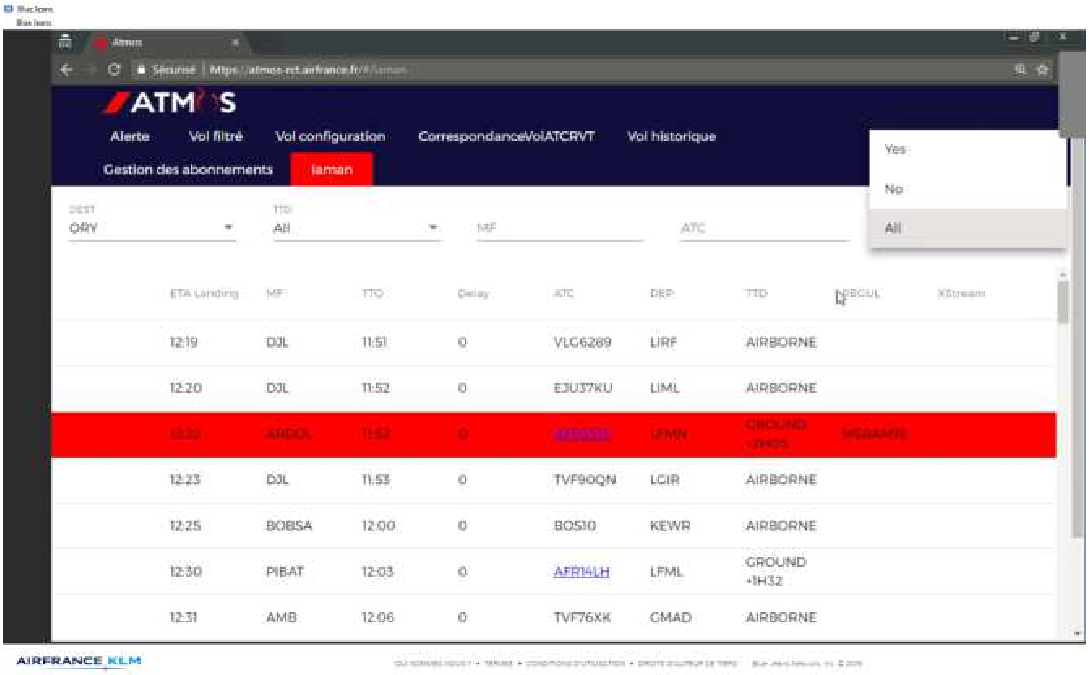


Figure 7: Air France decision support tool

The technical architecture and interfaces is summarized below:

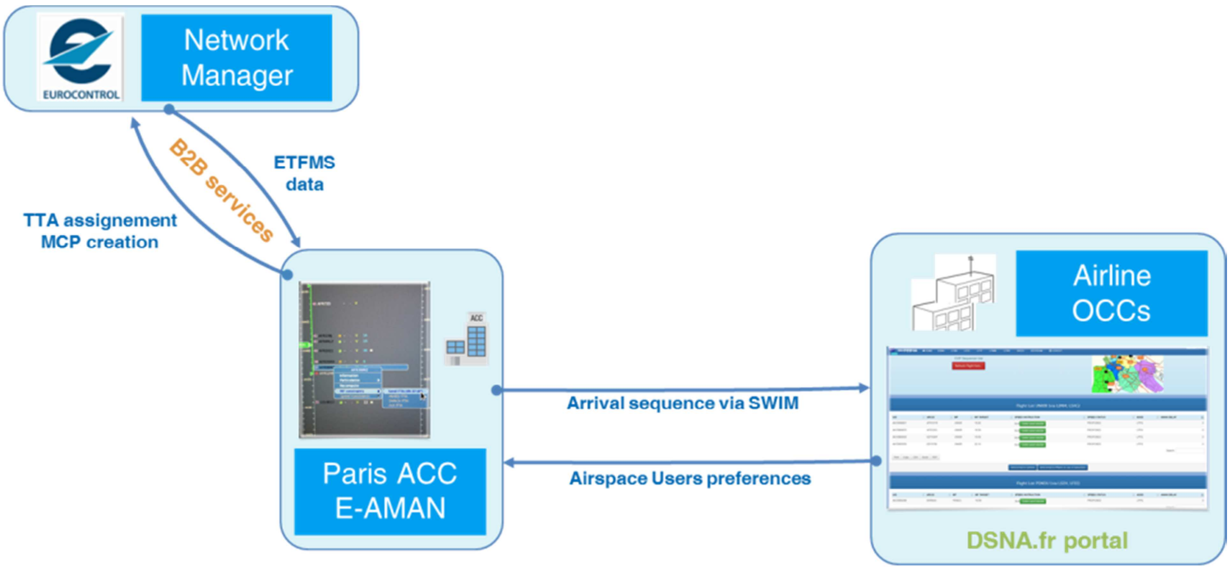


Figure 8: Technical architecture for feeding of Extended AMAN tool, TTA sending and exchange of AU preferences

The concept developed here is derived from SESAR Solution 18 “CTOT and TTA”, with two main differences:

- TTAs are only allocated in the planning phase to short/medium hauls (departing from IFPS zone);
- TTAs are not monitored nor updated after take-off.

The TTA is only provided in addition to CTOT as an indication of the actual constraint for the flight crew. Before take-off, crew may use this information to indicate preferred TakeOff time to respect TTA (within CTOT [-5; +10] tolerance). After take-off, and before entry in Extended AMAN horizon, no specific action is required to adhere to the TTA. Flight crew shall adhere to the Flight Plan and follow ATC instructions.

K.1.2 Summary of Demonstration Exercise EXE-VLD-07-003 Demonstration Objectives and Success Criteria

The Objectives and success criteria for EXE-VLD-07-003 are provided in the xStream DEMOR, in chapter 3.4 “Summary of xStream Demonstration Plan”.

K.1.3 Summary of Demonstration Exercise EXE-VLD-07-003 Scenarios

This exercise had been planned to be executed on the following dates and daytimes:

Internal ID	Period	Details	Objectives	Scenario
EXE7#3-SKI-2018	From Dec 15, 2017 to April 02, 2018.	-SKI Scenario for the winter season 2017-2018, -LFLL arrivals via ODEBU (in LFFF LMH sector) -Saturdays/Sundays, except in February 2018.	Optimization of LFLL arrivals in Paris ACC SKI arrival regulations	SKI
EXE7#3-ETMA-2018-1	From May 23, 2018 to June 15, 2018.	-CDG arrivals via TE and UJ sectors (E-TMA) -Any day	Optimization of LFPG arrivals in Paris ACC LFFTE3 or LFFUJ arrival regulations	Extended TMA
EXE7#3-ETMA-2018-2	From Sept 17, 2018 to Oct 26, 2018.	-CDG arrivals via UJ and TE sectors, -Any day	Optimization of LFPG arrivals in Paris ACC LFFTE3 or LFFUJ arrival regulations	Extended TMA
EXE7#3-ETMA-2018-3	From Oct 01, 2018 to Oct 26, 2018.	-CDG arrivals via UJ and TE sectors -Any day	Usage of iAMAN to electronically create MCP for Paris ACC arrival regulations LFFTE3 and LFFUJ & populate them with selected flights’ TTA	Extended TMA
EXE7#3-SKI-2019	From Dec 15, 2018 to March 31, 2019.	-SKI Scenario for the winter season 2018-2019, -LFLL arrivals via ODEBU (in LFFF LMH), -Saturdays/Sundays	Optimization of LFLL arrivals in Paris ACC SKI regulations	SKI
EXE7#3-ETMA-	From April 22, 2019 to	-CDG arrivals via LFFF UJ and	-Optimization of LFPG arrivals in Paris ACC LFFTE3 or LFFUJ arrival	Extended TMA

2019	June 14, 2019.	LFFF TE trials -Any day	regulations -Usage of iAMAN to electronically create MCP for Paris ACC arrival regulations LFFTE3 and LFFUJ & populate them with selected flights'	
EXE7#3-CDG-2019	From May 23, 2019 to June 14, 2019.	-CDG arrivals -Limited to P6 peak (17h00-18h00 UTC) -Any day	Usage of iAMAN to electronically create MCP for Paris CDG arrival regulation LFPGARR1 & populate them with selected flights' TTA	CDG
EXE7#3-ORLY-2019	From Jan 10, 2019 to June 14, 2019.	-ORLY arrivals -Any day	Optimization of LFPO arrival regulations	ORLY
EXE7#3-ORLY-2019-AFLEX	From August 12, 2019 to Sept 30, 2019.	-AFLEX scenarios within EXE3 ORLY -Any day	Usage of AFLEX in LFPO arrival regulations	ORLY + AFLEX

Table 1: Planned trial periods and peaks for EXE-VLD-07-003

All the implementations of the "Improved Arrival Planning Management and Airspace User Preferences" scenarios are detailed in the following sub-chapters.

K.1.3.1 SKI Scenario

This scenario aims at optimising LFLL arrivals within the existing airspace-based arrival regulations:

- LFFUPSK2/LFFMOU regulations (based on LFFF LMH sector for arriving SKI traffic)
- LFFUK/LFFUZ regulation.

The scenario had been firstly executed during winter 2017-2018 as a proof of concept to confirm the feasibility of the automatic coordination with NM API service with the LFLL arrivals.

The same scenario had been performed in winter 2018-2019 in combination with COP Sequencer EXE-VLD-07-002 use case on SKI arrival flows to LFLL and LSGG arrivals.

The two steps of this scenario had been designed to address Traffic volumes usually regulated during winter due to arrivals to Lyon airports:

Usually Regulated TV	Impacted Flow	Fix to show on iAMAN Timeline
LFFMOU LFFUPSK2 LFFUZ LFFUK	ODEBU-MOU-OMANI (to LFLL)	ODEBU

Figure 9: Usual regulations for LFLL arrivals concerning winter flows

The scenario was designed to provide Paris FMP, with the control of CTOs / Target Times to reduce the complexity of the SKI arrival sequence in Paris LMH sector.

The way to do so is to add or reduce ATFCM delays to improve the arrival sequence in Paris ACC LMH sector by sending optimized target times with iAMAN.

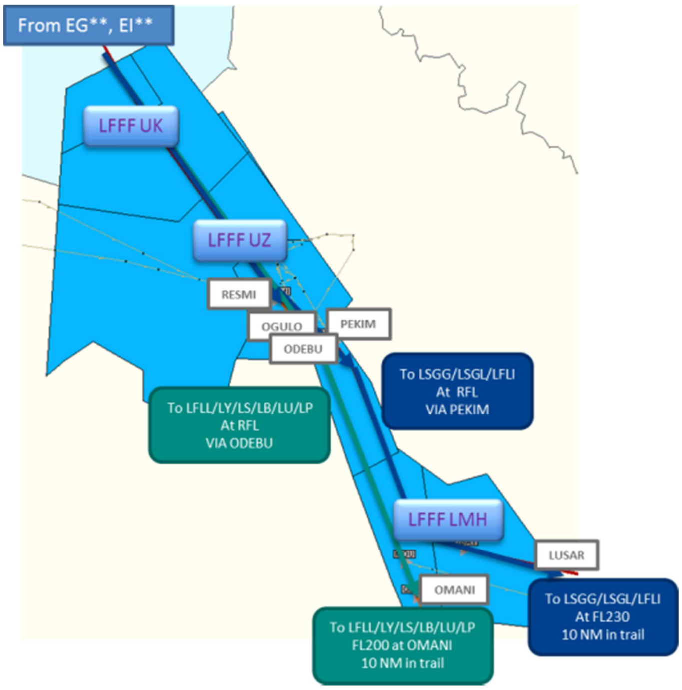


Figure 10: SKI airport flows via LFFF LMH processed by the EXE3 SKI scenario.

The EXE3 SKI trials had been supported by the iAMAN tool configured

The iAMAN was configured:

- To compute an arrival sequence for flights landing at LFLL airports flying via ODEBU,
- To allow Paris FMP to select flights allowing a more efficient arrival sequence in Paris ACC LMH sector,
- So as Paris FMP has the capability to directly send Target Times on selected flights to NM.

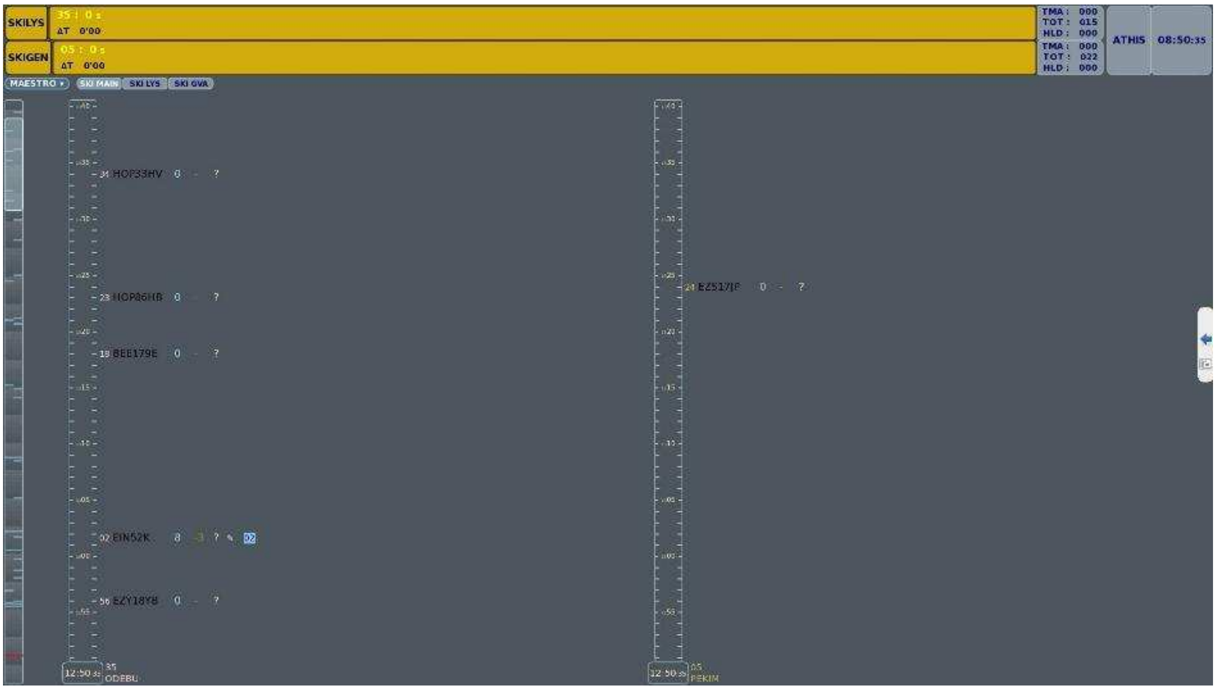


Figure 11: iAMAN HMI configured for SKI scenario

K.1.3.2 E-TMA Scenario

The EXE3 E-TMA scenario had been designed for Paris ACC TE sector (CDG arrivals from the North East) and Paris ACC UJ sector (CDG arrivals from South East), to de-bunch or to optimize the arrival flows to CDG airport within these Extended TMA sectors with the support of iAMAN during ATFCM regulations, in order to match the available sector capacity.

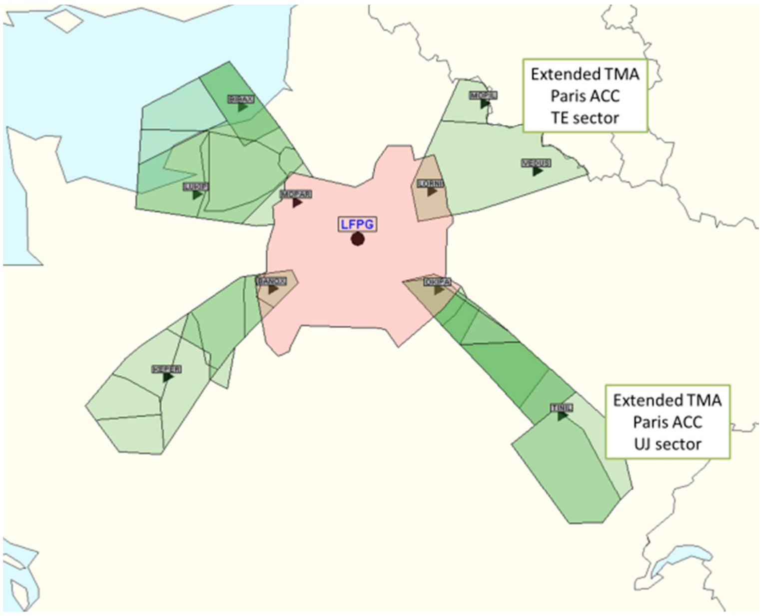


Figure 12: Paris ACC E-TMA sectors handling Paris-CDG arrivals

- **<u>For TE sector, the objective is to</u>**:
  - optimize LFPG arrivals captured by LFFTE3 regulations (based on LFFF TE sector) by electronically sending revised TTA with iAMAN;
  - have the ability to electronically request activation of LFFTE3 MCP (Mandatory Cherry Picking) regulations using iAMAN and select LFPG arrivals to be included in the MCP regulation by electronically sending TTA with iAMAN, generating the corresponding CTOT for the selected arrivals.

For the TE sector, the following airspace had been considered:

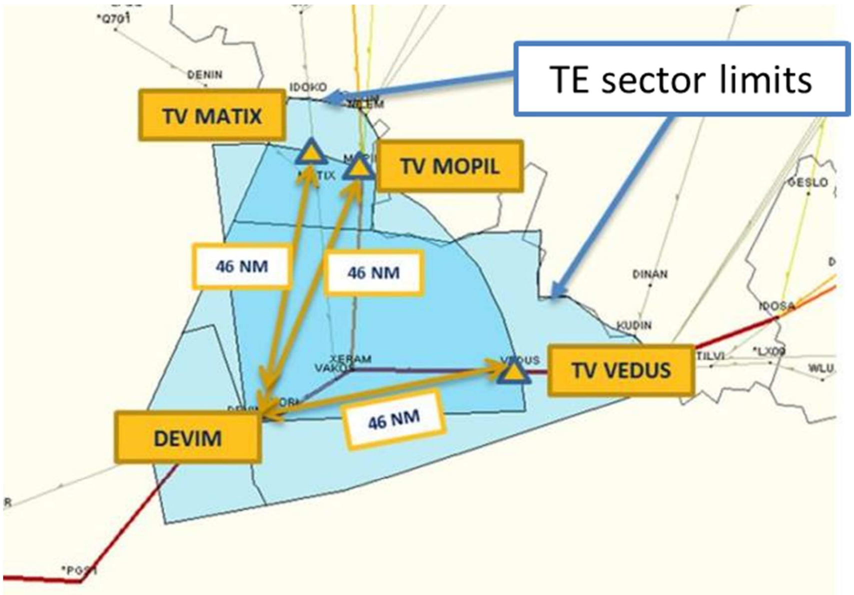


Figure 13: Flows targeted in the EXE3 CDG Scenario with TE Sector

iAMAN is displaying the arrival sequence on timelines at the different Metering Fixes (MATIX, MOPIL, VEDUS) then the aggregation of all, composing the LFFF TE sector entry timeline.

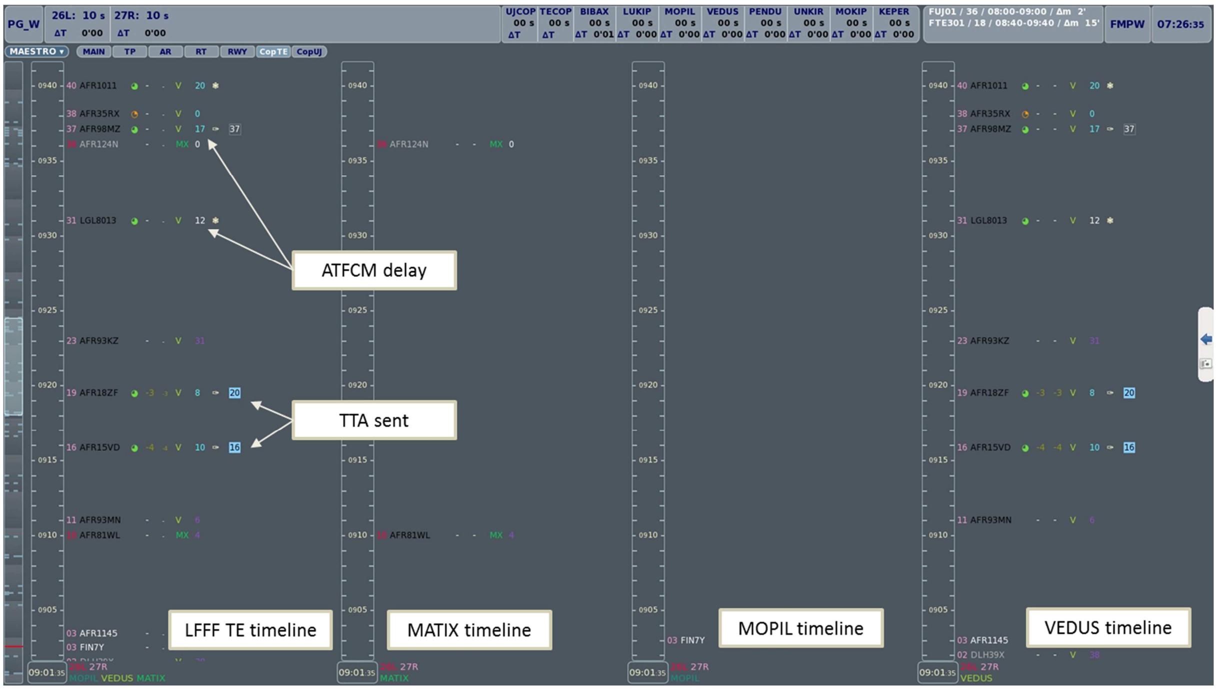


Figure 14: iAMAN HMI for the EXE3 E-TMA Scenario TE Sector

- **<u>For UJ sector, the objective is to</u>**:
  - optimize LFPG arrivals captured by LFFUJ regulations (based on LFFF UJ sector) by sending revised TTA with iAMAN
  - have the ability to electronically request activation of LFFUJ MCP (Mandatory Cherry Picking) regulations using iAMAN and select LFPG arrivals to be included in the MCP regulation by electronically sending TTA with iAMAN, generating the corresponding CTOT for the selected arrivals

For the UJ sector, the following airspace had been considered:

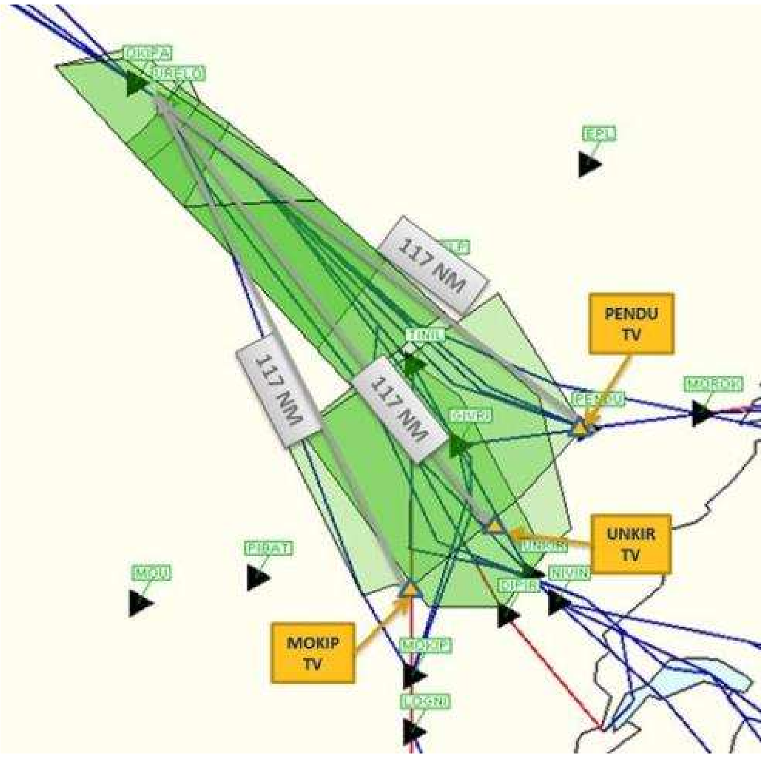


Figure 15: Flows targeted in the EXE3 CDG Scenario with UJ Sector

iAMAN is displaying the arrival sequence on timelines at the different Metering Fixes (MOKIP, UNKIR, PENDU) then the aggregation of all, composing the LFFF UJ sector entry timeline.

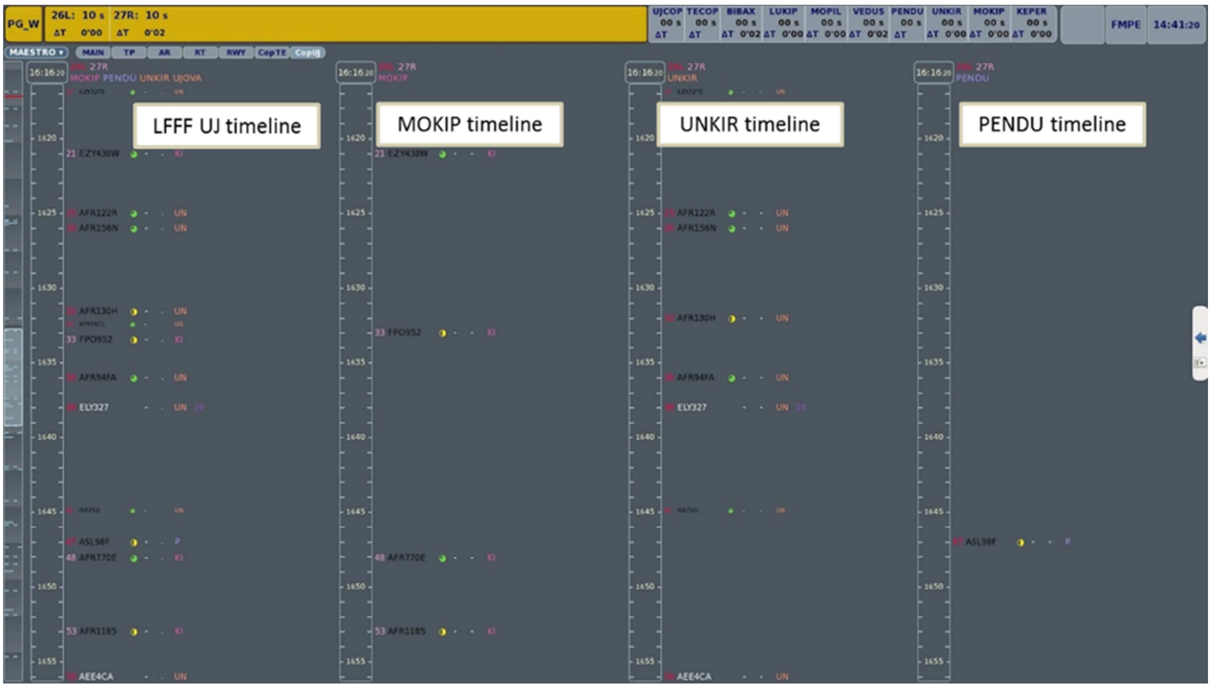


Figure 16: iAMAN HMI for the EXE3 E-TMA Scenario UJ Sector

For MCP creation, iAMAN HMI has been set up to allow Paris FMP to request MCP regulations on LFFUJ or LFFTE3 sector electronically without phone coordination.

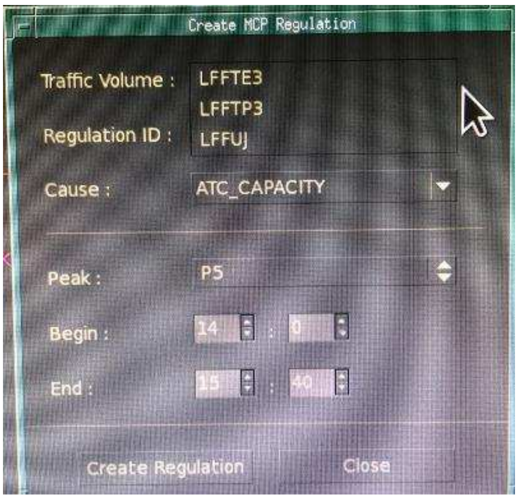


Figure 17: iAMAN HMI for MCP creation request

K.1.3.3 CDG scenario

In this scenario, iAMAN is installed in CDG Approach room in addition to Paris FMP position.

The trial scenario consists of:

- displaying the predicted arrival sequence in iAMAN at the runway and at the Metering fixes, computed using the arrival rate input in the tool (i.e. landing rate of 90s between each landing) to calculate delays;
- sharing the arrivals view on iAMAN with Paris FMP and Paris-CDG approach supervisor;
- coordination between Paris FMP and Paris-CDG approach supervisor to select the arrivals that are most prone to receiving airborne delay, according to iAMAN calculation;
- creating a MCP regulation on LFPGARR1 with iAMAN by Paris FMP;
- sending a TTA for the flights with the highest planned airborne delay in iAMAN, in order to generate a maximum of 10 mins of ATFCM delay (due to iAMAN limitation and to experiment the concept without generating too much ATFCM delay), generating a corresponding CTOT.

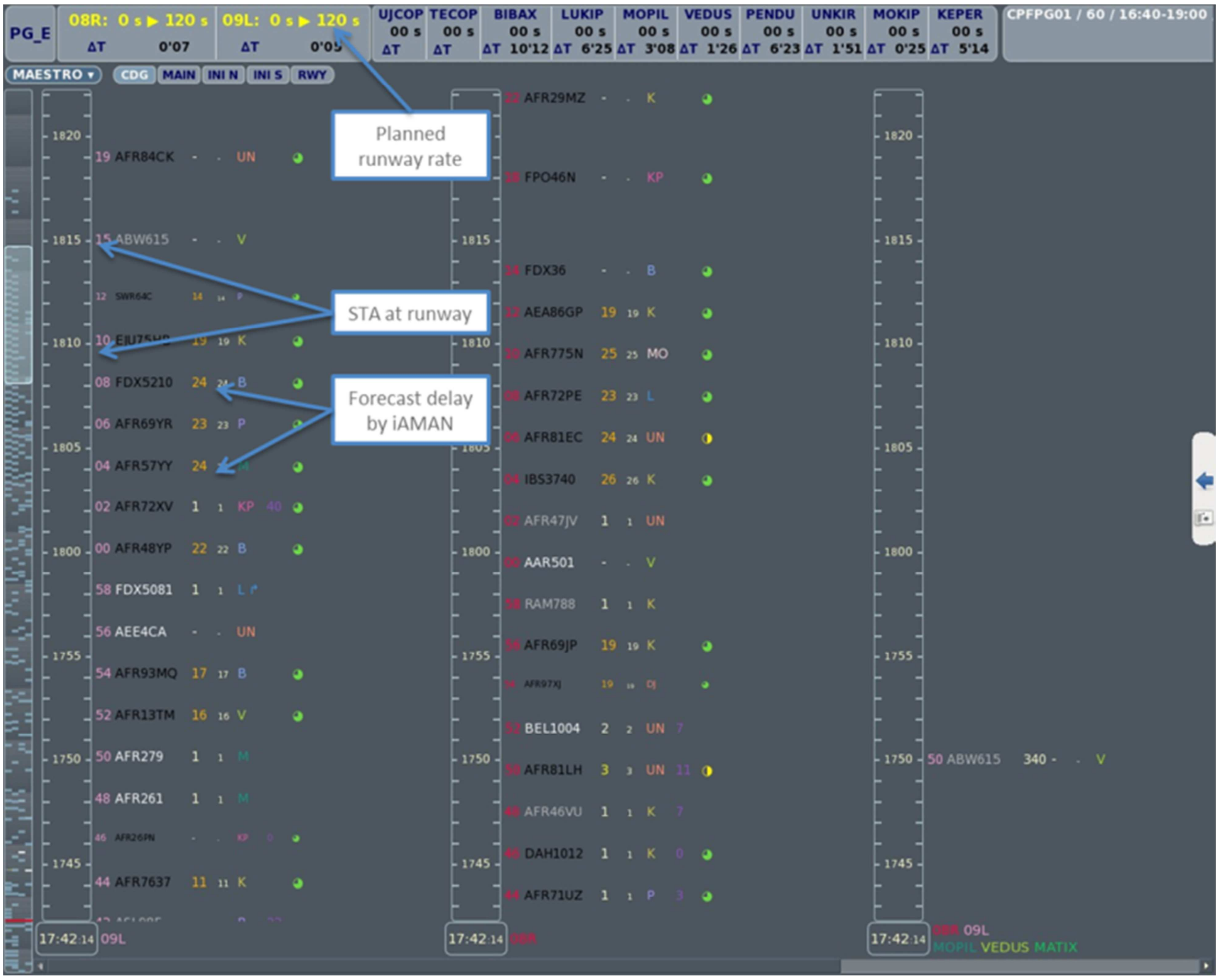


Figure 18: iAMAN HMI example during EXE7#3-CDG-2019

The use of a MCP request is made by FMP directly on iAMAN to target one or many flights to smooth & de-bunch the arrival sequence.

In that situation, the MCP request is created on the iAMAN and sent electronically to the NM as shown in the following iAMAN MMI:

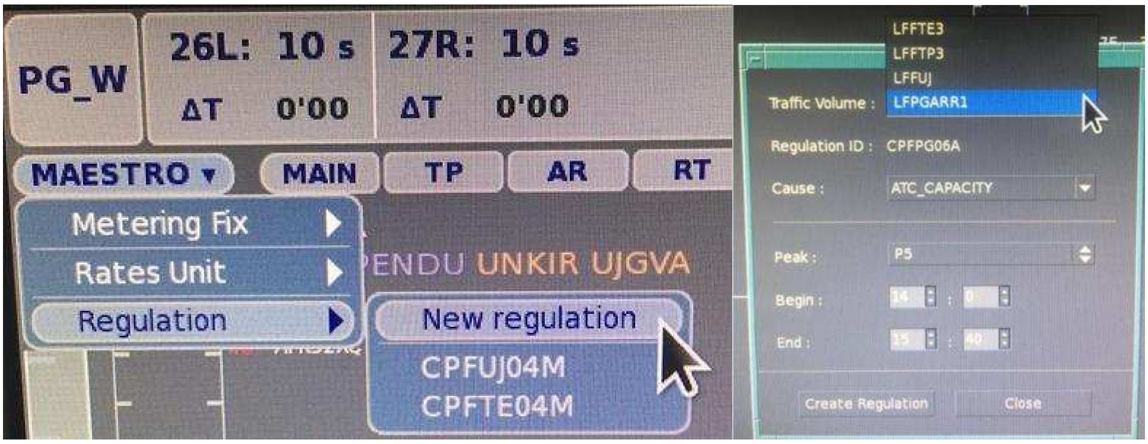


Figure 19: HMI for issuing an MCP in the EXE3 CDG scenario

The objective of this scenario is to optimize the arrival flows to Paris-CDG during a very high arrival peak by:

- Generating ATFCM delay on a few flights still on the ground, with a maximum ATFCM delay of 10 minutes (due to iAMAN limitations and for trial purposes);
- Reducing ASMA delay for the arrival sequence;
- Reducing ATC workload in the TMA;
- Maintaining a continuous and high runway feed.

The trial was planned during the evening peak “P6” between 17:00 and 18:00 UTC.

K.1.3.4 Orly Scenario

In this scenario, iAMAN is installed in Orly Approach room in addition to Paris FMP position.

The trial scenario consists of:

- displaying the predicted arrival sequence in iAMAN at the runway in addition to the arrival sequence at the Metering fixes, using the arrival rate input in the tool (i.e. landing rate of 90s between each landing) to calculate delays, when an ATFCM regulation on Orly arrivals (LFPOARR2) is activated;
- sharing the arrivals view on iAMAN with Paris FMP and Paris Orly Tower supervisor;
- optimizing the arrival sequence by sending TTA for arrivals if capacity is detected to be available at the runway during LFPOARR2 regulation time of activation, generating a corresponding CTOT.

The iAMAN had been configured to provide (Refer to the figure below):

- A runway timeline, providing the arrival sequence at the runway,
- Metering fixes timelines, providing the arrival sequence at the metering fixes in Paris ACC sectors.

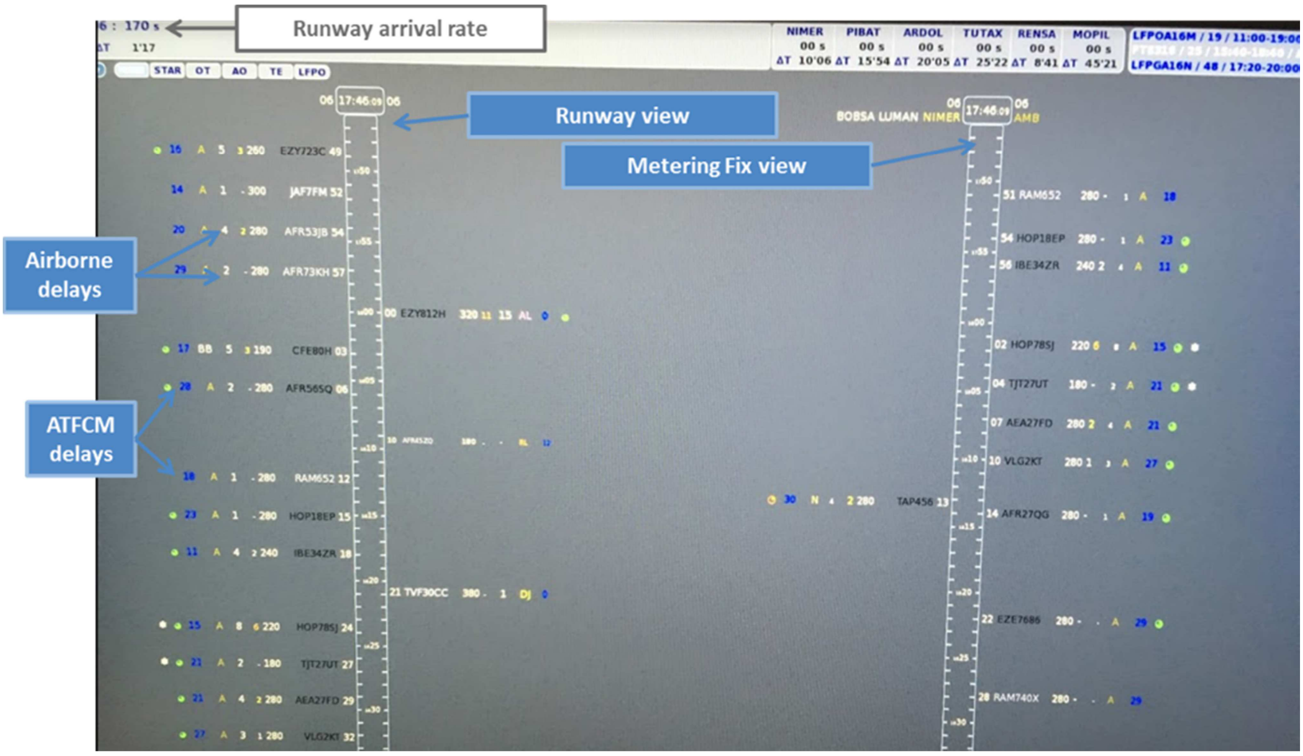


Figure 20: iAMAN HMI supporting the EXE3 ORLY scenario

This scenario aims at optimising Paris-Orly arrival regulations by:

- optimizing the management of LFPOARR2 regulations,
- limiting unnecessary ATFCM delays,
- providing Orly Tower with an extended view of the arrival sequence.

This scenario had been planned to run from Jan 10, 2019 to June 14, 2019.

K.1.3.5 AFLEX Scenario

The A-Flex scenarios had been designed to include airspace users in the decision making process. They had been built upon iStream CONOPS and results, with the following possibilities:

- Reduce to the minimum the impact of a flight (Priorization of « sensible » flights by degrading less important flights for the airline),
- Exchange the slot between 2 regulated flights (SWAP),

The process associated to the AFLEX concept is:

- For the AU to provide ATC with modification requests concerning the calculated arrival sequences,
- For ATC is able to take Users Preferences into account and accommodate them as often as possible but on the principle of equity for others AU.

To prove the success of the AFLEX procedure, the aim is to show for specific examples, that it was possible, in degraded situation, thanks to the adjustment to the arrival sequence, to obtain one or more of the following outcomes:

- Avoid an arrival outside curfew time,
- Reduce delay on the following departure of an arriving aircraft (including the avoidance of an end-of-day curfew),
- Ensure timely connection for inbound connecting passengers or flight crew rotations.

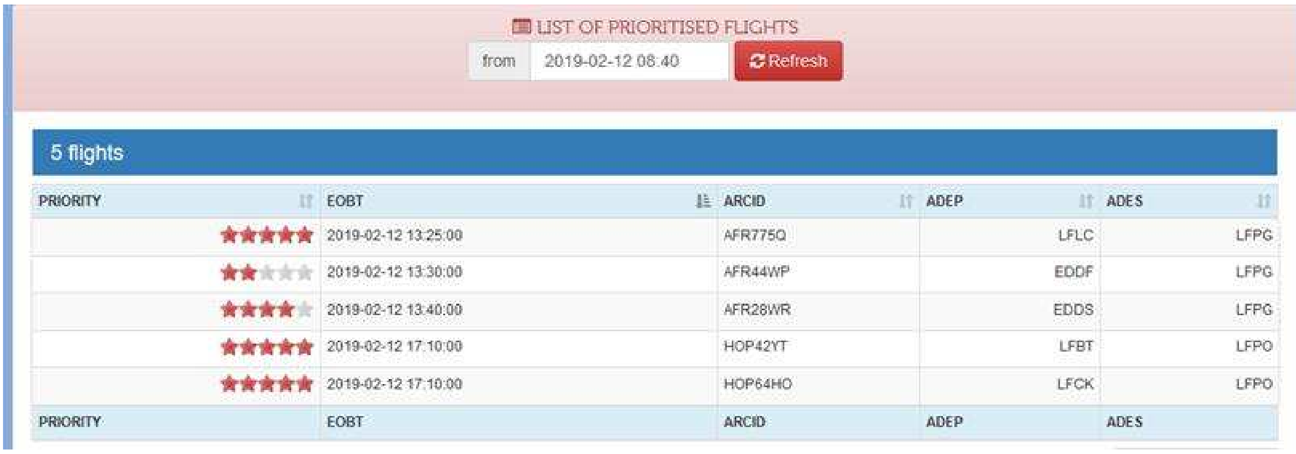
In addition to other WP7 EXE3 implementations, the following AU actions were foreseen:

- Reduce to the minimum the impact of a flight: “IMPROVEMENT”,
- Exchange the priority between 2 regulated flights: “SWAP”,

The AFLEX concept is requesting an exchange of data between Paris ACC and Air France:

- PARIS ACC shall share the calculated arrival sequence with the AU,
- Air France shall provide a list of flights with their relative importance (From Very important to normal).

The list of flights and their quotations provided by the AU is displayed also dsna.fr portal as shown below



PRIORITY	EOBT	ARCID	ADEP	ADES
★★★★★	2019-02-12 13:25:00	AFR775Q	LFLC	LFPG
★★☆☆☆	2019-02-12 13:30:00	AFR44WP	EDDF	LFPG
★★★★☆	2019-02-12 13:40:00	AFR28WR	EDDS	LFPG
★★★★★	2019-02-12 17:10:00	HOP42YT	LFBT	LFPO
★★★★★	2019-02-12 17:10:00	HOP64HO	LFCK	LFPO
PRIORITY	EOBT	ARCID	ADEP	ADES

Figure 21: EXE3 AFLEX HMI displaying the list of prioritised flights.

In case of ATC constraints, Paris FMP is able to take into account most important flights (Five stars) into their allocation of Target Time and rearrange the arrival sequence according to AU preferences.

The execution of the AFLEX scenario is providing only qualitative results, i.e. the feedback of AU with the improvements of most important flights in constrained conditions.

Note:

This scenario had been played with Air France and the companies of the Air France group, Transavia, Hop and Air France. For equity purposes, every AU member of the A-TEAM had been invited to participate to this process for Paris arrivals.

An example of the AFLEX process between Paris FMP and Air France is described below:

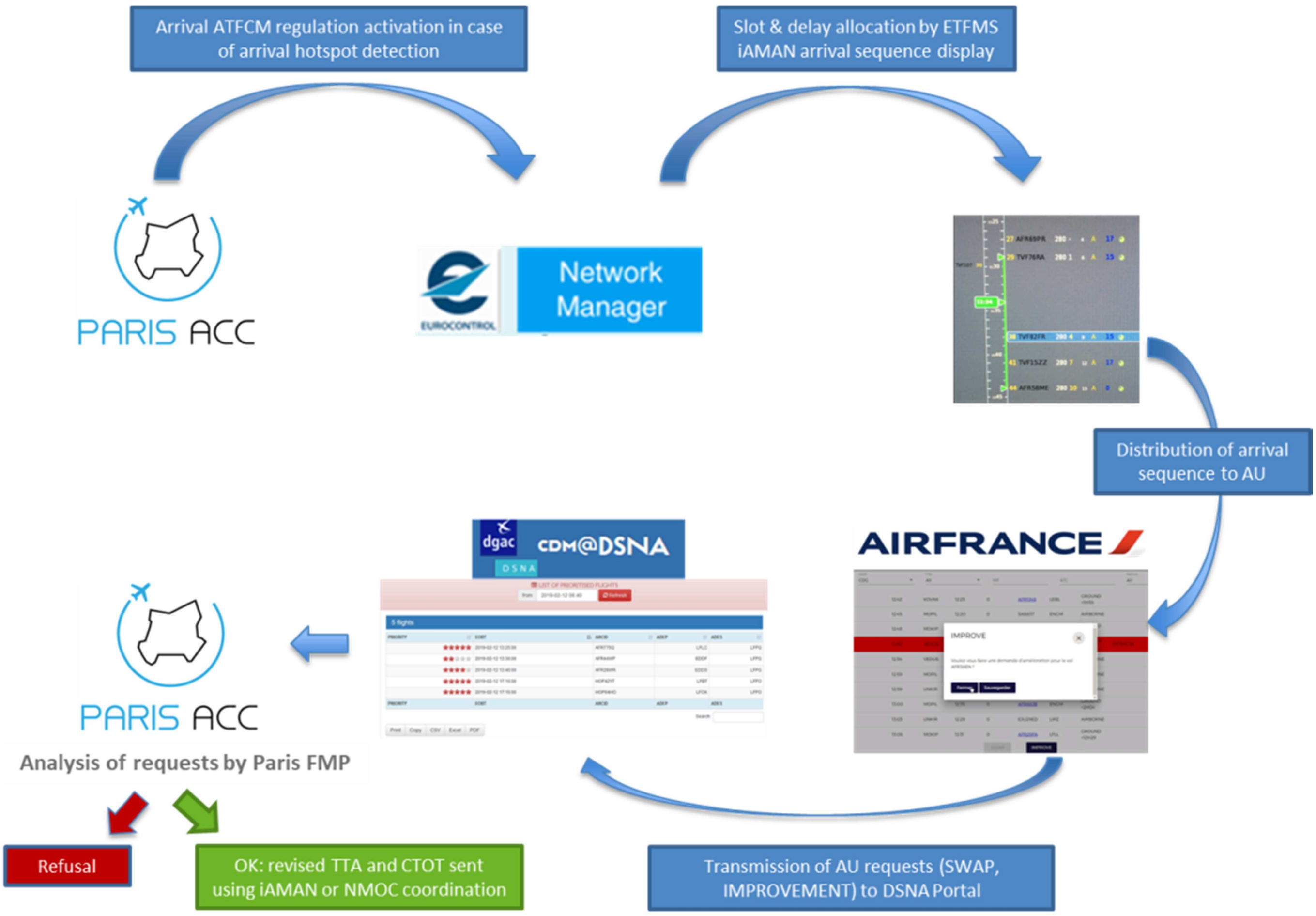


Figure 22: Process between Paris FMP & AU in use during AFLEX trials

With this process, when arrivals constraints such as CTOT are generated by Paris FMP for arrivals to Paris-Orly or Paris-CDG, the arrival sequence in iAMAN is shared in real time with the Airspace Users. Thus, it enables them to analyse the delay data and to send back to DSNA Portal the flights to be improved or swapped during the regulated period. The selected flights by the OCC are displayed on

DSNA Portal and available for analysis to Paris FMP. Finally, after analysing the OCC requests along with the arrival sequence, Paris FMP decided if the requests can be

- Denied (i.e. no capacity is available in the arrival sequence to improve a delayed flight)
- Fully granted (i.e a swap between 2 flights is accepted)
- Partially granted (i.e. a partial delay improvement of a flight is accepted)

The scenario was designed to run from August 12th to September 30th during EXE7#3-ORLY-2019 arrivals.

K.1.4 Summary of Demonstration Exercise EXE-VLD-07-003 Assumptions

The assumptions concerning EXE-VLD-07-003 are provided in the xStream DEMOR, in chapter 3.4 “Summary of xStream Demonstration Plan”.

K.2 Deviation from the planned activities

K.2.1 EXE-VLD-07-003 AFLEX Scenario

According to DEMOP, the AFLEX scenario was designed to be supporting four different use cases:

- Reduce to the minimum the impact of a flight (Prioritization of « sensible » flights by degrading less important flights for the airline),
- Exchange the slot between 2 regulated flights (SWAP),
- Departure before EOBT,
- Collaborative cherry picking (MCP in collaboration with Airspace users).

The use case "Departure before EOBT" was not trialled during AFLEX scenario after a common decision between Air France & Paris ACC, but remain open for discussions for other operational goals in the future.

K.3 Demonstration Exercise EXE-VLD-07-003 Results

K.3.1 SKI Scenario

EXE-VLD-07-003 SKI scenario was planned on Saturdays and Sundays from 15/12/2017 until 31/03/2018 (except in February due to NM request to avoid the busiest weekends) and from 16/12/2018 until 01/04/2019. This trial was activated only during ATC Capacity regulations: in case of weather issues (i.e. LVP in Lyon), technical issues, or industrial actions (i.e. ATC industrial action in Marseille ACC) the trial was not supposed to be run.

The objective was to optimize LFLL arrivals captured by potential LFFMOU, LFFUZ, LFFUK, LFFUPSK2 SKI arrival regulations.

The following picture is providing a view on iAMAN HMI and a summary on how the FMP is acting on a flight (Example with BAW41Y) with the transmission of a Target Time to optimize the arrival sequence in Paris ACC LMH sector:

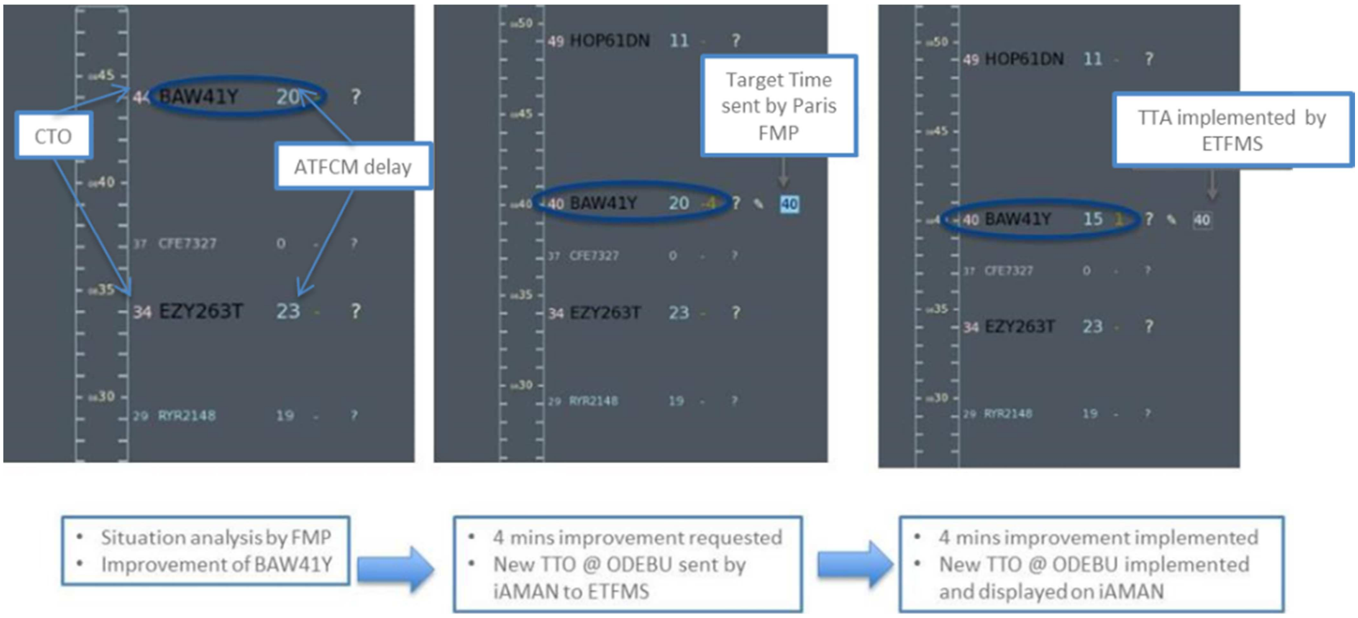


Figure 23: iAMAN HMI and FMP process to improve a sequence within EXE7#3-SKI-2018

In the figure above, BAW41Y had 20 minutes ATFCM delay due to LFFMOU arrival regulation, Paris FMP could send a new Target Time, generating a new CTOT sent to the AO via a SRM, resulting in an improvement of its ATFCM delay by 5 mins.

However, the trial was activated very few times during EXE7#3-SKI-2018 (5 days) and EXE7#3-SKI-2018 (2 days). Below is the summary EXE-VLD-07-003 SKI scenario in terms of flights having revised TTA sent by Paris FMP.

Trial period	Number of flights having TTA request by Paris FMP	Average requested action by Paris FMP	Nb of flights requested to have additional delays	Nb of flights requested to have reduced delays	Number of flights with TTA implemented	Implementation rate	Actual average delay modification per flight
EXE7#3-SKI-2018	38	-6,6 mins	0	38	10	26%	-4,8 mins

EXE7#3-SKI-2019	4	-1,5 mins	1	3	3	75%	-1,7 mins
Total	42	-6,2 mins	1	41	13	31%	-4 mins

Table 2: Summary of EXE-VLD-07-003 SKI scenario

The trial was not activated during many days due to different causes:

- Low traffic demand / no ATFCM regulation activated
- LFLL arrivals regulated but with already minimal ATFCM delays
- High FMP workload
- iAMAN technical issues
- Industrial action in Marseille ACC
- Weather issues in Lyon TMA

Furthermore, the overall implantation rate is around 31% due to many factors:

- TTA sent by Paris FMP too late (at a time too close to COBT)
- TTA outside the Slot Zone and no availability in the slot list
- Incorrect NM parameters for regulation IDs to have the Target Time sent by iAMAN
- API service not activated in NM
- FMP workload not allowing them to use iAMAN during busy shifts

The difference of the number of TTA requests between EXE7#3-SKI-2018 (38) and EXE7#3-SKI-2019 (4) comes from the fact in 2017-2018, a new airspace design & routes were implemented for the SKI arrivals flows between Paris ACC, Marseille ACC, Geneva ACC and Lyon TMA, (SMARTSKI project) leading to many ATFCM regulations and many delays during EXE7#3-SKI-2018 compared to EXE7#3-SKI-2019.

Therefore, there was less need for optimization of ATFCM arrival regulations during EXE7#3-SKI-2019.

During EXE-VLD-07-003 SKI scenario, Paris FMP transmitted revised TTA requests to NM for LFLL arrivals captured in LFFMOU regulations, representing:

- An average reduction request of 23% of ATFCM delay by regulation
- An average delay reduction request of 6 mins by selected flight having a revised TTA sent

Due to the TTA implementation rate of 31%, the achievements were

- An average reduction of 5% of ATFCM delay by regulation
- An average delay reduction of 4 mins by selected flight having a revised TTA implemented

K.3.1.1 Summary of Scenario Results

See Main Document chapter 4.1.2.3.4.

K.3.1.1.1 Results per KPA

As EXE-VLD-07-003 SKI scenarios were only activated during 7 days, the feedback from Paris FMP and ATCOs is minimal. Only 5 FMP questionnaires were filled.

Due to the low number of trial activation of the SKI scenario, and the lack of solid baseline (major differences in airspace & routes for SKI arrivals in winter 2017/2018), the quantitative assessment has not been performed for many KPAs. However, the proof of concept can be considered to be covered by the other scenarios.

K.3.1.1.1.1 KPA Safety

K.3.1.1.1.1.1 Quantitative Assessment

Number of Incident Reports:

No incident has been reported in connection with EXE-VLD-07-003 SKI scenario.

K.3.1.1.1.1.2 Qualitative Assessment

Questionnaire Results related to Safety

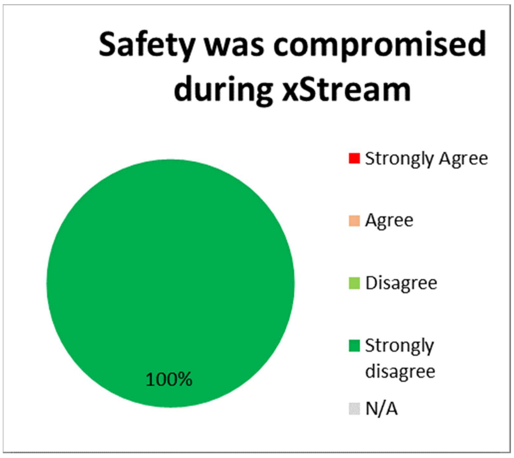


Figure 24: Feedback from Paris FMP regarding safety during EXE-VLD-07-003 SKI scenarios

According to FMP questionnaires, the trials had no impact on safety.

K.3.1.1.1.2 KPA Predictability and Punctuality

K.3.1.1.1.2.1 Quantitative Assessment

Due to the low number of trial activation of the SKI scenario, and the lack of baseline, the quantitative assessment has not been performed.

K.3.1.1.1.2.2 Qualitative Assessment

Feedback from Paris FMP indicates the use of iAMAN by Paris FMP was an accurate indicator for Paris ACC LMH sector, in terms of incoming workload and arrival sequencing.

K.3.1.1.1.3 KPA Cost Efficiency

K.3.1.1.1.3.1 Quantitative Assessment

None.

K.3.1.1.1.3.2 Qualitative Assessment

ANSP Cost:

Paris FMPs received training during their planned FMP course & multiple refresher course in Paris ACC. They also received training on iAMAN during their planned FMP shift and performed the trial days during planned FMP shifts. Therefore EXE-VLD-07-003 implied no extra cost for the ANSP; no extra staff had to be recruited for the trials.

K.3.1.1.1.4 KPA Capacity

K.3.1.1.1.4.1 Quantitative Assessment

Total ATFCM delay

A total of 53 mins of ATFCM delays has been saved as a result of the revised TTA sent by Paris FMP during the 7 trials days representing a 5% decrease of the total amount of ATFCM delays generated by the corresponding SKI arrival regulations during the period concerned, compared to the initial delays of the ATFCM regulation before the revised TTAs were sent & implemented in ETFMS.

K.3.1.1.1.4.2 Qualitative Assessment

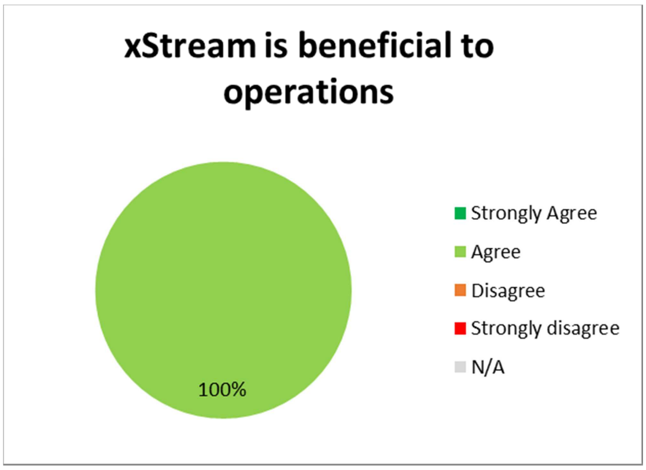


Figure 25: Feedback from Paris FMP regarding operational benefits during EXE-VLD-07-003 SKI scenarios

100% of the FMP assessed the trials & concepts were beneficial for operations.

K.3.1.1.1.5 KPA Flexibility

No flexibility exercise was implemented during this EXE-VLD-07-003 SKI scenario.

K.3.1.1.2 Results impacting regulation and standardization initiatives

The low implementation rate comes from a number of factors. This can be upgraded if:

- The “Slot Zone” is wider (i.e. [-10;+10]);
- The latest possible time to send a new TTA is available via NM B2B services;
- The latest & earliest TTA possible to be given to a flight is available via NM B2B services;
- The API service is always activated.

K.3.1.2 Analysis of Scenario Results per Demonstration objective

K.3.1.2.1 EXE-OBJ-VLD-01-001 Results

Objective: xStream operational improvements are respecting the current level of safety in air traffic management.

Success criterion: The safe management of traffic by ATC is not compromised. New procedures do not cause critical incidents.

This objective is fulfilled.

K.3.1.2.2 EXE-OBJ-VLD-02-001 Results

Objective: xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors

Success criterion: Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced.

According to the collected qualitative feedback the objective is fulfilled.

K.3.1.2.3 EXE-OBJ-VLD-04-001 Results

Objective: xStream operational improvements increase cost efficiency from more efficient processes for AU.

Success criterion: Flight efficiency is increased and flight management / flight coordination costs are reduced. During the EXE3-007-03 SKI trials, it has been demonstrated ATFCM delays could have been reduced with no negative impact on ATC workload. The objective is fulfilled.

K.3.1.2.4 EXE-OBJ-VLD-04-002 Results

Objective: xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.

Success criterion: ANSP personnel costs are maintained or reduced.

As Paris FMP received training during planned training hours and executed the trial during their planned FMP shifts, ANSP personnel costs are maintained. This objective is fulfilled.

K.3.1.2.5 EXE-OBJ-VLD-05-001 Results

Objective: ATC Capacity usage in TMA is optimized by xStream operational improvements.

Success criterion: Traffic Load, ATC Workload and Complexity in Terminal Sectors is reduced.

According to qualitative feedback from FMPs, this objective is fulfilled.

K.3.1.2.6 EXE-OBJ-VLD-05-003 Results

Objective: xStream operational improvements lead to a reduction of ATFCM measures.

Success criterion: Flight delay caused by ATFCM is reduced.

Average ATFCM delay per flight having a revised TTA by Paris FMP is reduced by 4 mins, and SKI arrival ATFCM regulation delays were reduced by 5% compared to initial ATFCM delays generated by the regulation before revised TTAs were sent. The objective is fulfilled.

K.3.1.2.7 EXE-OBJ-VLD-06-001 Results

Objective: xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users.

Success criterion: Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased

No flexibility exercise was implemented during EXE-VLD-07-003 SKI scenario.

K.3.1.3 Unexpected Behaviours / Results

Only 31% of the requested TTA by Paris FMP were implemented by NM. This was due to:

- iAMAN technical failure,
- TTA sent by Paris FMP too late (at a time too close to COBT),
- TTA outside the Slot Zone and no availability in the slot list,
- Incorrect NM parameters for regulation IDs to have the Target Time sent by iAMAN,
- API service not activated in NM,
- FMP workload not allowing them to use iAMAN during busy shifts.

Even though HMI was easy to use according to Paris FMP, the FMP workload during SKI weekends can be very high and workload may not allow to optimize the SKI arrival flows with iAMAN.

K.3.1.4 Confidence in the Demonstration Results

K.3.1.4.1 Level of Significance / Limitations of Demonstration Exercise Results

EXE-VLD-07-003 SKI scenario was activated only on 7 days, and many external factors made the TTA implementation rate low. However, the scenario was executed during days with high delays and high demand for SKI arrivals in Paris ACC LMH sector, and the operational feedback from Paris FMP running the trial was positive in terms of HMI usability and benefits to operations.

K.3.1.4.2 Quality of Demonstration Exercise Results

Due to the low samples of trials, no quantitative assessment was made except data about ATFCM delays. Furthermore, no baseline was available since the route organisation for SKI arrivals was different before winter 2017-2018 no comparison was possible for quantitative data.

ATFCM delay calculation was computed using the total amount of SKI arrival ATFCM delays obtained from CHMI before the TTA revisions were sent by Paris FMP and after the TTA revisions were sent & implemented by ETFMS.

Qualitative assessment from FMPs was only obtained with 5 questionnaires.

K.3.1.4.3 Significance of Demonstration Exercise Results

In spite of the low number of trial days, Paris FMP could activate the trial when facing high delays & high demand, and could send revised TTA as planned for the trial. In the end, the result of these actions led to a decrease of ATFCM delays by 5% for the SKI arrival regulations implemented by Paris FMP, without impacting negative the ATC workload.

K.3.2 E-TMA Scenario

This exercise had been planned on the following dates and daytimes:

Internal ID	Period	Details	Objectives
EXE7#3-ETMA-2018-1	From May 23, 2018 to June 15, 2018.	-CDG arrivals via UJ and TE sectors, -Any day	Optimization of LFPG arrivals in Paris ACC LFFTE3 or LFFUJ arrival regulations
EXE7#3-ETMA-2018-2	From Sept 17, 2018 to Oct 26, 2018.	-CDG arrivals via UJ and TE sectors, -Any day	-Optimization of LFPG arrivals in Paris ACC LFFTE3 or LFFUJ arrival regulations -Usage of iAMAN to electronically create MCP for Paris ACC arrival regulations LFFTE3 and LFFUJ & populate them with selected flights’
EXE7#3-ETMA-2019	From April 22, 2019 to June 14, 2019.	-CDG arrivals via UJ and TE sectors, -Any day	-Optimization of LFPG arrivals in Paris ACC LFFTE3 or LFFUJ arrival regulations -Usage of iAMAN to electronically create MCP for Paris ACC arrival regulations LFFTE3 and LFFUJ & populate them with selected flights’

Table 3: Planned trial periods and peaks for EXE-VLD-07-003 E-TMA

Optimization of LFPG arrivals in Paris ACC TE and UJ sectors:

The objective was to optimize LFPG arrivals captured by potential LFFTE3, LFFUJ regulations to make use of the available capacity. The scenario was activated only during ATC Capacity regulations. In case of ATC Industrial actions, technical issues, or weather issues (i.e. CBs in E-TMA), the trial was not activated.

The following picture is providing a view on iAMAN HMI and a summary on how the FMP is acting on a flight (Example with SAS579 and AFR1347) with the transmission of a Target Time to optimize the arrival sequence in Paris ACC TE sector:

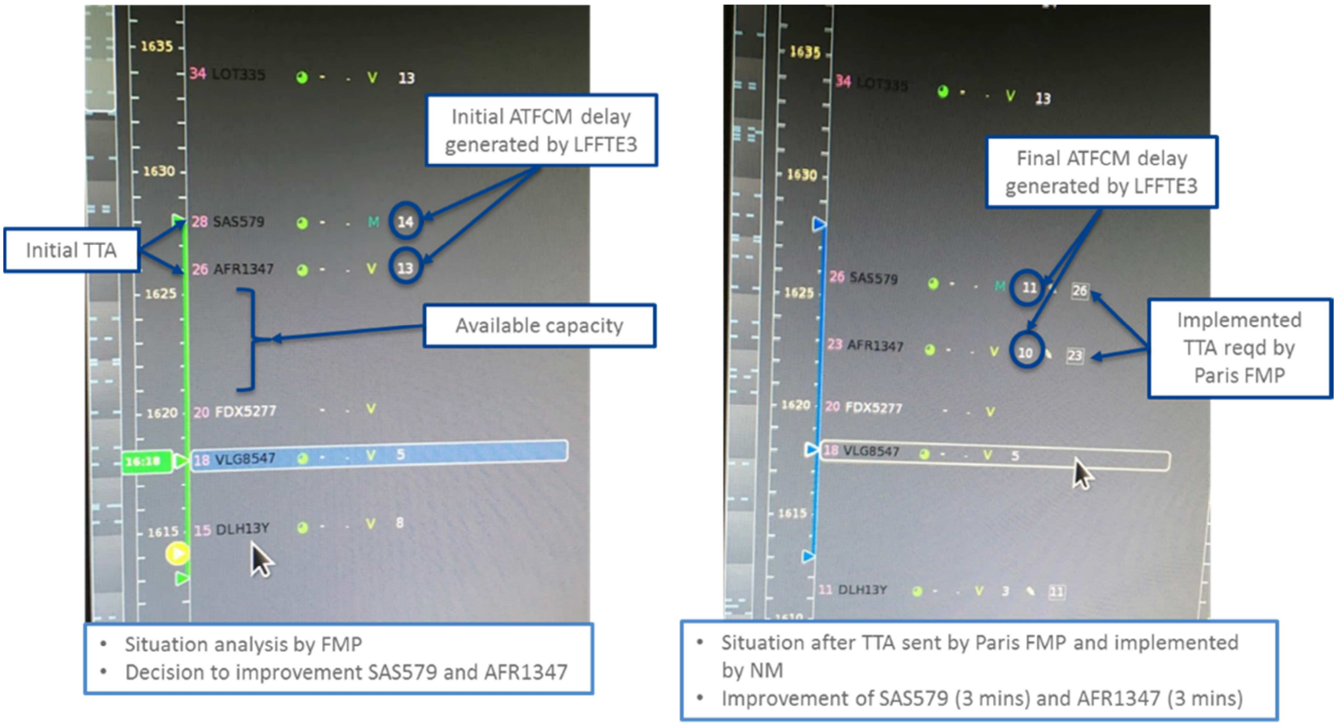


Figure 26: iAMAN HMI and FMP process to improve an arrival sequence during EXE3-VLD-07-003 E-TMA scenario

In the figure above, SAS579 had an initial ATFCM delay of 14 minutes due to LFFTE3 arrival regulation. Paris FMP could send a new Target Time, generating a new CTOT sent to the AO via a SRM, resulting in an improvement of its ATFCM delay by 3 mins. AFR1347 had an initial 13 minutes ATFCM delay due to LFFTE3 arrival regulation. Paris FMP could send a new Target Time, generating a new CTOT sent to the AO via a SRM, resulting in an improvement of its ATFCM delay by 3 mins.

In the table below is the summary of the optimization of CDG arrivals during the planned trials.

Trial period	Number of regulations addressed	Number of flights having TTA request by Paris FMP	Average requested action by Paris FMP	Nb of flights requested to have additional delays	Nb of flights requested to have reduced delays	Number of flights with TTA implemented	Implementation rate	Actual average delay modification per flight
EXE7#3-ETMA-2018-1	1	5	-1 min	1	4	4	60%	-4 mins
EXE7#3-ETMA-2018-2	18	64	-2,3 mins	11	53	37	58%	-2,8 mins

EXE7#3 -ETMA-2019	5	23	-3,4 mins	1	22	13	61%	-3,1 mins
Total	24	92	-2,5 mins	13	79	54	59%	-3 mins

Table 4: Summary of EXE-VLD-07-003 E-TMA scenario

During EXE7#3-ETMA-2018-1, the number of peaks addressed is very low because of intense CB activity during the trial period. Therefore, the results of EXE7#3-ETMA-2018-2 are described in detail in the following sections.

The trial was not activated during many days due to different causes:

- Low traffic demand / no ATFCM regulation activated
- High FMP workload
- iAMAN technical issues
- Industrial action
- Weather issues (CB activity or LVP in CDG)

Furthermore, the overall implantation rate is only at 59% due to many factors:

- TTA sent by Paris FMP too late (at a time too close to COBT)
- TTA outside the Slot Zone and no availability in the slot list
- After TTA implementation by ETFMS after request from Paris FMP, flights could be allocated a new CTOT due to
  - DPI from departure airport
  - Force CTOT from NM
  - Slot Swap mechanism
  - New regulation enroute being most penalizing

The summary of all ETMA arrival ATFCM regulation exercises is shown below, by E-TMA sector and by regulation:

E-TMA sector	Number of regulations addressed	Number of flights with TTA requested	Average ATFCM delay by regulation	% of delay difference requested by Paris FMP using TTA	% of delay difference implemented using TTA
UJ	14	45	130 mins	-8%	-4%

TE	10	47	101 mins	-11%	-7%
Total	24	92	118 mins	-9%	-5%

Table 5: EXE3-VLD-07-003 E-TMA (regulation optimization) demonstration summary

<u>Electronical MCP regulation creation :</u>

When Paris FMP needed to address an arrival hotspot in TE or UJ sector, he had the choice to implement a conventional regulation, a MCP regulation, or not to apply any regulation.

An example of the process is shown below:

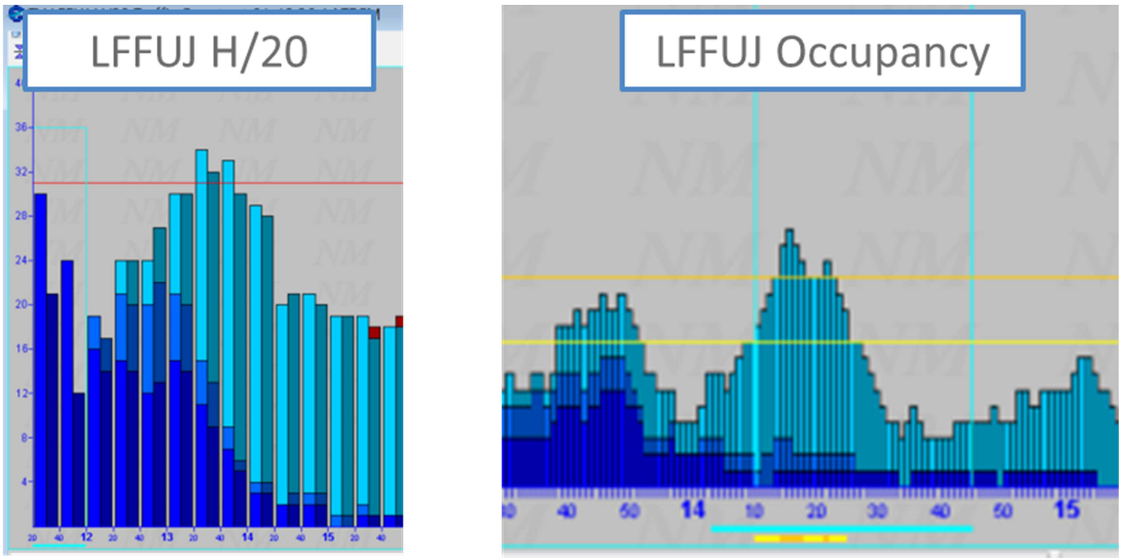


Figure 27: CHMI Traffic Counts for LFFUJ (Entry hours per 20 mins and Occupancy)

In the example above, an arrival hotspot was detected on LFFUJ sector on 01/10/2018 by Paris FMP, with the Traffic Load (H/20) over the Monitoring Value (MV) and the occupancy being above the peak of the Occupancy Traffic Monitoring Value (OTMV), indicating a high workload to come for the ATCO.

With iAMAN, Paris FMP could, instead of implementing a conventional regulation, implement a MCP regulation by requesting it electronically to NM, and select the flights to capture and their ATFCM delay allocation only by building the sequence on iAMAN timeline as shown below.

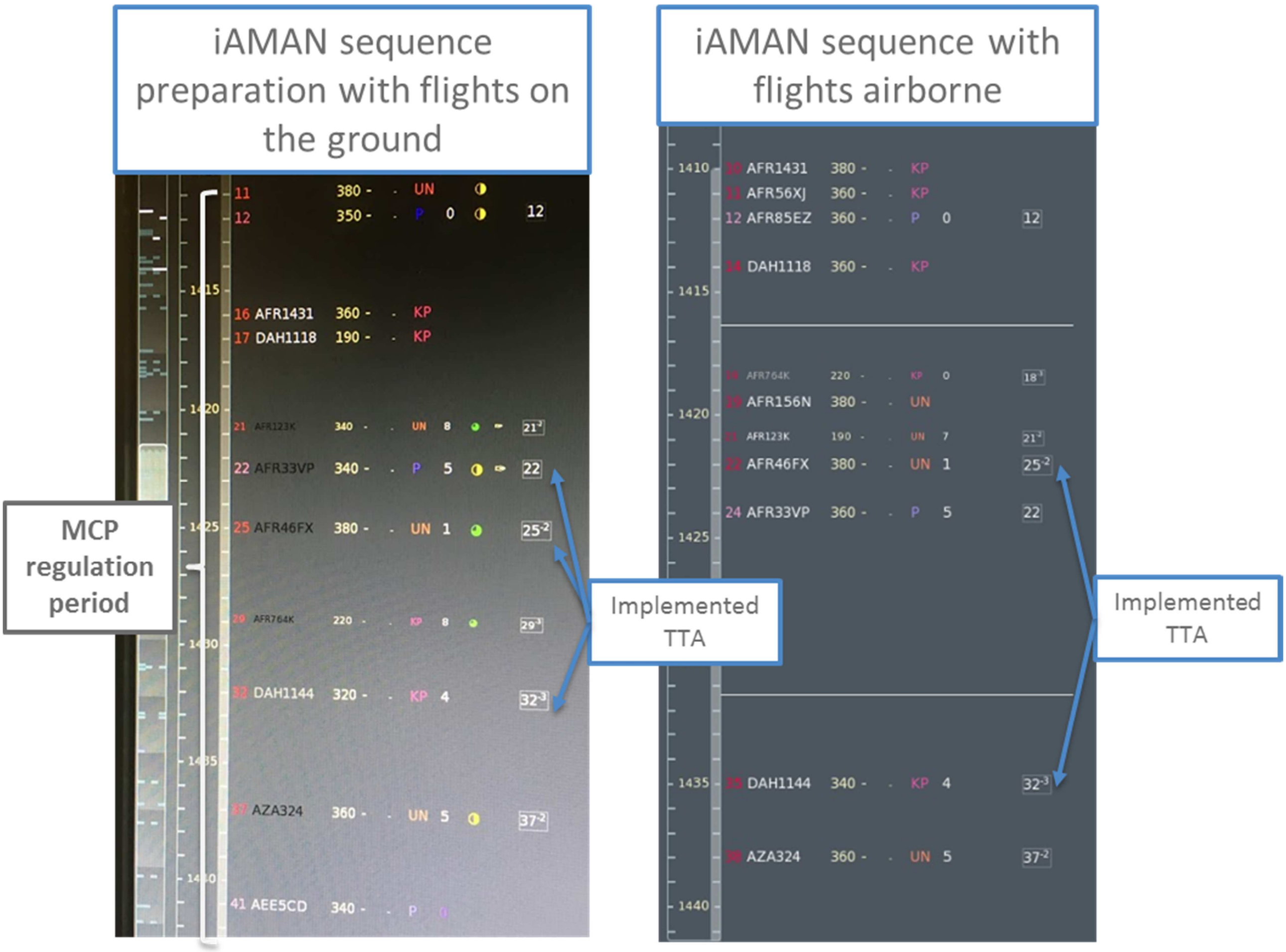


Figure 28: Preparation of arrival sequence on iAMAN

Thus, in this case, the total generated ATFCM delay was 18 mins and the result on the Occupancy count is shown below, with the traffic load being slightly reduced below the peak OTMV.

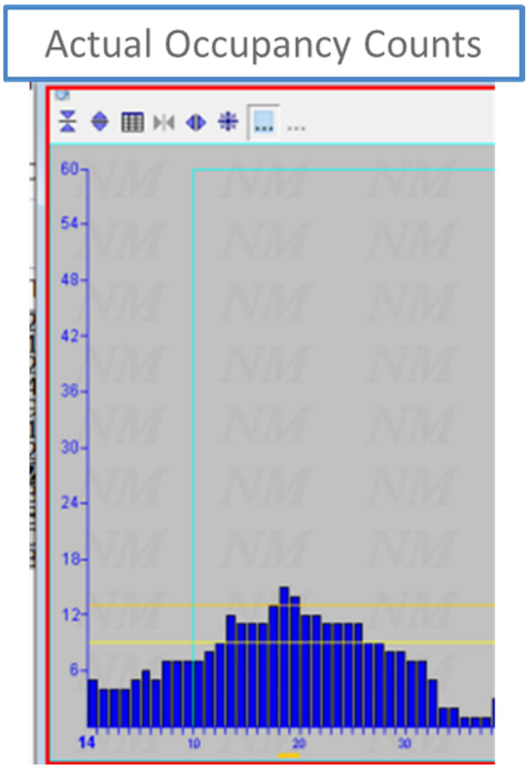


Figure 29: Actual LFFUJ Occupancy counts of 01/10/2018 example

The summary of all E-TMA MCP creation exercises is shown below, by E-TMA sector and by regulation:

E-TMA sector	Number of peaks addressed with MCP	Number of flights with TTA included in MCP	Average ATFCM delay per flight during MCP	Average ATFCM delay by regulation
UJ	10	21	4 mins	14 mins
TE	4	10	6 mins	13,8 mins

Table 6: EXE3-VLD-07-003 E-TMA (MCP creation) demonstration summary

K.3.2.1 Summary of Scenario Results

See Main Document chapter 4.1.2.3.3.

K.3.2.1.1 Results per KPA

For quantitative assessment, baseline for EXE-VLD-07-003 UJ scenario calculation was calculated between 01st of September 2018 and 26th of October 2018, during ATFCM regulations due to ATC Capacity only. That represents 16 regulated peaks for UJ sector.

For quantitative assessment, baseline for EXE-VLD-07-003 TE scenario calculation was calculated between 01st of April 2019 and 01st of June 2019, during ATFCM regulations due to ATC Capacity only. That represents 23 regulated peaks for TE sector.

For qualitative assessment, 10 FMP questionnaires were filled during EXE-VLD-07-003 E-TMA scenario by different FMPs who actually used iAMAN during the trial.

K.3.2.1.1.1 KPA Safety

K.3.2.1.1.1.1 Quantitative Assessment

Number of Incident Reports:

No incident has been reported in connection with EXE-VLD-07-003 E-TMA scenario.

K.3.2.1.1.1.2 Qualitative Assessment

Questionnaire results related to Safety:

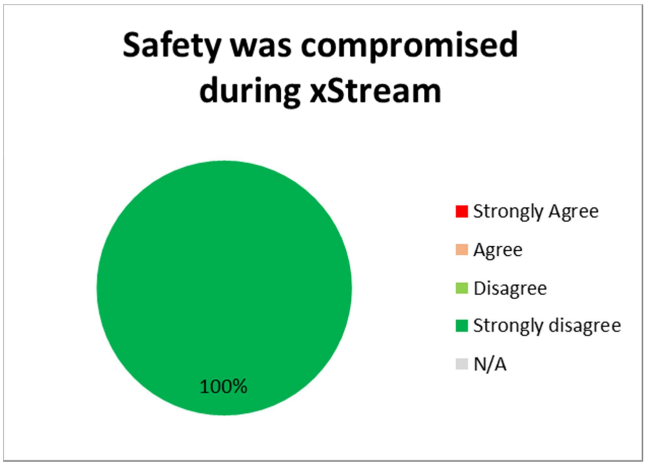


Figure 30: Feedback from Paris FMP regarding safety during EXE-VLD-07-003 E-TMA scenarios

According to FMP questionnaires, the trials had no impact on safety.

K.3.2.1.1.2 KPA Predictability and Punctuality

K.3.2.1.1.2.1 Quantitative Assessment

Time difference actual – planned (UJ sector):

Quantitative assessment was made during EXE7#3-ETMA-2018-2 on UJ sector.

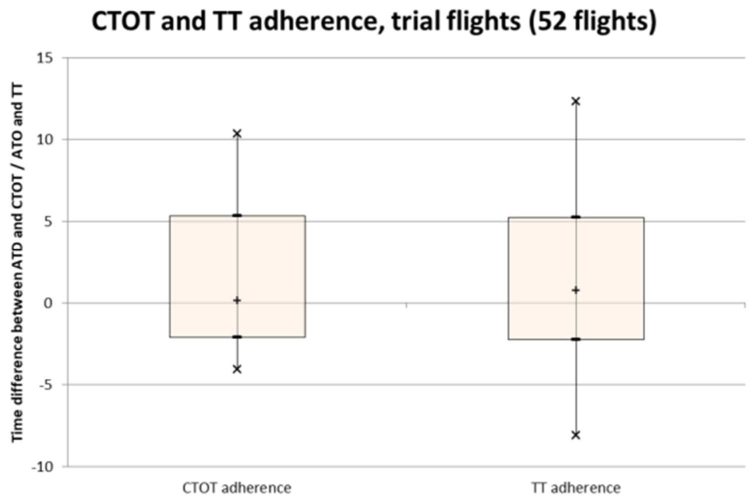


Figure 31: CTOT and TT adherence for flights having a revised TTA during EXE7#3-ETMA-2018-2

Overall CTOT adherence: For all the trial days and for all the metering fixes at the entry of UJ sector:

- 50% of the flights, CTOT adherence: **-2,1 min +5,3 min**
- 90% of the flights, CTOT adherence: **-4,1 min +10,3 min**

Overall TT adherence: For all the trial days and for all the metering at the entry of UJ sector:

- 50% of the flights, TT adherence: **-2,3 min +5,2 min**
- 90% of the flights, TT adherence: **-8,1 min +12,4 min**

In conclusion, TT adherence is strongly linked to CTOT adherence.

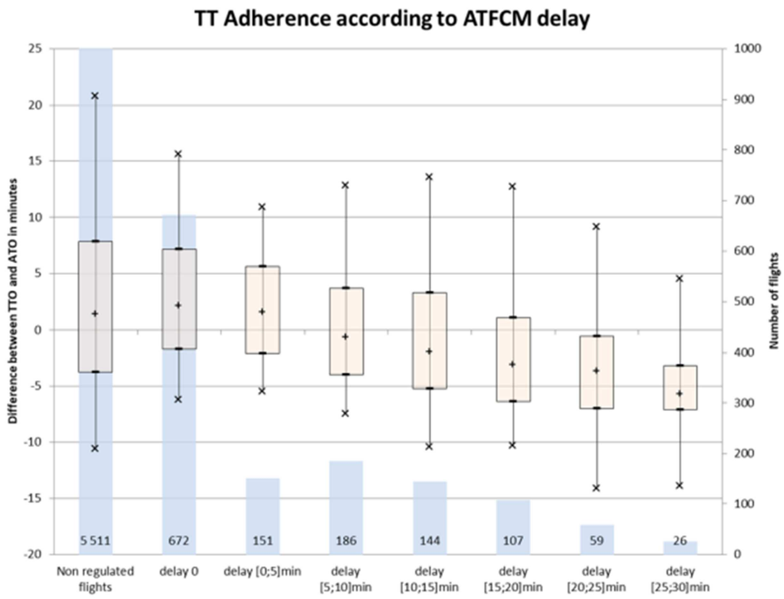


Figure 32: TT adherence according to generated ATFCM delay during UJ baseline

According to the figure above, we can notice the TT adherence is improved when ATFCM delays imposed to the aircraft are between 0 and 10 mins. That's due to the airlines trying to depart at CTOT-5 mins when ATFCM delays are >10 mins in order to catch up their delay.

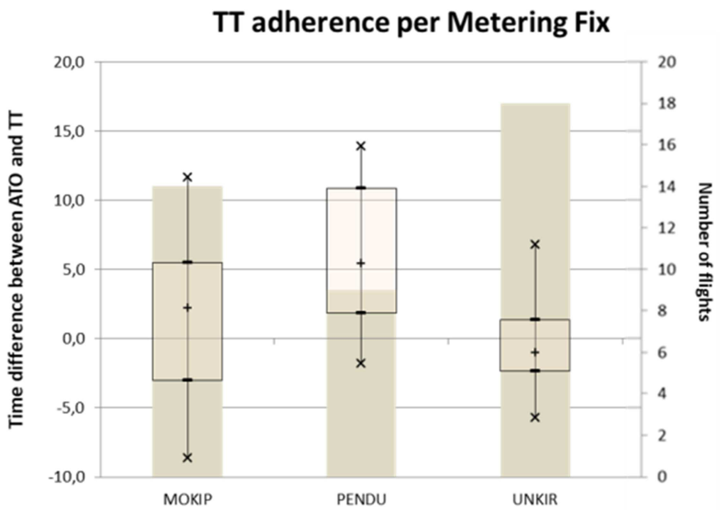


Figure 33: TT adherence by Metering Fix for flights optimized during conventional regulations or MCP regulations during EXE7#3-ETMA-2018-2

Either for the CTOT and TT adherence, we observe that the UNKIR navigation point (Metering Fix at the entry of UJ sector) is the one which respects more accurately the Target Time. It is also the point on which we have more trial flights and so, more "accurate" results. PENDU is showing an degraded

TT adherence due to low CTOT adherence for airports feeding this Metering Fix (i.e LFSB, OLBA, HECA..) as shown in the figure below:

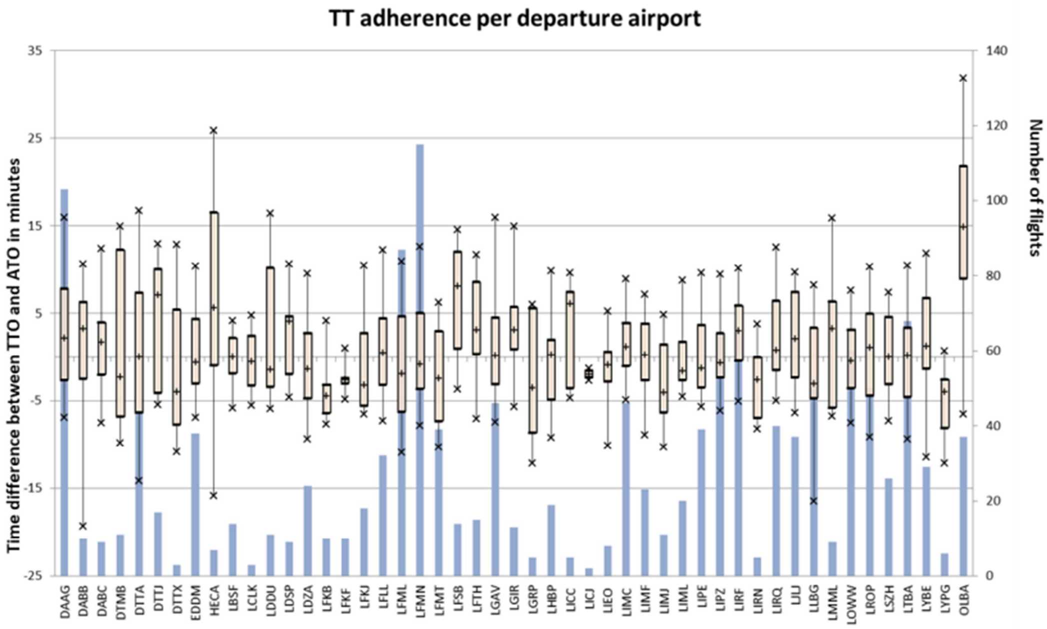


Figure 34: TT adherence per departure airport during baseline & EXE7#3-ETMA-2018-2

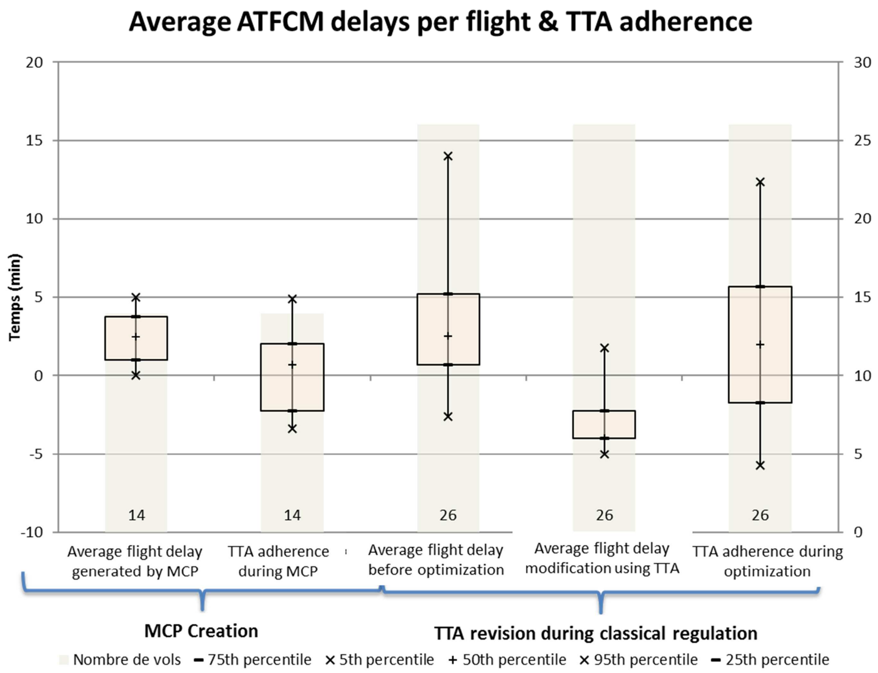


Figure 35: Average ATFCM delays per flight & TTA adherence during MCP creation or TTA revision during conventional regulation optimisation

According to the figure above, TTA adherence seems better for flights captured in MCP regulations compared to TTA sent during conventional regulation optimization. Since ATFCM delays generated by TTA during MCP regulations were around 9 mins per flight, that would explain the better adherence.

However the sample of the flights having a TTA captured in MCP regulation is quite low compared to the sample of flights having a TTA revised for optimization.

There is no obvious difference in TTA adherence between baseline & EXE7#3-ETMA-2018-2.

Time difference actual – planned (TE sector):

Quantitative assessment was made during EXE7#3-ETMA-2019 on TE sector.

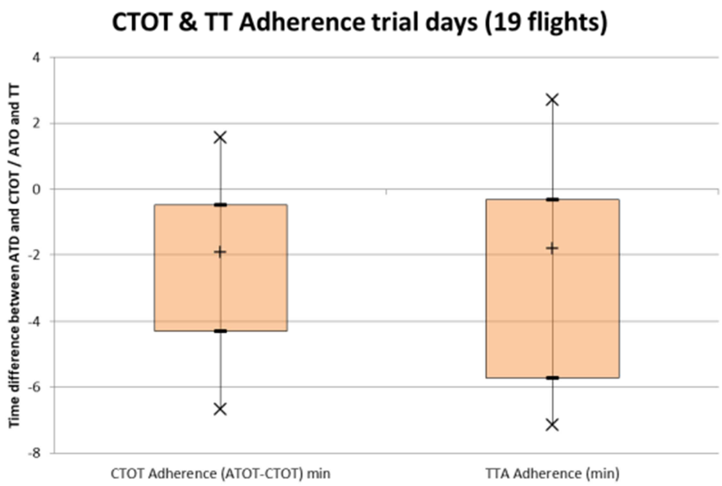


Figure 36: CTOT and TT adherence for flights having a revised TTA

We can see in the figure above that TT adherence is strongly linked to CTOT adherence.

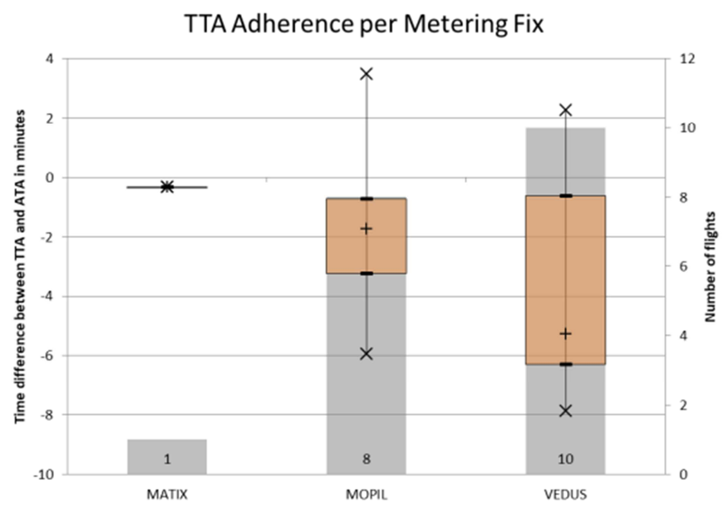


Figure 37: TT adherence by Metering Fix for flights optimized during conventional regulations or MCP regulations during EXE7#3-ETMA-2019

Either for the CTOT and TT adherence, we observe that the MOPIL navigation point (Metering Fix at the entry of TE sector) is the one which respects more accurately the Target Time. It is also the point on which we have more trial flights and so, more “accurate” results. VEDUS is showing a degraded TT adherence due to low CTOT adherence for airports feeding this Metering Fix and direct routes given upstream.

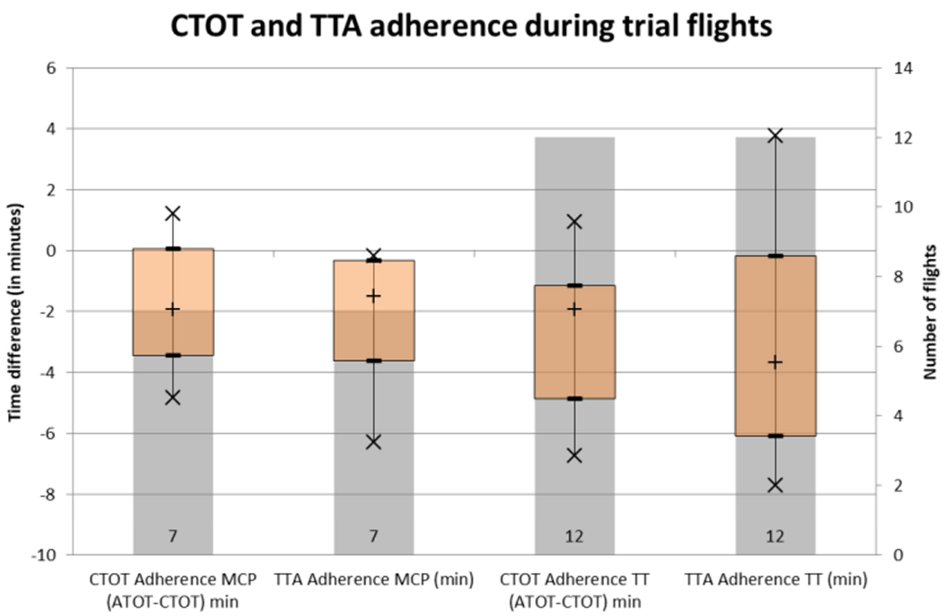


Figure 38: CTOT & TTA adherence during MCP creation or TTA revision during conventional regulation optimisation

According to the figure above, TTA adherence seems better for flights captured in MCP regulations compared to TTA sent during conventional regulation optimization. Since ATFCM delays generated by TTA during MCP regulations were around 6 mins per flight, which would explain the better adherence.

However the sample of the flights having a TTA captured in MCP regulation is quite low compared to the sample of flights having a TTA revised for optimization.

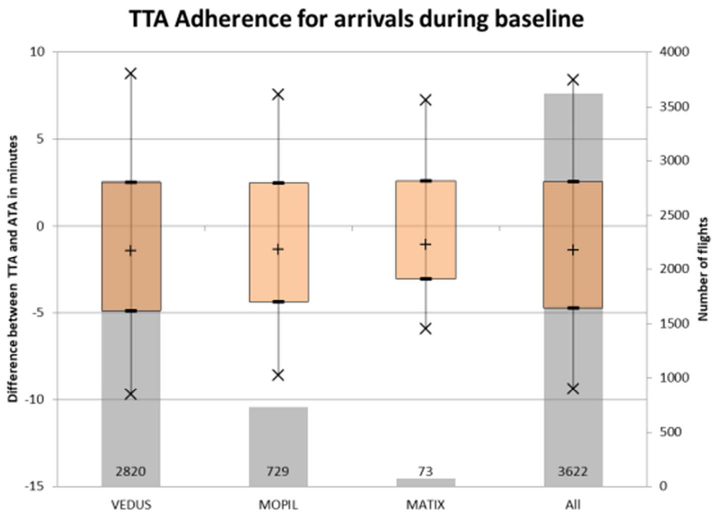


Figure 39: TTA adherence for arrivals during baseline

There is no obvious difference in TTA adherence between baseline & EXE7#3-ETMA-2019-2.

Landing sequence predictability

CPR and iAMAN scheduler data were used for this analysis. The results listed here were calculated with an in-house DLR software application which was developed especially for xStream performance assessment and calculates the number of sequence jumps in the predicted arrival sequence, compared to the actual arrival sequence, from the mentioned data.

All days between 01st September and 31th October 2018 that were no originally planned trial days were used as reference (21 days). Comparability checks indicated that the available 21 reference datasets are only limited usable to serve as baseline against the available 40 trial datasets due to occurrences of strong winds in most of the trial datasets.

Due to data quality (mainly mentioned comparability checks as well as gaps in the scheduler data), 2 of 21 reference datasets and 5 of 40 trial datasets are useable for analysis.

Within these trial datasets, described actions were actually performed on 1 of 5 usable trial datasets.

The following table shows the measured average number of sequence jumps per flight for CDG arriving traffic between actual landing sequence and planned arrival sequence at 50NM distance from CDG (hypothesis: Actions performed lead to a smoother and more predictable arrival flow). A distance of 50NM was chosen because of the proximity of the TE sector to CDG.

	Average sequence jumps per flight (standard deviation in brackets)	
	All usable datasets	Trial days with given speed advisories only
Reference	2,48 (SD: 0,257)	-
Trial	2,47 (SD: 1,095)	2,54 (SD: -)
Difference	-0,01	+0,06

Table 7: Landing sequence predictability results

Due to the very small sample size (5 trial datasets against 2 baseline datasets) the results in this table should be interpreted as "no change"; small differences are not interpretable.

K.3.2.1.1.2.2 Qualitative Assessment

None

K.3.2.1.1.3 KPA Cost Efficiency

K.3.2.1.1.3.1 Quantitative Assessment

Additional ASMA Time (UJ scenario):

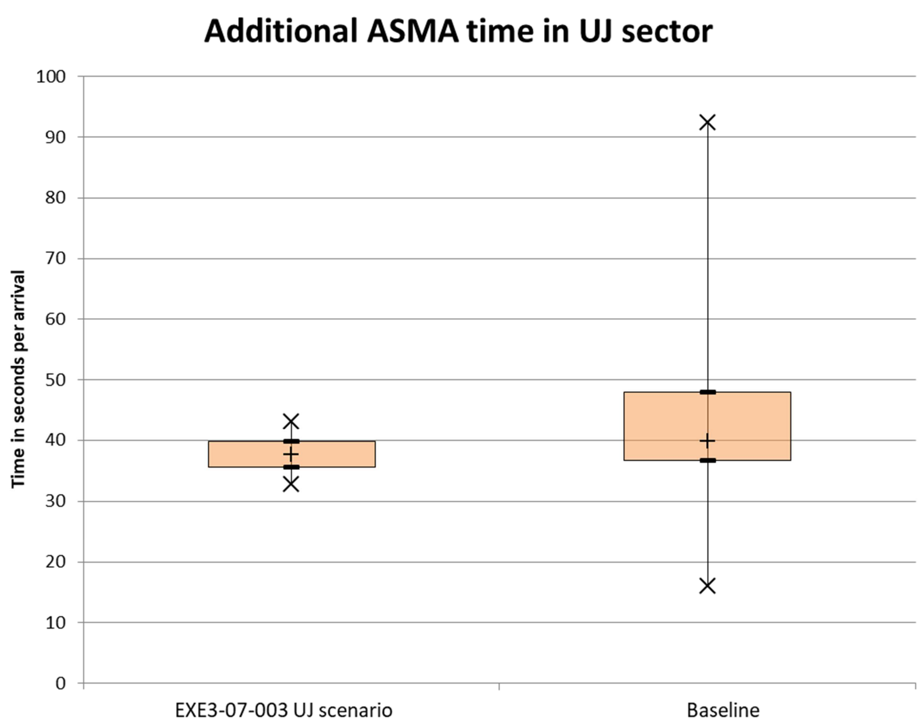


Figure 40: Additional ASMA time in UJ sector during baseline and EXE3-07-003 UJ scenario during EXE7#3-ETMA-2018-2

According to the figure above, there seems to be no change in the mean additional ASMA time between the baseline and the trial on the UJ sector. However, the additional ASMA seems to be less disperse.

Additional ASMA Time (TE scenario):

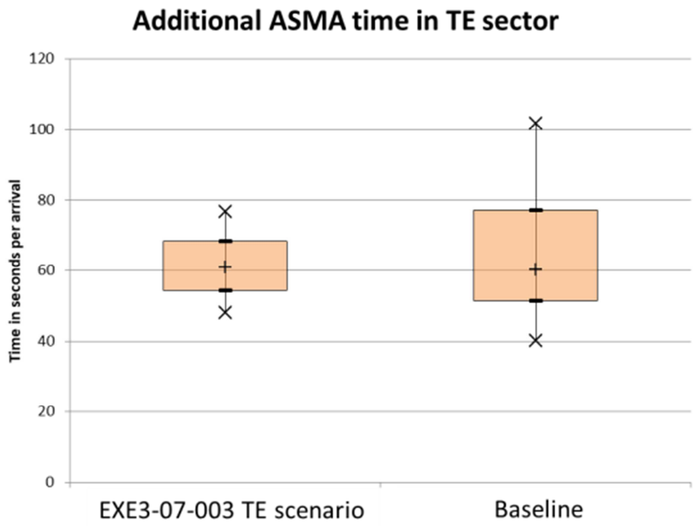


Figure 1: Additional ASMA time in TE sector during baseline and EXE3-07-003 TE scenario during EXE7#3-ETMA-2019

According to the figure above, there seems to be no change in the mean additional ASMA time between the baseline and the trial on the TE sector. However, the additional ASMA seems to be less disperse.

Number of Holding pattern flown in E-TMA:

No holding pattern was detected during EXE7#3-ETMA-2019 or baseline.

K.3.2.1.1.3.2 Qualitative Assessment

ANSP Costs:

Paris FMPs received training during their planned FMP course & multiple refresher course in Paris ACC. They also received training on iAMAN during their planned FMP shift and performed the trial days during planned FMP shifts. Therefore EXE-VLD-07-003 implied no extra cost for the ANSP. No additional staff needed to be recruited to conduct the trials.

AU Costs:

The Extended Arrival Management process as implemented does not require any change in the procedures of the airline neither on ground nor by the crew.

An information campaign to pilots and dispatchers has been organized to raise awareness about the purpose of the procedure: information about the new procedure would most probably have to be incorporated in the appropriate internal support, but the cost of this action is negligible.

K.3.2.1.1.4 KPA Capacity

K.3.2.1.1.4.1 Quantitative Assessment

Total ATFCM delay

Optimization of LFPG arrivals in Paris ACC TE and UJ sectors:

For ATFCM arrival regulation optimization, the summary of the demonstration exercises by E-TMA sector is listed in the table below:

Scenario	Number of regulations addressed	Number of flights with TTA requested	Implementation rate	% of actual delay difference in classical ATFCM regulations after implementation of TTA requests
UJ	14	45	69%	-4%
TE	10	47	49%	-7%
Total E-TMA	24	92	59%	-5%

Table 8: EXE3-VLD-07-003 E-TMA (Optimization) demonstration summary

As shown in the table above, the following results in terms of ATFCM delays reduction were obtained:

- An average reduction of 5% of ATFCM delay by regulation,
- An average delay reduction of 3 mins by selected flight having a revised TTA implemented.

When ATFCM regulations were optimised with iAMAN, as a result of EXE-VLD-07-003 E-TMA scenario, the ATFCM delay per regulation LFFTE3/LFFUJ was decreased by an average of 5%.

Electronical MCP regulation creation :

For MCP regulation creations, the summary of the demonstration exercises by E-TMA sector is listed in the table below:

E-TMA sector	Number of peaks addressed with MCP	Number of flights with TTA included in MCP	Average ATFCM delay per flight during MCP	Average ATFCM delay by regulation
UJ	5	21	4,2 mins	14 mins
TE	4	10	6 mins	13,8 mins
Total E-TMA	9	31	5 mins	14 mins

Table 9: EXE3-VLD-07-003 E-TMA (MCP) demonstration summary

When MCP regulations were implemented with iAMAN, as a result of EXE-VLD-07-003 E-TMA scenario, this helped:

- to avoid a conventional regulation,
- to minimize the number of flights impacted: according to the table above, during MCP regulations on E-TMA sectors, only an average of 3,6 flights were impacted by MCP regulation, with an average delay of 5 mins, which is minimal
- to have a better TT adherence and a better predictability since ATFCM delays generated per flight were around 5 mins

However, the sample of MCP regulations used to generate arrival ATFCM constraints is quite minimal, this kind of operations should be renewed to consolidate these conclusions.

K.3.2.1.1.4.2 Qualitative Assessment

<u>Questionnaire results related to TMA capacity:</u>

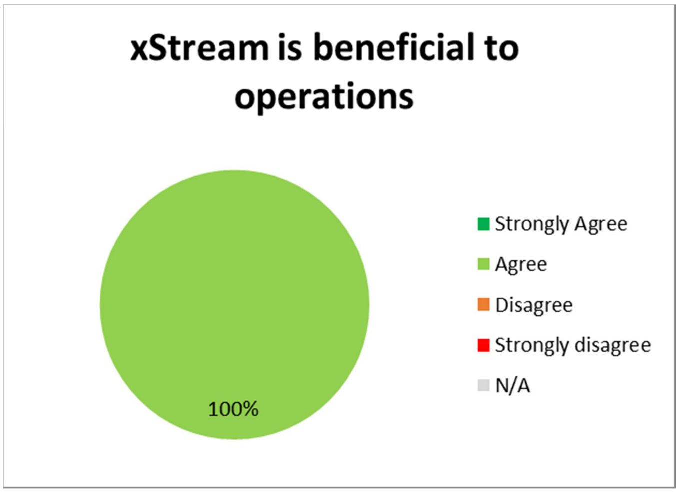


Figure 2: Feedback from Paris FMP regarding operational benefits during EXE-VLD-07-003 E-TMA scenarios

Feedback from 100% of Paris FMP who filled the questionnaires was very positive during EXE-VLD-07-003 E-TMA scenario about

- the ability to revise TTAs to optimize a conventional regulation,
- the use of iAMAN to electronically send MCP requests to mitigate the complexity in the E-TMA sector instead of
  - using a conventional regulation that would probably generate more delays and impact more flights,
  - or having a high traffic load for the E-TMA sector TE or UJ.

K.3.2.1.1.5 KPA Flexibility

No flexibility assessment was conducted during this EXE-VLD-07-003 E-TMA scenario.

K.3.2.1.2 Results impacting regulation and standardization initiatives

The implementation rate of TTA could be improved in the future, provided:

- The “Slot Zone” is wider (i.e. [-10 mins ; +10 mins]),
- The latest & earliest TTA possible to be given to a flight is available via NM B2B services,
- The “SLOT SWAP” & “FORCE CTOT” mechanisms used by NMOC don’t impact flights having received a revised TTA without coordination with the ATS unit having sent the TTA,

The predictability of the regulated arrival sequence and the confidence in using TTA and MCP could be improved in the future, provided the flight crew and the ATC of departure airport adhere more to the CTOT, and therefore to the TTA.

K.3.2.2 Analysis of Scenario Results per Demonstration objective

K.3.2.2.1 EXE-OBJ-VLD-01-001 Results

Objective: xStream operational improvements are respecting the current level of safety in air traffic management.

Success criterion: The safe management of traffic by ATC is not compromised. New procedures do not cause critical incidents.

This objective is fulfilled.

K.3.2.2.2 EXE-OBJ-VLD-02-001 Results

Objective: xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors.

Success criterion: Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced.

According to the results in K.3.2.1.1.2, the objective is not fulfilled.

K.3.2.2.3 EXE-OBJ-VLD-04-001 Results

Objective: xStream operational improvements increase cost efficiency from more efficient processes for AU.

Success criterion: Flight efficiency is increased and flight management / flight coordination costs are reduced.

During the EXE3-007-03 E-TMA trials, it has been demonstrated ATFCM delays could have been reduced with no negative impact on ATC workload, or flight efficiency. The objective is fulfilled.

K.3.2.2.4 EXE-OBJ-VLD-04-002 Results

Objective: xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.

Success criterion: ANSP personnel costs are maintained or reduced.

As Paris FMP received training during planned training hours and executed the trial during their planned FMP shifts, ANSP personnel costs are maintained. This objective is fulfilled.

K.3.2.2.5 EXE-OBJ-VLD-05-001 Results

Objective: ATC Capacity usage in TMA is optimized by xStream operational improvements.

Success criterion: Traffic Load, ATC Workload and Complexity in Terminal Sectors is reduced.

According to quantitative feedback in terms of ATFCM delay reduction (5%), and qualitative feedback from FMPs in terms of complexity mitigation and optimization of capacity in E-TMA, this objective is fulfilled.

K.3.2.2.6 EXE-OBJ-VLD-05-003 Results

Objective: xStream operational improvements lead to a reduction of ATFCM measures.

Success criterion: Flight delay caused by ATFCM is reduced.

During optimization of classical E-TMA regulation, average flight delay caused by ATFCM is reduced by 3 mins, and arrival ATFCM regulation delays were reduced by 5%.

During MCP regulations, average flight delay was 5 mins but helped to avoid a conventional regulation generating more delays and capturing more flights, according to FMP feedback.

The objective is fulfilled.

K.3.2.2.7 EXE-OBJ-VLD-06-001 Results

Objective: xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users.

Success criterion: Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased.

No flexibility exercise was implemented during EXE-VLD-07-003 E-TMA scenario.

K.3.2.3 Unexpected Behaviours / Results

During EXE-VLD-07-003 E-TMA scenario, Paris FMPs only managed to implement 59% of their sent TTA to NM via iAMAN because of multiple reasons:

- TTA sent by Paris FMP too late (at a time too close to COBT),
- TTA outside the Slot Zone and no availability in the slot list,
- After TTA implementation by ETFMS after request from Paris FMP, flights could be allocated a new CTOT due to
    - DPI from departure airport,
    - Force CTOT from NM,
    - Slot Swap mechanism enforced by NMOC,
    - New regulation enroute being most penalizing.

During MCP regulation creation with iAMAN, it was impossible for Paris FMP to ask for ATFCM delay greater than 10 minutes, due to technical limitations of iAMAN tool.

The average results obtained regarding Predictability (see K.3.2.1.1.2) are logical since no formal briefing had been made to flight crews or departure airports regarding CTOT and TTA adherence, thus no improvement can be seen over day-to-day operations.

K.3.2.4 Confidence in the Demonstration Results

K.3.2.4.1 Level of Significance / Limitations of Demonstration Exercise Results

EXE-VLD-07-003 E-TMA scenario was applied during the busiest CDG arrival peaks flying through UJ and TE sectors. Paris FMP were properly trained on the concept and on iAMAN tool so they could pick the most relevant flights to receive TTA revision in order to better match E-TMA capacity with the demand. A checklist was prepared for Paris FMP operators so the concept is properly applied, and an operational instruction was issued to Paris ACC Supervisors.

The demonstrations exercises were limited by NM “Slot Zone” of -5 mins / +10 mins which limited TTA implementation and limited the efficiency of the request ATFCM delay reductions.

However, with a fair implementation rate of 59% of TTA regarding conventional regulation optimisation, a total of 92 flights among 24 peaks were optimized which represents a valid sample for analysis.

Regarding MCP regulation creation, only 31 flights among 9 peaks were included in MCP regulations created with iAMAN, with TTA being sent with the tool. This sample would need to be increased for a more significant performance analysis.

K.3.2.4.2 Quality of Demonstration Exercise Results

Demonstrations results were compiled in different ways:

For quantitative results, the data was obtained from Eurocontrol data for TTA and CTOT adherence calculation, during the busiest periods of the trials (period of EXE7#3-ETMA-2018-2 for UJ sector and EXE7#3-ETMA-2019 for TE sector). For ATFCM delay calculation, data was extracted from CHMI: ATFCM delay was calculated between the initial ATFCM delay generated for the revised flights and the delays generated after the implementation of the TTA in the ETFMS. Therefore, the difference between the total amount of saved ATFCM delays and the total amount of generated ATFCM delays for the arrival regulations could be calculated.

These calculations about ATFCM delay optimization were made for 14 LFFUJ regulations and 10 LFFTE3 regulations during main arrival peaks into Paris-CDG.

For qualitative results, questionnaires were distributed during the whole trial periods but only 10 FMP questionnaires were collected, and post trials interviews were made.

About TT/CTOT adherence and additional ASMA calculation, calculation was made during EXE7#3-ETMA-2018-2 on UJ sector and EXE7#3-ETMA-2019 on TE sector.

K.3.2.4.3 Significance of Demonstration Exercise Results

EXE3-VLD-07-003 E-TMA scenario was performed during the busiest period in Paris ACC regarding TE and UJ sector traffic and regulation activation. Paris FMP were fully trained on iAMAN tool and on the concept and were informed of the limitations of the tool and by NM systems.

With an implementation rate close to 60% and ATFCM delay reductions by 5% during the busiest arrivals peaks for CDG via the TE and UJ sector, the results should be considered as significant. Moreover, this result was obtained without any impact regarding ATC workload.

Results regarding TT adherence show the adherence to TT is strongly linked to CTOT adherence. However, TT adherence during MCP regulations, even if improved compared to conventional regulation optimization, lacks a large sample to draw a final conclusion.

K.3.3 CDG Scenario

This scenario was planned from May 23, 2019 to June 14, 2019. The objective was to use iAMAN to electronically create MCP for Paris CDG arrival regulation LFPGARR1 & populate them with selected flights' TTA.

The summary of the demonstration exercise is shown below:

Number of peaks addressed with MCP	Number of flights with TTA included in MCP	Average ATFCM delay per flight during MCP	Average ATFCM delay by regulation
3	16	8 mins	42 mins

Table 10: EXE-VLD-07-003 CDG demonstration summary

During the planned period of EXE-VLD-07-003, only 3 "P6" peaks between 17h00 UTC and 18h00 UTC were trialled.

The average delay per flight during MCP LFPGARR1 regulations was 8 mins, and the average MCP LFPGARR1 regulation was 42 mins.

Below is an example of the trial that took place on 01st of June 2019 (7 flights captured in LFPGARR1 MCP with 9 minutes ATFCM delay each):

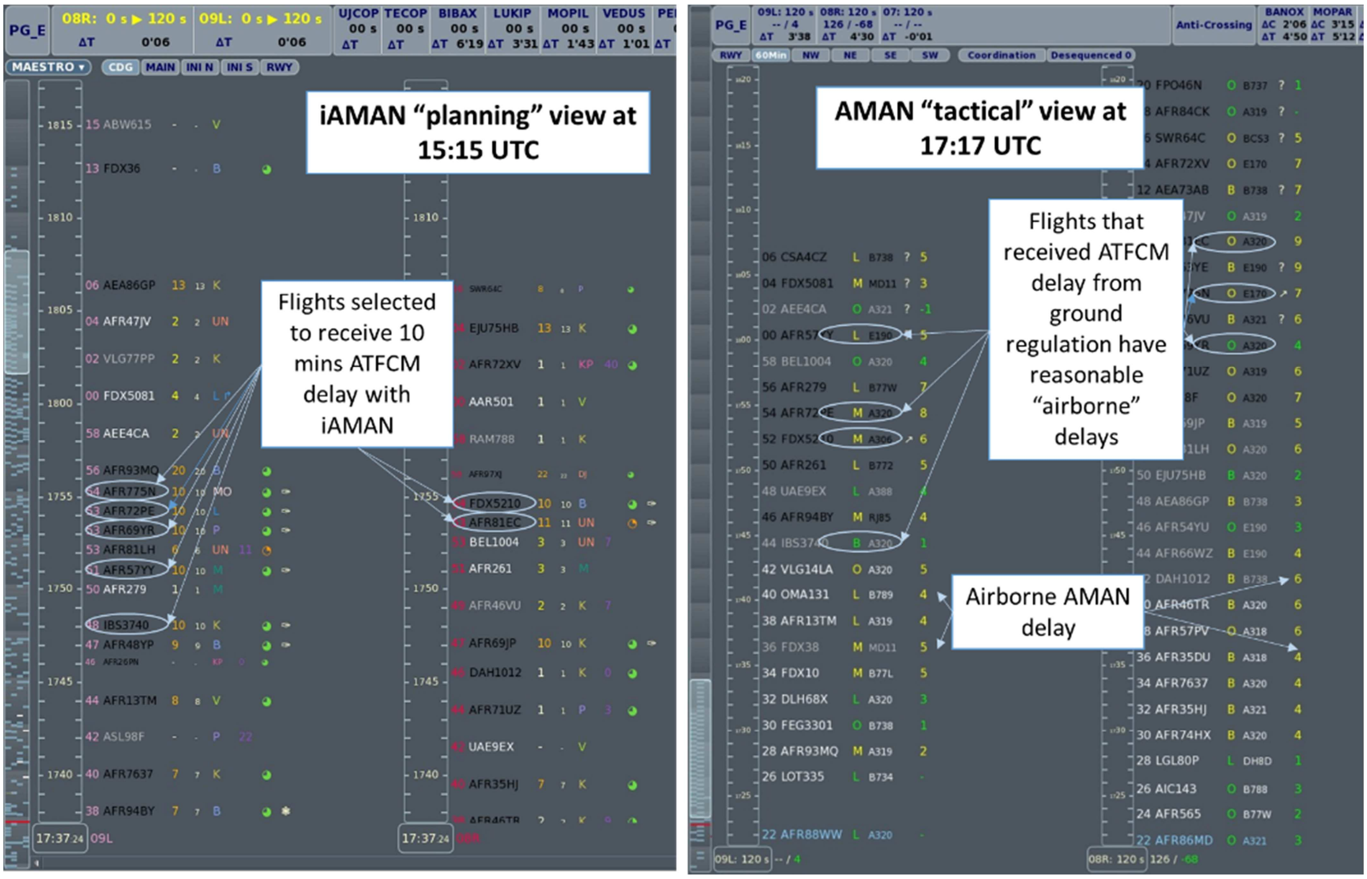


Figure 3: iAMAN view at 15:15 UTC (left) and AMAN view at 17:17 UTC (right) of P6 peak for CDG arrivals

In this example, 7 CDG arrivals received TTAs generated by Paris CDG approach supervisor and were sent to NM by Paris FMP. Thus, they received CTOTs and were captured in the MCP arrival regulation.

Consequently, once in the regular 120 NM AMAN horizon, the arrival sequence was recalculated according to the actual flight positions detected by Paris ACC radars and AMAN (airborne) delay was calculated. The calculated AMAN delay for these 7 flights was reasonable and comparable to the other arrivals AMAN delay. The generation of ATFCM delay allowed AMAN delay not to build up too high and to be absorbed by using ATFCM delays on a few flights.

K.3.3.1 Summary of Scenario Results

See Main Document chapter 4.1.2.3.1.

K.3.3.1.1 Results per KPA

Quantitative assessment:

Baseline was chosen between 01st of April 2019 and 23rd of May 2019, during P6 arrival peak in Paris-CDG, with no other ATFCM regulation in effect in Paris ACC or CDG, with no special weather phenomenon detected, with a comparable amount of arriving traffic during the P6 time period. That represents 16 P6 arrival peaks into Paris-CDG.

Qualitative assessment:

No questionnaires were filled by Paris FMP. Only Paris-CDG supervisors filled questionnaires during the trial peaks during the 3 days of trial.

K.3.3.1.1.1 KPA Safety

K.3.3.1.1.1.1 Quantitative Assessment

Number of Incident Reports:

No incident has been reported in connection with EXE-VLD-07-003 CDG scenario in Paris-CDG or in Paris-ACC.

K.3.3.1.1.1.2 Qualitative Assessment

No questionnaire about safety was filled by Paris CDG supervisors or Paris FMP.

K.3.3.1.1.2 KPA Predictability and Punctuality

K.3.3.1.1.2.1 Quantitative Assessment

Time difference actual – planned

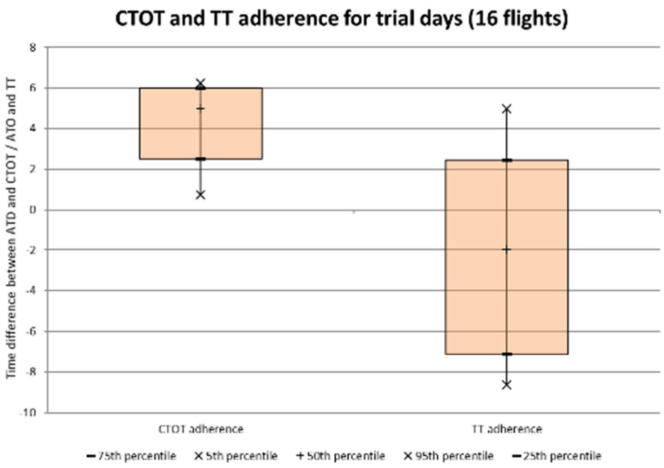


Figure 4: CTOT and TT adherence during EXE-VLD-07-003 CDG scenario

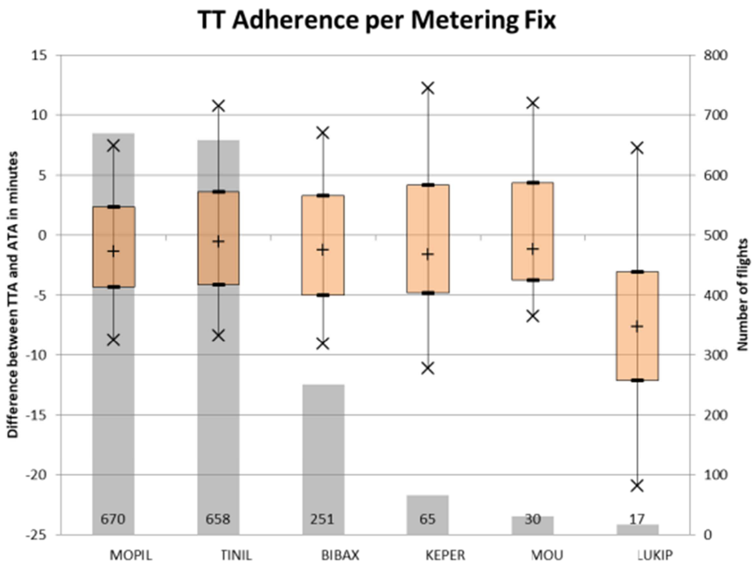


Figure 5: TT adherence per Metering Fix during baseline

We can observe no difference between TT adherence between the baseline and the EXE-VLD-07-003 CDG scenario.

Landing sequence predictability

CPR and iAMAN scheduler data were used for this analysis. The results listed here were calculated with an in-house DLR software application which was developed especially for xStream performance assessment and calculates the number of sequence jumps in the predicted arrival sequence, compared to the actual arrival sequence, from the mentioned data.

All days between 01st May and 30th June 2019 that were no originally planned trial days were used as reference (40 days). Due to data quality (mainly data gaps in the scheduler data), 6 of 40 reference datasets and 7 of 21 trial datasets are useable for analysis.

Within these trial datasets, actions were taken on 3 of 7 usable trial datasets.

Comparability checks indicated that the used 6 reference datasets are usable to serve as baseline against the remaining 7 trial datasets.

The following table shows the measured average number of sequence jumps per flight for CDG arriving traffic between actual landing sequence and planned arrival sequence at 100NM distance from CDG (hypothesis: operational improvement leads to a smoother and more predictable arrival flow).

	Average sequence jumps per flight (standard deviation in brackets)	
	All usable datasets	**Trial days where actions were taken only**
Reference	2,76 (SD: 0,50)	-
Trial	2,17 (SD: 0,70)	1,37 (SD: 1,21)
Difference	-0,59	-1,39

Table 1: Landing sequence predictability results

A clear decrease of the average number of sequence jumps per flight can be seen, indicating an improved predictability of the whole arrival sequence for all LFPG arrivals.

K.3.3.1.1.2.2 Qualitative Assessment

In questionnaires filled by Paris-CDG approach supervisors and post-trial interviews, their feedback indicated the landing sequence predictability was accurate when comparing iAMAN for arrival planning and AMAN for tactical arrival sequencing. Moreover, the use of iAMAN in the planning phase on top of a CHMI tool is seen as positive in assessing the situation regarding a busy arrival peak.

K.3.3.1.1.3 KPA Cost Efficiency

K.3.3.1.1.3.1 Quantitative Assessment

<u>Additional ASMA Time (optional):</u>

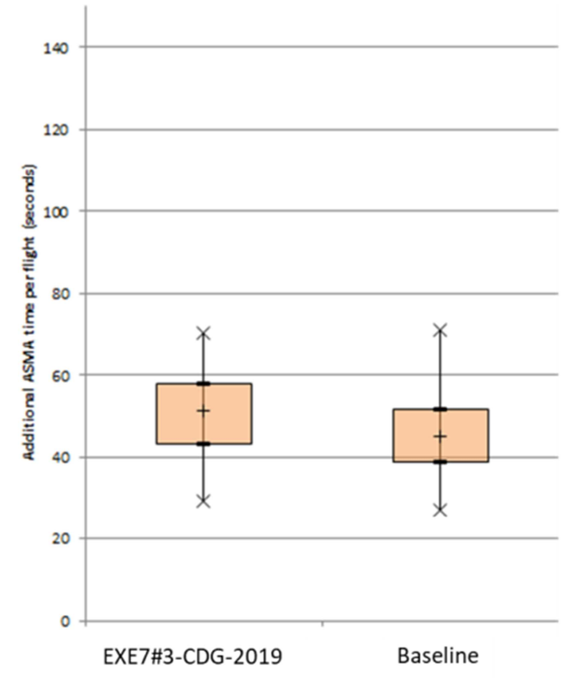


Figure 6: Additional ASMA time per flight during Baseline and EXE7#3-CDG-2019

Analysis of additional ASMA time per flight during EXE7#3-CDG-2019 and its comparison with the baseline show no obvious difference, especially regarding the low number of trial days (3) and the sensibility of ASMA figures in relation with the weather parameters (i.e wind, temperature etc.).

Number of Holding pattern flown in TMA (optional):

No holding pattern was detected during EXE7#3-CDG-2019 or baseline.

K.3.3.1.1.3.2 Qualitative Assessment

Questionnaire results / other feedback related to ANSP Cost Efficiency

Paris FMPs & Paris CDG supervisors received training during their planned FMP course & multiple refresher course. They also received training on iAMAN during their planned shift and performed the trial days during planned shifts. Therefore EXE-VLD-07-003 implied no extra cost for the ANSP. No additional staff needed to be recruited for performing the trials.

K.3.3.1.1.4 KPA Capacity

K.3.3.1.1.4.1 Quantitative Assessment

Runway throughput

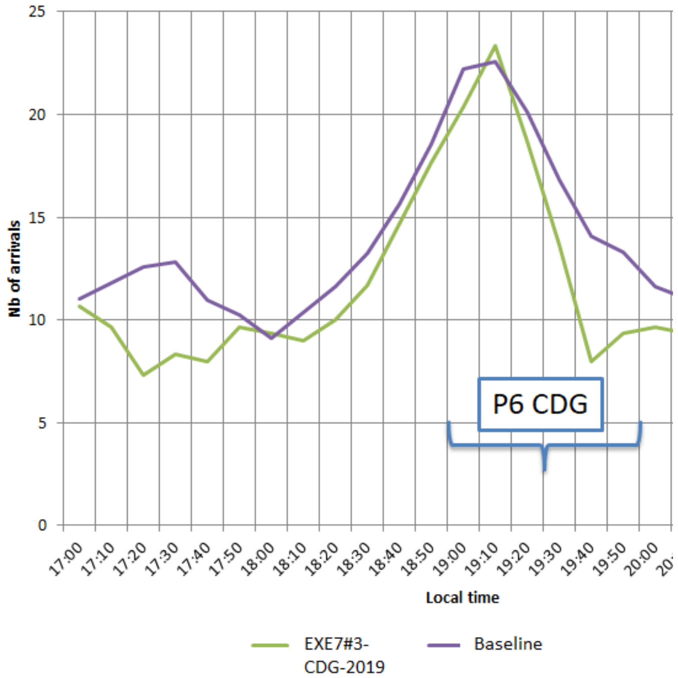


Figure 7: Runway throughput comparison between baseline and P6 CDG MCP trials

Runway throughput analysis between EXE7#3-CDG-2019 and baseline shows a similar number of arrivals during the P6 arrival period, especially during the core of the peak between 19:00 and 19:30 LOC.

Total ATFCM delay

When MCP regulations were implemented for CDG arrivals, as a result of EXE7#3-CDG-2019, this generated an average of 8 minutes of delay ATFCM delays per flight, and 42 minutes per MCP regulation. More details are shown in the table below:

Date	Number of flights with TTA included in MCP regulation	Average ATFCM delay per flight during MCP regulation	Total ATFCM delay
23/05/2019	7	6,6 mins	46 mins
26/05/2019	2	9 mins	18 mins
01/06/2019	7	9 mins	63 mins

Table 11: EXE7#3-CDG-2019 trial dates and MCP details

K.3.3.1.1.4.2 Qualitative Assessment

In questionnaires filled by Paris-CDG approach supervisors and post-trial interviews, their feedback indicated:

- Runway throughput was maintained at a high level,
- Impact on the arrival sequence was felt positively by CDG Approach ATCOs in terms of reduction of the ATC workload in the TMA for the Approach controllers.

K.3.3.1.1.5 KPA Flexibility

No flexibility related modification was implemented during this EXE-VLD-07-003 CDG scenario.

K.3.3.1.2 Results impacting regulation and standardization initiatives

The implementation rate of TTA could be improved in the future, provided:

- The latest & earliest TTA possible to be given to a flight is available via NM B2B services,
- The “SLOT SWAP” & “FORCE CTOT” mechanisms enforced by NMOC don’t impact flights having received a revised TTA without coordination with the ATS unit having sent the TTA.

The predictability of the regulated arrival sequence and the confidence in using TTA and MCP could be improved in the future, provided the flight crew and the ATC of departure airport adhere more to the CTOT, and therefore to the TTA.

K.3.3.2 Analysis of Scenario Results per Demonstration objective

K.3.3.2.1 EXE-OBJ-VLD-01-001 Results

Objective: xStream operational improvements are respecting the current level of safety in air traffic management.

Success criterion: The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents.

According to reports from Paris ACC and Paris CDG, this objective is fulfilled.

K.3.3.2.2 EXE-OBJ-VLD-02-001 Results

Objective: xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors

Success criterion: Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced

According to qualitative feedback, this objective is fulfilled.

K.3.3.2.3 EXE-OBJ-VLD-04-001 Results

Objective: xStream operational improvements increase cost efficiency from more efficient processes for AU.

Success criterion: Flight efficiency is increased and flight management / flight coordination costs are reduced.

The reduction of ATFCM delay and of Additional ASMA time brings a benefit through smoother operation, which will require less actions from AU personnel to seek improvements. This objective is fulfilled.

K.3.3.2.4 EXE-OBJ-VLD-04-002 Results

Objective: xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.

Success criterion: ANSP personnel costs are maintained or reduced.

As Paris FMP & CDG supervisors received training during planned training hours and executed the trial during their planned shifts, ANSP personnel costs are maintained. This objective is fulfilled.

K.3.3.2.5 EXE-OBJ-VLD-05-001 Results

Objective: ATC Capacity usage in TMA is optimized by xStream operational improvements.

Success criterion: Traffic Load, ATC Workload and Complexity in Terminal Sectors is reduced.

According to qualitative data, complexity & ATC workload in the TMA has been reduced.

The objective is fulfilled.

K.3.3.2.6 EXE-OBJ-VLD-05-003 Results

Objective: xStream operational improvements lead to a reduction of ATFCM measures.

Success criterion: Flight delay caused by ATFCM is reduced.

MCP regulations generated ATFCM delays to lower the pressure & ATC workload in the TMA.

The objective is not fulfilled.

K.3.3.2.7 EXE-OBJ-VLD-06-001 Results

Objective: xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users.

Success criterion: Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased.

No flexibility exercise was implemented during EXE7#3-CDG-2019.

K.3.3.3 Unexpected Behaviours / Results

The trials were planned between 23rd of May 2019 and 14th of June 2019 during the P6 peak between 17h UTC and 18h UTC. However, the trial was activated only 3 times because of:

- LFFUJ or LFFTE3 ATFCM arrival regulation already spreading the traffic in CDG,
- Weather issues (i.e. CBs),
- Low traffic demand.

Moreover, iAMAN faced technical difficulties and the electronical creation of MCP regulations was impossible with the current settings of iAMAN. That was also the case for TTA sending during this trial.

Therefore, the trial could be run 3 times with only phone coordination between Paris FMP & NM to create the MCP regulations and to delay the selected flights by Paris-CDG. The phone coordination between Paris FMP & NM were long & complex because of all the details to transmit to NM only by phone.

K.3.3.4 Confidence in the Demonstration Results

K.3.3.4.1 Level of Significance / Limitations of Demonstration Exercise Results

EXE-VLD-07-003 CDG scenario was applied during the "P6" peak, one of the busiest CDG arrival peaks during the day. Paris FMP and Paris CDG Supervisors were properly trained on the concept and on iAMAN tool so they could pick the most relevant flights to be included in a MCP regulation. A checklist was prepared for Paris FMP and Paris CDG Supervisors operators so the concept is properly applied.

However, on many occasions, the P6 arrival peaks couldn't be trialled if the traffic demand was too low, if CBs were impacting the air traffic management strategies, and if arrival traffic was already regulated by E-TMA ATFCM regulations (in UJ or TE sector). The generated ATFCM delays for CDG arrivals, in the scope of this trial, was limited to 10 mins to avoid generating excessive delays for the flights.

K.3.3.4.2 Quality of Demonstration Exercise Results

EXE7#3-CDG-2019 was planned during one of Paris-CDG busiest arrival peak and managed to lower the pressure in the TMA, reducing ATC workload while maintaining a high runway throughput. This was achieved using MCP regulations capturing a few arrivals, and not imposing a conventional regulation to a large number of flights. However, demonstration exercise results in terms of additional ASMA calculation are limited since ASMA may be very sensitive to weather parameters (temperature, wind etc..) and the amount of sample is very low (only 3 trial dates).

Demonstrations results were compiled in different ways:

For quantitative results, the data was obtained from Eurocontrol data for TTA and CTOT adherence calculation, during the period of trials. For ATFCM delay calculation, data was extracted from CHMI.

The baseline was chosen between 01st of April 2019 and 23rd of May 2019, during P6 arrival peak in Paris-CDG, with no other ATFCM regulation in effect in Paris ACC or CDG, with no special weather phenomenon detected, with a comparable amount of arriving traffic during the P6 time period. That represents 16 P6 arrival peaks into Paris-CDG

The runway throughput between the baseline and the trials is comparable with a very high value, indicating the P6 peak is significant to trial such a procedure for arrival management.

For qualitative results, questionnaires were distributed to Paris-CDG supervisors who were actually running the trial but only 3 questionnaires were collected, and post trials interviews were made.

K.3.3.4.3 Significance of Demonstration Exercise Results

Only 16 flights among 3 peaks were included in MCP regulations during the trials. Even if occurred during a very busy peak, and even if the results are positive in terms of predictability and ATC workload mitigation in the TMA, this type of process for arrival management during a busy arrival peak should be experimented again in the future to have more data to build a solid analysis.

K.3.4 Orly Scenario

This scenario was planned from January, 10th 2019 to June 14, 2019. The objective was to use iAMAN to optimize LFPOARR2 ATFCM arrival regulations by sending revised TTA using iAMAN, installed both on Paris FMP position and in Orly Tower Supervisor position.

Below is an example of a potential optimization of an arrival (VLG8635) to Paris-Orly during a LFPOARR2 regulation and a runway arrival rate of 1 arrival per 90s. In this example, VLG8635 received an ATFCM delay of 24 mins due to LFPOARR2 regulation, and according to the mentioned runway arrival rate, generating a capacity gap between 17:01 and 17:06 at the runway. Therefore, VLG8635 Schedule Time of Arrival could be upgraded from 17:06 to 17:03, potentially generating an improvement of 3 mins of ATFCM delays thus improving the efficiency of the arrival sequence and potentially optimizing the runway throughput.

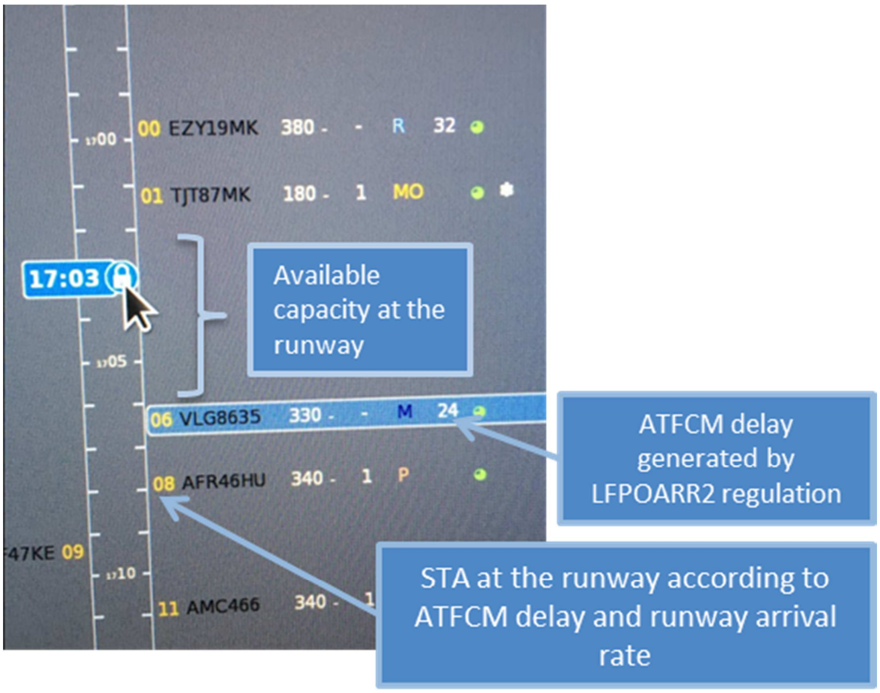


Figure 8: Example of VLG8635 being able to be optimized during LFPOARR2 regulation using TTA revision

The summary of the demonstration exercise is shown below:

Number of regulations addressed	Number of flights having TTA request by Paris FMP	Average requested action by Paris FMP	Nb of flights requested to have additional delays	Nb of flights requested to have reduced delays	Number of flights with TTA implemented	Implementation rate	Actual average delay modification per flight
14	102	-3,4 mins	4	98	83	81%	-3,7 mins

Table 12: EXE-VLD-07-003 Orly demonstration summary

During the planned period of EXE-VLD-07-003 Orly scenario, any peak during the day could be trialled.

The trial was not activated during many days due to different causes:

- Low traffic demand / no ATFCM regulation activated;
- iAMAN technical issues;
- Industrial action;

- Weather issues (CB activity).

Furthermore, the overall implantation rate is at 81% due to the following factors:

- DLA sent by the AU shifting the flight after the regulated period;
- API service closed by NM due to AIRAC change;
- TTA sent by Paris FMP too late to be implemented by ETFMS;
- After TTA implementation by ETFMS after request from Paris FMP, flights could be allocated a new CTOT due to:
    - REA messages,
    - DLA sent by AU,
    - Force CTOT from NM,
    - New enroute regulation being most penalizing.

K.3.4.1 Summary of Scenario Results

See Main Document chapter 4.1.2.3.2.

K.3.4.1.1 Results per KPA

Quantitative assessment:

The baseline used for quantitative results in terms of additional ASMA calculation and TT adherence consists of 81 LFPOARR2 regulations due to “ATC Capacity” or “Aerodrome Capacity” from 10/01/2019 until 14/06/2019.

Qualitative assessment:

Only 2 questionnaires were filled by Paris FMP during with EXE-VLD-07-003 Orly scenario. Further post trial interviews with Paris FMP were performed for feedback collection.

K.3.4.1.1.1 KPA Safety

K.3.4.1.1.1.1 Quantitative Assessment

Number of Incident Reports:

No incident has been reported in connection with EXE-VLD-07-003 Orly scenario in Paris-Orly or in Paris-ACC.

K.3.4.1.1.1.2 Qualitative Assessment

According to FMP questionnaires, the trials had no impact on safety.

K.3.4.1.1.2 KPA Predictability and Punctuality

K.3.4.1.1.2.1 Quantitative Assessment

Time difference actual – planned

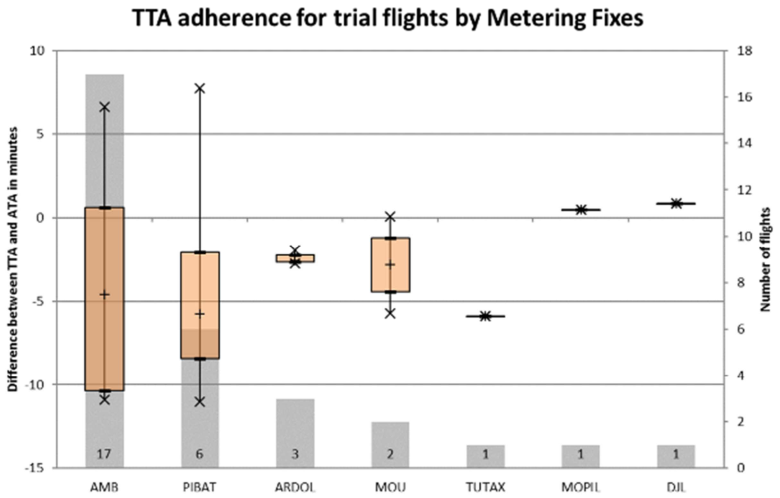


Figure 9: TT adherence for trial flights during EXE-VLD-07-003 Orly scenario

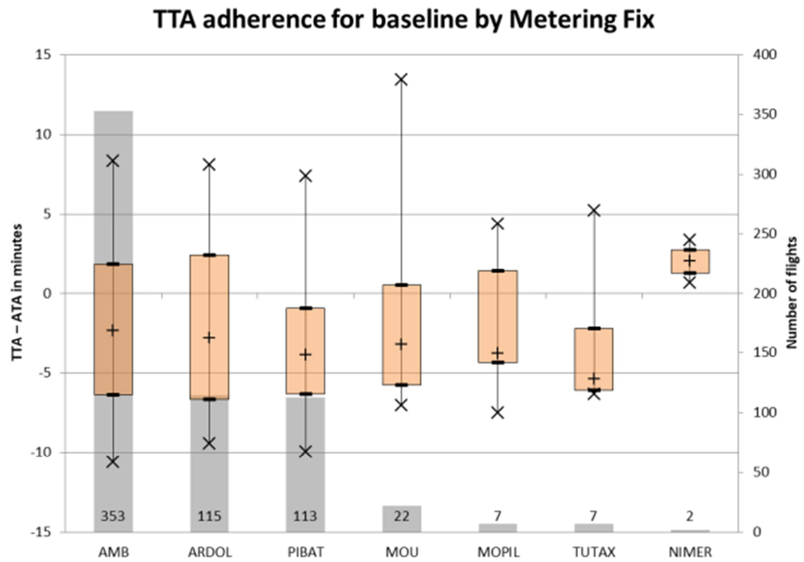


Figure 10: TT adherence for flights during baseline

We can observe no clear difference between TT adherence between the baseline and the EXE-VLD-07-003 Orly scenario.

Landing Sequence Predictability:

CPR and iAMAN scheduler data were used for this analysis. The results listed here were calculated with an in-house DLR software application which was developed especially for xStream performance assessment and calculates the number of sequence jumps in the predicted arrival sequence, compared to the actual arrival sequence, from the mentioned data.

All days between 1st October 2018 and 15th June 2019, that were no originally planned trial days were used as reference (102 days). Due to data quality (problems decoding the data), 6 of 102 reference datasets and 22 of 156 trial datasets are useable for analysis.

Within these trial datasets, actions were taken on 6 of 22 usable trial datasets.

It has to be noted that results may be unreliable as only 6 reference datasets are compared against 22 trial datasets.

The following table shows the measured average number of sequence jumps per flight for LFPO arriving traffic between actual landing sequence and planned arrival sequence at 100NM distance from LFPO (hypothesis: modifications lead to a smoother and more predictable arrival flow of the traffic closer to the airport).

	Average sequence jumps per flight (standard deviation in brackets)	
	All usable datasets	**Trial days with given speed advisories only**
Reference	0,70 (SD: 0,54)	-
Trial	0,85 (SD: 0,53)	0,76 (SD: 0,12)
Difference	+0,15	+0,06

Table 1: Landing sequence predictability results

It has to be stressed again that a lot of data could not be used for analysis. Further, there are only few usable samples for the reference. Therefore, these results may be on one hand unprecise and on the other hand not representative for the whole trial period.

K.3.4.1.1.2.2 Qualitative Assessment

Feedback from Paris FMP indicates the use of iAMAN by Paris FMP was an accurate indicator for Paris-Orly arrivals, in terms of incoming traffic load on the runway, available capacity at the runway and arrival sequencing. Moreover, the use of iAMAN in the planning phase on top of a CHMI tool is seen as positive in assessing the situation regarding a busy arrival peak.

K.3.4.1.1.3 KPA Cost Efficiency

K.3.4.1.1.3.1 Quantitative Assessment

Additional ASMA time

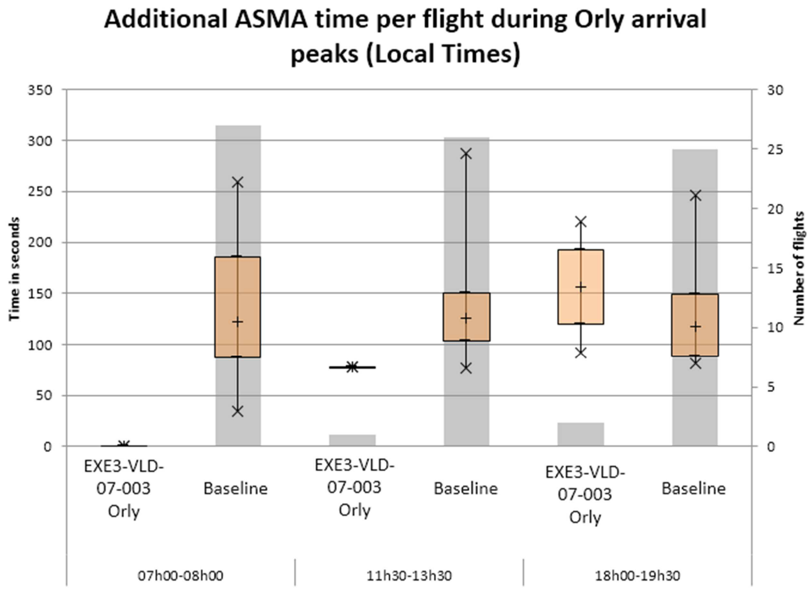


Figure 11: Additional ASMA per flight for Orly arrivals in TMA and E-TMA during baseline and EXE3-VLD-07-003 Orly scenario

According to the figure above, additional ASMA per arrival during EXE7#3-ORLY-2019 was not degraded compared to the baseline. However the sample is too limited to draw a conclusion.

K.3.4.1.1.3.2 Qualitative Assessment

Questionnaire results / other feedback related to ANSP Cost

Paris FMPs received training during their planned FMP course & multiple refresher course in Paris ACC. They also received training on iAMAN during their planned FMP shift and performed the trial days during planned FMP shifts. Therefore EXE-VLD-07-003 implied no extra cost for the ANSP.

Questionnaire results / other feedback related to AU Cost

The Extended Arrival Management process as implemented does not require any change in the procedures of the airline neither on ground nor by the crew.

An information campaign to pilots and dispatchers has been organized to raise awareness about the purpose of the procedure: information about the new procedure would most probably have to be incorporated in the appropriate internal support, but the cost of this action is negligible.

K.3.4.1.1.4 KPA Capacity

K.3.4.1.1.4.1 Quantitative Assessment

Total ATFCM delay

The summary of demonstrations is shown below:

Number of regulations addressed	Number of flights having implemented TTA	Average ATFCM delay by regulation	% of delay difference requested by Paris FMP using TTA	% of delay difference implemented using TTA
14	83	445 mins	-9%	-6%

Table 13: EXE3-VLD-07-003 Orly demonstration summary

During EXE-VLD-07-003 Orly scenario, Paris FMP transmitted revised TTA requests to NM for Paris-Orly arrivals captured in LFPOARR2 regulations, representing:

- An average reduction of 6% of ATFCM delay by regulation,

An average delay reduction of 3,7 mins by selected flight having a revised TTA sent.

When ATFCM arrival regulations were optimised with iAMAN, as a result of EXE-VLD-07-003 Orly scenario, the ATFCM delay per regulation LFPOARR2 was decreased by an average of 6%.

K.3.4.1.1.4.2 Qualitative Assessment

Questionnaire results related to TMA capacity

Questionnaire feedback shows the scenario is an enabler to an increase of capacity.

Other subjective feedback related to TMA capacity

Paris FMP assessed EXE-VLD-07-003 Orly scenario enabled the use of iAMAN as an efficient tool to optimize arrival ATFCM regulations to better match the planned runway arrival rate.

Questionnaire results related to ATCO workload

Questionnaire feedback shows the scenario is an enabler to an ATCO workload decrease.

Other subjective feedback related to ATCO workload

The impact on the ATC workload was transparent according to FMP feedback.

K.3.4.1.1.5 KPA Flexibility

Flexibility exercise was implemented during this EXE-VLD-07-003 AFLEX scenario and described in K.3.5.

K.3.4.1.2 Results impacting regulation and standardization initiatives

The implementation rate of TTA could be improved in the future, provided:

- The “Slot Zone” is wider (i.e. [-10 mins ; +10 mins])
- The latest & earliest TTA possible to be given to a flight is available via NM B2B services
- The “SLOT SWAP” & “FORCE CTOT” mechanisms enforced by NMOC don’t impact flights having received a revised TTA without coordination with the ATS unit having sent the TTA

The predictability of the regulated arrival sequence and the confidence in using TTA could be improved in the future, provided the flight crew and the ATC of departure airport adhere more to the CTOT, and therefore to the TTA.

K.3.4.2 Analysis of Scenario Results per Demonstration objective

K.3.4.2.1 EXE-OBJ-VLD-01-001 Results

Objective: xStream operational improvements are respecting the current level of safety in air traffic management.

Success criterion: The safe management of traffic by ATC is not compromised. New procedures do not cause critical incidents.

According to quantitative & qualitative feedback, this objective is fulfilled.

K.3.4.2.2 EXE-OBJ-VLD-02-001 Results

Objective: xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors.

Success criterion: Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced.

According to qualitative feedback, this objective is fulfilled.

K.3.4.2.3 EXE-OBJ-VLD-04-001 Results

Objective: xStream operational improvements increase cost efficiency from more efficient processes for AU.

Success criterion: Flight efficiency is increased and flight management / flight coordination costs are reduced.

The reduction of ATFCM delay and of Additional ASMA time brings a benefit through smoother operation, which will require less actions from AU personnel to seek improvements.

The objective is fulfilled.

K.3.4.2.4 EXE-OBJ-VLD-04-002 Results

Objective: xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.

Success criterion: ANSP personnel costs are maintained or reduced.

The objective is fulfilled.

K.3.4.2.5 EXE-OBJ-VLD-05-001 Results

Objective: ATC Capacity usage in TMA is optimized by xStream operational improvements.

Success criterion: Traffic Load, ATC Workload and Complexity in Terminal Sectors is reduced.

ATC capacity usage was optimized with the use of iAMAN by Paris FMP for Orly arrivals during ATFCM regulations, the objective is fulfilled.

K.3.4.2.6 EXE-OBJ-VLD-05-003 Results

Objective: xStream operational improvements lead to a reduction of ATFCM measures.

Success criterion: Flight delay caused by ATFCM is reduced.

Paris-Orly ATFCM arrival regulations saw their generated ATFCM delay reduced by 6%, the objective is fulfilled.

K.3.4.2.7 EXE-OBJ-VLD-06-001 Results

Objective: xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users.

Success criterion: Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased.

AFLEX trials were performed during EXE-VLD-07-003 Orly scenario.

K.3.4.3 Unexpected Behaviours / Results

For many flights, the implemented TTA by Paris FMP got cancelled because of a flight update due to DPI from departure airport or due to a DLA message then by the AO.

Furthermore, for many flights, new TTA sent to NM by Paris FMP were discarded because they were sent too late.

K.3.4.4 Confidence in the Demonstration Results

K.3.4.4.1 Level of Significance / Limitations of Demonstration Exercise Results

EXE-VLD-07-003 Orly scenario was applied during the busiest Orly arrival peaks during the day. Paris FMP were properly trained on the concept and on iAMAN tool so they could pick the most relevant flights to receive TTA revision in order to better match Orly runway capacity with the demand. A checklist was prepared for Paris FMP operators so the concept is properly applied, and an operational instruction was issued to Paris ACC Supervisors.

The demonstrations exercises were limited by NM "Slot Zone" of -5 mins / +10 mins which limited TTA implementation and limited the efficiency of the requested ATFCM delay reductions. With an implementation rate of 80% of TTA regarding conventional regulation optimisation, a total of 83 flights among 14 peaks were optimized which represents a valid sample for analysis, during the busiest Orly arrival peaks.

K.3.4.4.2 Quality of Demonstration Exercise Results

However, only 2 questionnaires were collected from Paris FMP which is very low. However post-trial debriefings were made with Paris FMPs who ran the trials.

Demonstrations results were compiled in different ways:

For quantitative results, the data was obtained from Eurocontrol data for TTA and CTOT adherence calculation, using large samples of flights (52) during the busiest periods of the trials (period of EXE7#3-ORLY). For ATFCM delay calculation, data was extracted from CHMI. ATFCM delay difference was calculated between the initial ATFCM delay generated for the revised flights and the delays generated after the implementation of the TTA in the ETFMS. Therefore the difference between the total amount of saved ATFCM delays and the total amount of generated ATFCM delays for the arrival regulations could be calculated.

These calculations about ATFCM delay optimization were made for 14 LFPOARR2 regulations during main arrival peaks into Paris-Orly.

The baseline used for quantitative results in terms of additional ASMA calculation and TT adherence consists of 81 LFPOARR2 regulations due to "ATC Capacity" or "Aerodrome Capacity" from 10/01/2019 until 14/06/2019.

For qualitative results, questionnaires were distributed during the whole trial periods but only 2 FMP questionnaires were collected, and post trials interviews were made.

K.3.4.4.3 Significance of Demonstration Exercise Results

EXE3-VLD-07-003 Orly scenario was performed during the busiest arrival peaks in Paris-Orly, with usual regulation rates. Paris FMP were fully trained on iAMAN tool and on the concept and were informed of the limitations of the tool and by NM systems.

With an implementation rate close to 80% and ATFCM delay reductions of 6% during the busiest arrivals peaks for Orly, without a negative impact in terms of safety. The results should be considered as significant.

However, comparison in terms of additional ASMA times are not significant since the baselines and the trials were not comparable in terms of traffic load and ATFCM regulation rate.

K.3.5 AFLEX Scenario

The AFLEX scenario was planned during Orly arrival ATFCM regulations between 12th of August and 30th of September 2019.

The following AU requests were enabled during the scenario:

- Reduce to the minimum the impact of a flight: “IMPROVEMENT”,
- Exchange the priority between 2 regulated flights: “SWAP”,

The iAMAN arrival sequence, taking into account the regulated flights captured by LFPOARR2 Orly ATFCM arrival regulations, was distributed to all participating stakeholders.

Air France was able to retrieve the arrival sequence, process it in their own AFLEX tool and send back their list of requests (IMPROVEMENT or SWAP) back to DSNA Portal. This portal was accessible to Paris FMP using a web browser pointing to DSNA.fr.

SWAP example:

LIST OF AFLEX REQUESTS

ARCID1	ADEP1	ADES1	EOBT1	ARCID2	ADEP2	ADES2	EOBT2
AFR84HB	LFMP	LFPO	2019-09-19 08:30:00	AFR627G	LFBD	LFPO	2019-09-19 08:25:00
ARCID1	ADEP1	ADES1	EOBT1	ARCID2	ADEP2	ADES2	EOBT2

Figure 12: Example of a SWAP request sent by Air France displayed on DSNA.fr website

In the example shown above, Air France requests a swap of ATFCM delay between AFR84HB (initially with 14 mins delay) and AFR627G (initially with 0 min delay.). The request was granted by Paris FMP using iAMAN and in the end AFR84HB finally received a SRM with 0 min delay and AFR627G with 30 mins delay. Paris FMP tried to implement this swap using the API Service but was limited due to the “slot zone” limitation of [-5 mins ; +10 mins]. Therefore this swap was done via phone coordination with NMOC.

IMPROVEMENT example:

LIST OF IMPROVEMENTS REQUESTS

ARCID	ADEP	ADES	CTOT	MP REG.	UID
AFR64QA	LFLL	LFPO	-	undefined	AA18159016
ARCID	ADEP	ADES	CTOT	MP REG.	UID

Figure 13: Example of an IMPROVEMENT request sent by Air France displayed on DSNA.fr website

In the example shown above, Air France requests an improvement of ATFCM delay for AFR64QA. Initially, this flight had received 28 mins of ATFCM delay. After the assessment from Paris FMP using iAMAN, Paris FMP partially accepted the request, and AFR64QA eventually received an ATFCM delay of 7 mins. Since this delay modification was outside the "Slot Zone", this had to be done via phone coordination with NMOC.

Flight AFR64QA (LYS-ORY, commercial number AF7417, incidentally a flight operated by Hop!) was scheduled to arrive at the gate in Orly at 10:20. This flight was carrying a number of connecting passengers, to the following onward flights:

Onward flight	Destination	Scheduled Departure	Nb of connecting passengers
AF842	FDF	11:15	19
AF6120	TLS	11:45	2
AF032	JFK	12:15	11
AF644	RUN	15:50	36
AF642	RUN	19:00	4

Notice in particular that for flight AF842, a long haul departure, the scheduled connection time from AF7417 is of 55 minutes. The other connections have more margin.

With the original 28 minutes ATFCM delay, the connections from AF7417 to AF842 would not have been possible: the delay would have propagated to the onward departure.

Thanks to the slot improvement to only 7 minutes delay, AF7417/20SEP actually arrived to the gate at 10:27 (exactly 7 minutes late on the scheduled arrival) and the connection process was facilitated.

Besides the inconvenience to the passengers and the network effect from the delay, the AU cost of delay for this single case (a B777-300 aircraft delayed between 15 and 30 minutes at the gate) can be estimated at a few thousand euros (using the customary figures published by Eurocontrol, considered by AFR as a good first level approximation).

Although this case is relatively small, it illustrates very well the potential benefit in allocating ATFCM delay to flights where it has the least impact to the passengers and to the operator, when this does not introduce additional complication for ATC. When AFLEX will be implemented in the CDG hub, multiple cases similar to this, or with much larger avoided impact – especially avoided rebookings – can be expected every day. (The limit to 3 or 4 max AFLEX requests that one operator can issue in one day has to be kept in mind, however).

Scenario	Number of swap requested	Number of improvements requested	Non-acceptance rate	Partial acceptance rate	Full acceptance rate
AFLEX-ORLY	1	4	40%	40%	20%

Table 14: Acceptation rate of AFLEX requests

During the AFLEX trials, 1 swap was requested between 2 flights, 4 flights were requested to be improved. 60% of the requests were accepted, fully or partially. The non-acceptance rate comes from the absence of notification for Paris FMP of new flights being fed to the DSNA.fr portal. An additional phone coordination has been established between Air France OCC and Paris FMP to make sure Paris FMP has the information of the flights being displayed on the AFLEX section of DSNA.fr portal.

K.3.5.1 Summary of Scenario Results

See Main Document chapter 4.1.2.3.5.

K.3.5.1.1 Results per KPA

Due to the late implementation of the scenario, and due the limitation to the Orly arrival regulations, only a few cases were actually trialled.

No questionnaires have been filled by Paris FMP during AFLEX trials.

K.3.5.1.1.1 KPA Safety

K.3.5.1.1.1.1 Quantitative Assessment

Number of Incident Reports:

No incident has been reported in connection with EXE-VLD-07-003 AFLEX scenario in Paris-Orly or in Paris-ACC.

K.3.5.1.1.1.2 Qualitative Assessment

According to FMP feedback, the trials had no impact on safety since the AFLEX requests were granted after an analysis by Paris FMP using the necessary tools for workload and traffic assessment (i.e. iAMAN).

K.3.5.1.1.2 KPA Predictability and Punctuality

This KPA is linked with K.3.4.1.1.2

K.3.5.1.1.2.1 Quantitative Assessment

See K.3.4.1.1.4.1

K.3.5.1.1.2.2 Qualitative Assessment

See K.3.4.1.1.4.2

K.3.5.1.1.3 KPA Cost Efficiency

K.3.5.1.1.3.1 Quantitative Assessment

Aircraft ID	AFLEX type	Date	Initial ATFCM delay	Final ATFCM delay after AFLEX	ATFCM delay difference
AFR64QA	IMPROVEMENT	20/09/2019	28 mins	7 mins	-21 mins
AFR84HB	SWAP	19/09/2019	14 mins	0 mins	-14 mins
AFR627G			0 min	30 mins	+30 mins
AFR39KW	IMPROVEMENT	29/08/2019	39 mins	30 mins	-9 mins

Table 15: List of accepted AFLEX requests by Paris FMP for Paris-Orly arrivals

Improvement requests ended up in ATFCM delay gains of 30 mins for 2 flights.

SWAP request ended up in additional ATFCM delay of 16 mins, due to a change of priority at the request of the Airspace User. Although primarily a capacity indicator, ATFCM delay is also directly linked with AU Cost Efficiency. (according to Standard Inputs for EUROCONTROL CBAs Edition 8.0, 1 min of ATFCM delay costs 100 EUR.)

K.3.5.1.1.3.2 Qualitative Assessment

ANSP Costs:

Paris FMPs received training during their planned FMP course & multiple refresher course in Paris ACC. They also received training on AFLEX during their planned FMP shift and performed the trial days during planned FMP shifts. Therefore EXE-VLD-07-003 AFLEX scenario implied no extra cost for the ANSP. No additional staff needed to be recruited to conduct the trials.

AU Cost Efficiency:

The participation in AFLEX scenarios has been done by Air France using the SWIM-like machine-machine interfaces made available by the DSNA systems. These interfaces have been embedded in the ATM tool ("ATMOS") used by the Dispatch at AFR's OCC, where additional decision-support functions (using other pieces of the Information System) are available. This system constitutes an important investment; it is difficult to separate the exact marginal cost to implement AFLEX, and the entire tool is a multi-man-year project. But this tool is considered necessary for the Dispatch to efficiently perform their mission of support to the flight crews and optimization of daily flight operations.

The AFLEX procedures will most probably become accessible via an HMI (portal webpage), that certain operators may prefer, to avoid investment in new tools.

In both cases, the personnel working on ATM/ATC procedures can easily be trained to the simple new process. No additional dedicated staff in considered necessary.

K.3.5.1.1.4 KPA Capacity

K.3.5.1.1.4.1 Quantitative Assessment

Total ATFCM delay

During the AFLEX trials, total ATFCM delays have been reduced by 30 mins during “IMPROVEMENT” requests.

For “SWAP” requests, ATFCM delays were increased by 16 mins because the focus was made on the order of the flights, not on the quantity of ATFCM delays.

K.3.5.1.1.4.2 Qualitative Assessment

Other subjective feedback related to TMA capacity

Combined with EXE-VLD-07-003 Orly scenario, Paris FMP assessed the integration of AFLEX requests from AU was as an efficient tool to optimize arrival ATFCM regulations by taking into account the airlines operational needs.

K.3.5.1.1.5 KPA Flexibility

K.3.5.1.1.5.1 Quantitative Assessment

60% of the AFLEX requests were received and accepted (partially or fully). 40% were displayed on DSNA.fr portal but were unnoticed and therefore not accepted.

For reasons of late implementation, the AFLEX trial was limited to the month of September, when only the Orly trials were still running. Therefore, the number of opportunities for AFR to issue AFLEX requests has been lower than it would have been on CDG. Quantitative indicators have to be extrapolated from a single case, where 19 passengers connecting to a long-haul flight could arrive with minimal delay. This can be estimated to a few thousand euros of avoided impact, and on a case of relatively small delay.

K.3.5.1.1.5.2 Qualitative Assessment

<u>Other subjective feedback related to AU requests</u>

Paris FMP welcomed the initiative of being able to take into account Airspace Users requests and priorities in the arrival sequence planning for Paris-Orly arrivals. However, they pointed out this type of process is feasible only if a limited number of requests are transmitted for the same peak by AU.

They also underlined the AU requests should be integrated in the extended arrival manager in order not to add another HMI to their workstation.

K.3.5.1.2 Results impacting regulation and standardization initiatives

Regarding AFLEX processes, all Airspace Users should participate to the process and should limit the number of requests per arrival peak to 3-4 so they are still manageable by the FMPs.

K.3.5.2 Analysis of Scenario Results per Demonstration objective

K.3.5.2.1 EXE-OBJ-VLD-01-001 Results

<u>Objective</u>: xStream operational improvements are respecting the current level of safety in air traffic management.

<u>Success criterion</u>: The safe management of traffic by ATC is not compromised. New procedures do not cause critical incidents.

According to quantitative & qualitative feedback, this objective is fulfilled.

K.3.5.2.2 EXE-OBJ-VLD-02-001 Results

<u>Objective</u>: xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors.

<u>Success criterion</u>: Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced.

See K.3.4.2.2

K.3.5.2.3 EXE-OBJ-VLD-04-001 Results

<u>Objective</u>: xStream operational improvements increase cost efficiency from more efficient processes for AU.

<u>Success criterion</u>: Flight efficiency is increased and flight management / flight coordination costs are reduced.

The objective is fulfilled.

K.3.5.2.4 EXE-OBJ-VLD-04-002 Results

Objective: xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.

Success criterion: ANSP personnel costs are maintained or reduced.

The objective is fulfilled.

K.3.5.2.5 EXE-OBJ-VLD-05-001 Results

Objective: ATC Capacity usage in TMA is optimized by xStream operational improvements.

Success criterion: Traffic Load, ATC Workload and Complexity in Terminal Sectors is reduced.

ATC capacity usage was optimized by taking into account AU AFLEX requests during Orly arrivals during ATFCM regulations, the objective is fulfilled.

K.3.5.2.6 EXE-OBJ-VLD-05-003 Results

Objective: xStream operational improvements lead to a reduction of ATFCM measures.

Success criterion: Flight delay caused by ATFCM is reduced.

60% of the flights delay requested to be improved during AU AFLEX requests saw their generated ATFCM delay reduced during Orly arrival regulations. The objective is fulfilled.

K.3.5.2.7 EXE-OBJ-VLD-06-001 Results

Objective: xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users.

Success criterion: Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased.

The objective is fulfilled.

K.3.5.3 Unexpected Behaviours / Results

The AFLEX scenario was ready later than expected, therefore only Use Cases on Orly arrival regulations could be prepared for the planned trial time period.

Furthermore, the Collaborative cherry picking (MCP in collaboration with Airspace users) possibility was inexistent since Orly Tower supervisors decided to only implement classical ATFCM regulations during Orly runway works.

Finally, 20% of the AFLEX requests were missed by Paris FMP because they were shown too late on DSNA.fr portal and were unnoticed. A phone coordination had to be set up between Air France OCC and Paris FMP to notify new AFLEX requests were sent.

K.3.5.4 Confidence in the Demonstration Results

K.3.5.4.1 Level of Significance / Limitations of Demonstration Exercise Results

EXE-VLD-07-003 AFLEX scenario was applied during the busiest Orly arrival peaks when ATFCM regulations were in force. Paris FMP were properly trained on the concept, on DSNA.fr portal, and on iAMAN so they had an easy access to the list of the AU priorities and could easy spot the available capacity to answer the AU requests. However, due to the FMP workload, they had to be notified by phone by Air France of an incoming request.

Moreover, with the limitation of NM "Slot Zone" of -5 mins / +10 mins, any AFLEX request expressing a delay reduction of more than 5 mins had to be coordinated with NM via phone.

K.3.5.4.2 Quality of Demonstration Exercise Results

5 AFLEX requests were made during 5 different days, during Orly arrival regulations, concerning 7 Air France arrivals. 3 AFLEX requests were accepted (partially or fully).

At the beginning of trial, a few requests were unnoticed by Paris FMP because the AFLEX requests arrived too late on DSNA.fr portal. A phone call was then set up between Air France OCC and Paris FMP to correct this.

4 flights out of 7 saw their ATFCM delay modified after the analysis of Paris FMP. Overall ATFCM delays were decreased.

Demonstrations results were compiled in different ways:

For quantitative results, for ATFCM delay calculation, data was extracted from CHMI.

The AFLEX requests were extracted from DSNA.fr portal database which worked without issue.

For qualitative results, post trials interviews were made with Paris FMP.

K.3.5.4.3 Significance of Demonstration Exercise Results

EXE3-VLD-07-003 AFLEX scenario was performed during the busy arrival peaks in Paris-Orly during runway works. Paris FMPs were fully trained on AFLEX DSNA tool and on the concept and were informed of the limitations of the process.

With an acceptation rate of 60% of AFLEX requests, a robust DSNA.fr portal, a reliable process, and clear ATFCM reductions during the busiest arrivals peaks for Orly during runway works, the process should be considered as valid & robust.

Moreover, in spite of a late implementation and only a few days of activation, the flights when AFLEX scenario took place could actually be improved in terms of ATFCM delays, bringing more effective processes for the airline to help the connecting passengers with their onward flight. These few examples clearly proved the significance of the exercise results in terms of lowering the cost of ATFCM delays & improving the integration of AU priorities in ATFCM processes.

K.4 Conclusions

K.4.1 DSNA conclusions

K.4.1.1 ATFCM arrival regulation optimization

A summary of the trial results regarding ATFCM arrival regulation optimization is listed below:

Scenario	Number of regulations addressed	Number of flights with TTA revision requested	Number of flights with TTA revision implemented	Implementation rate	% of actual delay difference in classical ATFCM regulations
SKI	7	42	10	31%	-5%
E-TMA	24	92	54	59%	-5%
ORLY	14	102	83	81%	-6%

Table 16: EXE-VLD-007-03 result summary (ATFCM arrival regulation optimization)

Clearly, while addressing 45 arrival ATFCM regulations and with the implementation of revised TTA to almost 150 flights, EXE-VLD-007-03 enabled to reduce ATFCM arrival delays by better matching the demand to the available capacity in the E-TMA or at the runway. This ATFCM delay reduction, by around 5%, could be achieved while:

- maintaining a high safety level,
- maintaining or decreasing the additional ASMA time for arrivals
- maintaining the operating cost for the ANSP

K.4.1.2 MCP arrival regulation

A summary of the trial results regarding MCP arrival regulation creation is listed below:

Scenario	Number of peaks addressed with MCP	Number of flights with TTA included in MCP	Average ATFCM delay by regulation	Average ATFCM delay per flight during MCP
E-TMA	10	31	15 mins	5 mins
CDG	3	16	42 mins	8 mins

Table 17: EXE-VLD-007-03 result summary (MCP arrival regulation creation)

Paris-CDG supervisors and Paris FMP assessed EXE-VLD-07-003 enabled them to pinpoint the arrivals the most prone to receive ATFCM delay in a MCP regulation, allowing them to:

- Lower the TMA/E-TMA pressure,
- Mitigate ATC workload,
- Maintain high runway/E-TMA throughput

while limiting the number of flights receiving ATFCM delays.

K.4.1.3 Overall DSNA conclusions

Overall feedback from DSNA is very positive during EXE-VLD-07-003, especially about:

- The optimization of ATFCM arrival regulations for airports or E-TMA by reducing ATFCM delays by around 5% by sending revised TTAs with the Arrival Planning Information service provided by NM B2B
- The ability to perform electronic sending of MCP regulations requests and to pinpoint the arrivals easily to send pre-departure ATFCM constraints to a few flights
- The ability to easily select, move, and send the flights TTA on the HMI's Metering Fix or runway timeline to better match the demand with the actual E-TMA or runway capacity,
- The ability to send TTA and have the feedback about its acceptation on the HMI, in a fully digital way,
- The ability to add some arrival flexibility parameters to the arrival sequence preparation by the ACC or Airport Flow Manager, taking into account the Airspace Users priorities.

This could be achieved while maintaining a high safety level, maintaining or improving the flight efficiency, at an identical cost for the ANSP.

However, limitations during the trial appeared ("Slot Zone", new SRM coming after implemented TTAs, iAMAN limits...) and there is some need to address these issues to enhance the TTA implementation rate that are described in K.5.

Nevertheless, DSNA assesses the "Improved Arrival Planning" concept is beneficial for both FMP, airports and Airspace Users and

- should be further be developed and implemented permanently by NM (with the use of API B2B service),
- should be implemented for daily operations for the future arrival sequencing tools used by DSNA.

Eventually, the AFLEX process coordinated with Air France during EXE-VLD-07-003 is implemented and will be used in daily operations for Orly, CDG arrival regulations and E-TMA arrival regulations by Paris FMP.

K.4.2 Network Manager conclusions

The PJ25 WP07 Paris procedures were run during 2018 and 2019 including during an extremely challenging summer 2019 where the European ATM capacity struggled to support record air traffic demand.

From the NMOC perspective the procedures ran very smoothly. DSNA made best use of digital services to propose Network Cherry Pick regulation measures. Once the regulations were activated, they affected very few flights and those flights affected had small ATFM delays.

K.4.3 Airspace Users conclusions

K.4.3.1.1 On extended AMAN performed through TTAs sent before departures

Air France supports this procedure and recognizes its benefits as they are described in the Demo Report.

Constraints communicated before departure (as is the case of TTAs sent with CTOTs) have the advantage that they make it possible to re-calculate a flight plan (although this has not been done during the trials).

They also make it possible for the operator to express preferences on the arrival sequence, as was done in the WP7 trial with Aflex.

K.4.3.1.2 AFLEX

The Aflex implementation was a very successful first step, despite the fact that it had to be limited to Orly.

The few cases of flight improvements or arrival swaps have confirmed the expected benefit, especially in terms of ensuring connecting flights for the passengers.

The automatic transmission of priority flights is also very appreciated.

The technical connection of the AFR and DSNA systems is now in place and can be made operational with reasonable effort.

Aflex is basically an improved slot-swap procedure, but with a lot of added value in terms of directly Involving both NM and local ATC and that it is integrated in the main tool of the "ATC dispatcher", which makes it much easier to use.

Further industrialization of the Aflex tool, and standardization with similar solutions (especially for lists of priority flights) is highly recommended.

Aflex is complementary to UDPP: AFLEX for a quick adjustment on few flights, UDPP to be used in case of large number of concerned flights.

The visibility of the arrival sequence, even when no Aflex requests are given, gives situational awareness for the airline, and this is an additional appreciated feature. We recommend that this possibility is given in all AMAN systems.

In general, in view of extended AMAN becoming operational on more and more locations, an information campaign to the pilots will be beneficial, to recall the usage and purpose of the concept, in its different variants.

K.5 Recommendations

K.5.1 Recommendations for industrialization and deployment

TTA usage in terms of ATFCM regulation optimization or MCP creation was proven to be beneficial during EXE-VLD-07-003 to better match arrival capacity and demand and to better select the flights to be ATFCM-constrained. Therefore the NM B2B services providing Arrival Planning Information should be implemented as part of operational B2B services.

However, the implementation rate of TTA could be improved in the future, provided:

- The latest & earliest possible TTA to be given to a flight is available via NM B2B services,
- The “Slot Zone” is wider (i.e. minimum [-10 mins; +10 mins]),
- if the TTA is sent outside the “Slot Zone”, have the Network Impact Assessment done without delay and have the result available as a B2B service
- the FMP managing an arrival sequence has the full ability to swap flights in an arrival regulation electronically using the B2B services without phone coordination with NMOC
- The “SLOT SWAP” & “FORCE CTOT” mechanisms don’t impact flights having already received a revised TTA without coordination with the ATS unit having sent the TTA.

Moreover, the list of AU priorities and requests should be integrated in the Extended Arrival Manager used by FMP or Tower supervisors.

K.5.2 Recommendations on regulation and standardization

The predictability of the regulated arrival sequence and the confidence in using TTA and MCP could be improved in the future, provided the flight crew and the ATC of departure airport adhere more to the CTOT, and therefore to the TTA. The adherence to the TTA could also be better respected when the arrivals will be using future datalink systems to share updated airborne TTA between the aircraft and the ANSPs. (e.g. EPP, 4D trajectory).

Regarding AFLEX processes, all Airspace Users should participate to the process and should limit the number of requests per peak to 3-4 so they are still manageable by the FMPs. Airspace Users should be partners to agree on priority exchange strategies between different airlines.

=== End of Appendix I Demonstration Exercise EXE-VLD-07-003 Report ===