xStream Demonstration Report

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xStream Demonstration Report

This Demonstration Report (DEMOR) is part of a project that has received funding from the SESAR Joint Undertaking under grant agreement No 734145 under European Union's Horizon 2020 research and innovation programme.

Abstract

The present document as the xStream DEMO report is providing high level results associated to all xStream exercises performed by live trials and shadow mode trials.

The xStream VLD aims at validating and assessing new arrival management tools in order to reduce the use of operational measures to absorb delays at low levels in TMA and improve flight efficiency.

Trials have been performed from July 2017 to Oct 2019 on major European hubs (London-Gatwick, London-Heathrow, Paris-Orly, Paris-CDG, Zurich and Frankfurt), as well as involving a large number of surrounding area control centers (UAC/ACCs) and Airspace Users.

Conclusions show very promising benefits in terms of environment (fuel gains), capacity (ATFCM delay and complexity reduced in TMA) and flexibility (reduction of cost of delay for Airspace Users), which are further detailed in this report.

This serves as a proof of concept for PCP AF#1 (Extended AMAN), solutions being now ready for implementation.

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1 Executive summary

In major hub airports, during peak hours, variation in aircraft arrival times exceeds the capacity of the destination airport to handle them without incurring airborne delay.

These delays can be computed through Arrival Management systems (AMAN), that take into consideration runway capacities, aircraft characteristics and separation standards to compute an arrival sequence. However, in today's operation, the arrival management strategy is decided and implemented at a late stage of the flight since most of AMANs have limited horizon, capability and accuracy.

Because of this late implementation, the tendency is to absorb those delays at low levels in the TMA with holding and/or vectoring, generating high workload for Air Traffic Control Operators (ATCO), extra costs for airlines and poor environmental efficiency.

For those major airports, another area of interest is the optimisation of Air Traffic Flow and Capacity Management constraints (ATFCM), with the use of locally computed pre-departure Target Time of Arrival (TTA).

Also, even without capacity constraints, arrival streaming can be efficient for airport curfew management, as for example to avoid holdings or vectoring before the opening of the airport.

The integration of the Airspace Users into the loop is essential as a few minutes gained on a flight can be sufficient to ensure connection for dozens of passengers, or avoid diversion because of a curfew at the destination airport.

Combined with pre-departure TTAs, the development of collaborative processes with Airspace Users, ANSPs and Network Manager brings efficiency gains and arrival flexibility to improve arrival management process performance.

To address these challenges, the xStream project has demonstrated, at a very large-scale, new extended arrival management tools and techniques that improve flight efficiency and flight predictability at airports, in TMA, Extended TMA, and in en-route UAC / ACC.

This includes the following solutions:

- **Extended AMAN between 200 to 350 NM**: the main target of xStream is to provide a ready-for-implementation solution for PCP deployment, with an extended arrival management horizon up to at least 200 NM in order to enable delay absorption earlier in the flight and at higher altitude, which is more fuel-efficient. When dealing with high levels of arrival delay, or for pre-sequencing the aircrafts before a detected congestion at the entry of the Extended TMA, this horizon can be extended up to 350 NM for maximum efficiency.
- Also, the concept of target times for airborne long haul flights was applied with a horizon outside of the European Network involving the AU's OCCs in the process.
- **Handling of multiple inbound flows to multiple airports in the sectors of upstream ACCs**: with the extension of AMAN horizon, the cumulative effect of E-AMAN requests in the same sector may lead to an increase of ATCO workload, because of the competition between the flows, and induced conflicts. To prevent this, a CDM process has to be implemented to better coordinate E-AMAN activities, and assess upstream ACCs ability to deliver the E-AMAN service.
- **Improvement of Arrival Planning**: by using locally computed Pre-departure Target Time of Arrival sent to Network Manager in addition with a collaborative process to integrate Airspace Users' preferences/priorities, the impact and cost of ATFCM delays can be reduced. TTA allocation also contributes to the arrival management process by enhancing

the short-haul adherence to the targeted sequence.

- **Integration of Airspace Users Preferences** in the arrival planning process, thus limiting the cost of delay for airlines. UDPP and A-FLEX provide an efficient solution to reallocate ATFCM delay in order to optimize arrivals according to Airspace User needs, reducing the impact on Airline operations.

To address these topics, live and shadow mode trials have been performed between July 2017 and October 2019, in order to demonstrate that these concepts are mature enough in high density areas.

Demonstrations have been performed in major hub airports: Zurich, Paris CDG & Orly, London Gatwick & Heathrow, and Frankfurt-Main.

They involved:

- A large number of ACCs around those platforms (actually most of ACCs of the Core Area),
- The Network Manager,
- Airspace Users (Lufthansa Group, Air France, British Airways, EasyJet, Ryanair).

The detail of exercises per focus area is provided below:

Location	Scenario ID	Scenario title	Extended AMAN	Multiple E-AMAN operations	Improved arrival planning – Pre-departure Target Time of Arrival (TTA)	AU Preferences
Heathrow & Gatwick airports	EXE-VLD-06-001	Deploy Heathrow & Gatwick Arr-Dep Timeline in Swanwick Terminal Control	X			
	EXE-VLD-06-002	Gatwick XMAN 350NM	X			
	EXE-VLD-06-003	Elements of Partners TP sharing with AMAN	X			
Paris Orly and CDG airports	EXE-VLD-07-001	Paris-Orly Extended AMAN	X			
	EXE-VLD-07-002	COP sequencer for hotspot resolution	X			
	EXE-VLD-07-003	Improved Arrival Planning Management and Airspace Users preferences			X	X
Zurich airport	EXE-VLD-08-001	Extended Arrival Management (E-AMAN)	X			
	EXE-VLD-08-002	Collaborative tool AU / ATC / NM (integrating AUs preferences)				X
	EXE-VLD-08-003	Improved Arrival Planning Management & NM integration			X	X
Frankfurt Airport	EXE-VLD-09-002	Frankfurt Early Morning Arrival Stream Optimization			X	
	EXE-VLD-09-003	Multiple XMAN operation in multiple ACC/UAC		X		

Table 1: Summary of xStream exercises.

Those demonstrations were successful and delivered the following operational benefits:

- Environment:
  - Reduction of airborne holding and vectoring in lower airspace
  - In Paris and London demonstrations, fuel savings in the arrival phase, up to 30 kg of fuel per flight (based on BADA estimates), equivalent to a reduction of gas emissions up to 90 kg of CO2 per flight.
- Capacity:
  - Reduction of congestion and complexity in TMA, enabling capacity improvements in terminal area during traffic peaks.
  - Optimization of ATFCM constraints, by better matching available capacity with traffic demand.
  - Arrival ATFCM delays reduced up to 5% in Paris area
- Flexibility:
  - Ability to integrate Airspace Users priorities in capacity constrained situations or not (arrival streaming); thus allowing optimized hub carrier operations at the destination airport, as well as reducing the cost of ATFCM delay for airlines.
  - Through UDPP, ability to reallocate ATFCM delay in order to optimize arrivals according to Airspace User needs, reducing the impact on Airline operations.
- Safety :
  - Reduction of TMA workload, while maintaining a safe management in upper airspace.
  - Predictability:
  - Improvement of arrival sequence predictability, allowing a better anticipation of operations for Flow Managers and Supervisors.

Details on use case and scenarios are provided in the corresponding appendixes of each exercise.

Theses demonstrations were a step beyond “Industrial Research” and prepare operational use, resolving potential operational issues raised by previous projects. They served as proof of concept for AF#1 in Pilot Common Project (PCP) . Results show that operational benefits are reached, and solutions are ready for implementation. Yet, some recommendations are provided as a margin for improving the demonstrated solutions:

- Adjust the Extended AMAN horizon with local parameters, such as in-horizon departures, low performance aircraft, or airspace configuration.
- In the perspective of multiple AMAN operations in the same area, define between ACCs and E-AMAN airports an acceptable number of E-AMAN requests per hour, and a strategy management policy. This could be helped with the use of a collaborative portal between airports and ACCs.
- Improve as much as possible Estimated Time Overs (ETOs) computed by AMAN systems, for example using local Trajectory Prediction data.
- Develop a feedback loop for the information of actually enforced E-AMAN requests.
- Implement the Arrival Planning Information (API) service as a Network Manager B2B service, with some improvements in the algorithm, e.g. extend the “Slot Zone”
- Continue raising awareness on CTOT adherence for Airspace Users and airports, in order to improve sequence prediction.

- Standardize the format of data exchange for A-Flex and UDPP priorities between Airspace Users, ANSPs and NM.

2 Introduction

2.1 Purpose of the document

This document is the Demonstration Report for the xStream project, providing information on:

- Objectives of the xStream exercises and trials,
- Scenarios that had been executed with schedule, trial platforms, facilities and stakeholders,
- Project organization and schedule,
- Communication activities.

This Demonstration Report provides results of exercises performed by live trials or shadow mode trials from beginning July 2017 to End October 2019:

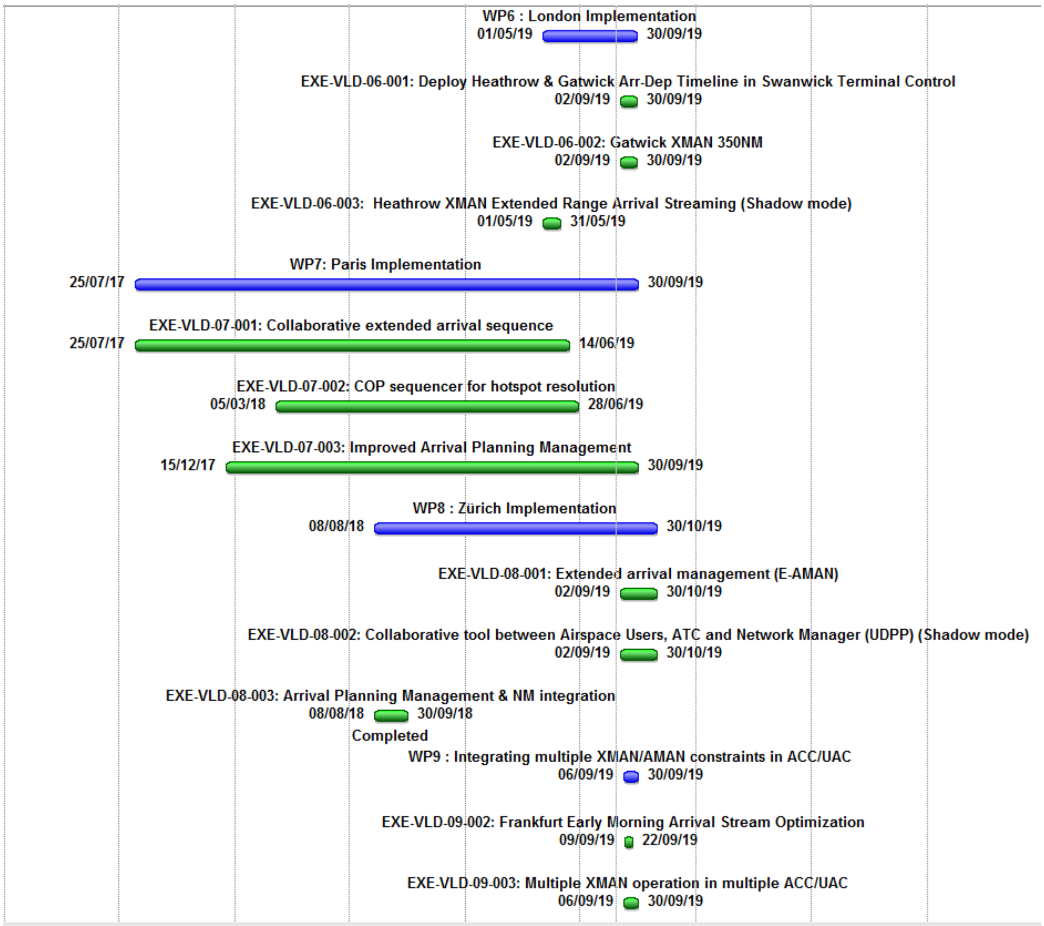


Fig. 1: Overview of xStream trials

2.2 Intended readership

This document primarily is of interest to:

- xStream project partners and the SJU who will use it as the baseline for the execution of the

project,
- Airlines willing to support the project execution,
- SESAR 2020 interested projects such as:
  - PJ01-01: Extended Arrival Management with overlapping AMAN operations and interaction with DCB,
  - PJ07 OAUO: Optimised Airspace User Operations,
  - PJ09-02: Integrated Local DCB Processes,
  - PJ24 : Network collaborative management,
- Transversal SESAR2020 projects:
  - PJ19 CI: Content Integration,
  - PJ20 AMPLE: Master Plan Maintenance,
  - PJ22 Validation and Demonstration Engineering,
- Other SESAR2020 projects,
- The consortium members,
- External readers out of the SESAR2020 programme such as ANSPs, Airports, Industry, R&D institutes and organizations, ATM professional organizations, Trade publications and other media channels.

2.3 Background

The xStream project takes into account the outcome of several projects already performed in SESAR 1 referring to arrival management, namely:

- Project 05.06.04: Tactical TMA and En-Route Queue Management,
- Project 05.06.07: Integrated Sequence Building/Optimization of Queues,
- FAIRSTREAM project,
- iStream project,
- FABEC XMAN project.

These results are used as an input when creating this xStream Demonstration Plan (DEMOP) but also when designing appropriate scenarios and executing demonstration activities (Live trials or shadow mode trials).

The focus is on the feasibility of the demonstrations, using mature concepts of SESAR1 and their ability to be proofs of concept for AF#1.

All these are prerequisites that will prevent the creation of un-necessary risks for the involved ATM actors, being ANSPs, Airports, AUs or NM.

2.4 Structure of the document

This section states how the document is organized with the following chapters:

- Chapter 1 “Executive summary”: High level description of xStream project goal and objectives,
- Chapter 2: Introduction”: Scope of the xStream Demonstration Report,
- Chapter 3 “Very Large Demonstration (VLD) Scope”: Presentation of the xStream project,

- Chapter 4 “Demonstration Results”: Presentation of results brought by all xStream trials,
- Chapter 5 “Conclusions and recommendations”: General conclusions of results brought by all xStream trials,
- Chapter 6 “Summary of Communications and Dissemination activities”: Presentation of xStream communication actions to ATM community,
- Chapter 7 “References”: List of reference documents, supporting xStream project and issued by the xStream project.
- General appendixes:
    - Appendix A: Safety Assessment Report (SAR),
    - Appendix B: Security Assessment Report (SecAR),
    - Appendix C: Human Performance Assessment Report (HPAR),
    - Appendix D: VLD progress towards TRL-7,
    - Appendix E: Presentation of the xStream methodology for Performance assessment,
- Specific appendixes addressing each exercise:
    - Appendix F: EXE-VLD-06-001: Deploy Heathrow & Gatwick Arr-Dep Timeline in Swanwick Terminal Control,
    - Appendix G: EXE-VLD-06-002: Gatwick XMAN 350NM,
    - Appendix H: EXE-VLD-06-003: Elements of Partners TP sharing with AMAN,
    - Appendix I: EXE-VLD-07-001: Collaborative extended arrival sequence,
    - Appendix J: EXE-VLD-07-002: COP sequencer for hotspot resolution,
    - Appendix K: EXE-VLD-07-003: Improved Arrival Planning Management and Airspace users preferences,
    - Appendix L: EXE-VLD-08-001: Extended Arrival Management (E-AMAN),
    - Appendix M: EXE-VLD-08-002: Collaborative tool AU / ATC / NM (integrating AUs preferences),
    - Appendix N: EXE-VLD-08-003: Improved Arrival Planning Management & NM integration,
    - Appendix O: EXE-VLD-09-002: Frankfurt Early Morning Arrival Stream Optimization,
    - Appendix P: EXE-VLD-09-003: Multiple XMAN operation in multiple ACC/UAC.

The documentation tree of the xStream DEMOR is summarized in the figure below:

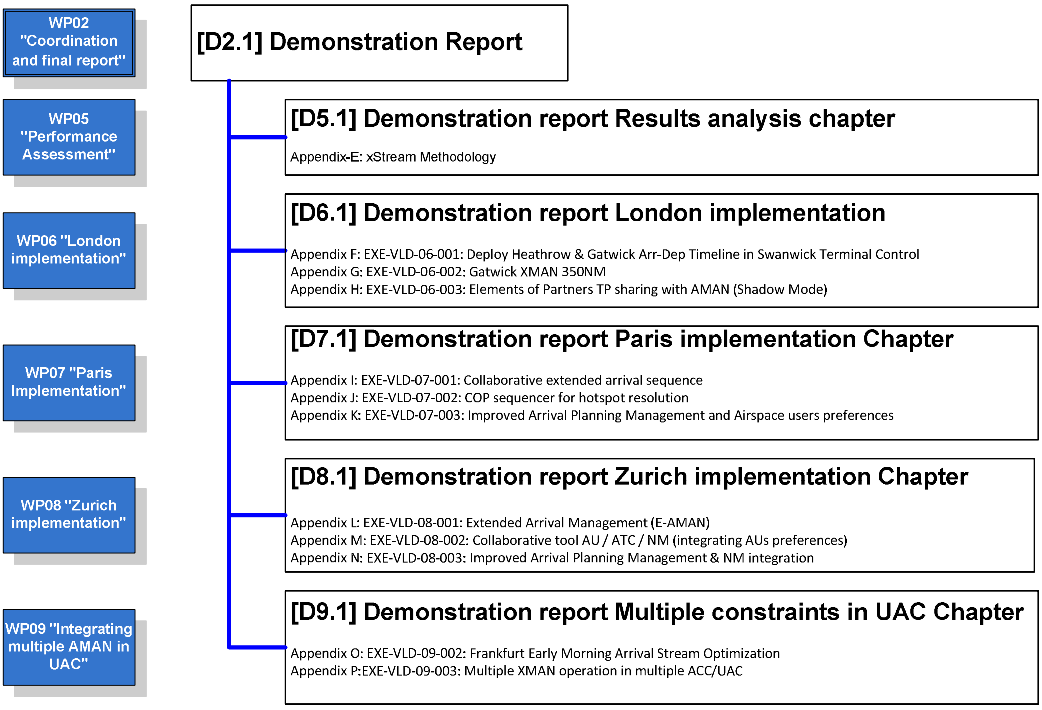


Fig. 1 : Documentation tree of xStream DEMOR

2.5 Glossary of terms

Term	Definition	Source of the definition
A-FLEX	A concept allowing arrival slot flexibility to airlines. Airlines can swap slots based on their operational needs.	iStream CONOPS
AMAN Allocated Time	This is a time at a point of constraint, allocated by the Extended AMAN system and communicated to a flight to be incorporated into the trajectory.	SESAR CONOPS
Arrival Manager	A planning system to improve arrival flows at one or more airports by calculating the optimized approach / landing sequence and Target Landing Times (TLDT) and, where needed, times for specific fixes for each flight, taking multiple constraints and preferences into account.	SESAR CONOPS Step 1
Target Time of Arrival	An ATM computed arrival time. It is not a constraint but a progressively refined planning time that is used to coordinate between arrival and departure management applications.	SESAR Integrated Dictionary
Target Time Over	A planning time computed by ground systems for flight planning and execution to coordinate at	SESAR Integrated Dictionary

	network level and enhance the effectiveness of ATFCM measures for congestions at en-route locations.	

Table 2: Glossary of terms

2.6 List of Acronyms

Acronym	Definition
AAT	AMAN Allocated Time
ACARS	Aircraft Communication Addressing and Reporting System
ACC	Area Control Centre
A-CDM	Airport Collaborative Decision Making
ADS-C	Automatic Dependent Surveillance - Contract
AF	ATM Functionality
AFLEX	Arrival FLEXibility
AIBT	Actual In-Block Time
ALDT	Actual Landing Time
AMAN	Arrival Manager
AMAN2	Arrival Manager Step 2
ANS	Air Navigation Services
ANSP	Air Navigation Service Provider
AO	Airline Operator
AOC	Airline Operational Communication
AOR	Area of Responsibility
AoR	Areas of Responsibility
API	Arrival Planning Information
APOC	Airport Operations Centre
APP	Approach
ASMA	Arrival Sequencing and Metering Area
ATC	Air Traffic Control
ATCO	Air Traffic Control Operator
ATEAM	Airline Team xStream (AU consortium)
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management

Acronym	Definition
ATM	Air Traffic Management
ATS	Air Traffic Service
AU	Airspace Users
B2B	Business to Business
BADA	Base of Aircraft Data
CALM AMAN	Zurich operational AMAN
CANSO	Civil Air Navigation Services Organisation
CASA	Computer Assisted Slot Allocation
CCS	Capacity Constraint Situation
CDG	“Charles de Gaulle” Airport
CDM	Collaborative Decision Making
CDO	Continuous Descent Operation
CHMI	CFMU Human Machine Interface
CI	Cost Index or Content Integration
CMAN	Center Manager
CNS	Communication, Navigation and Surveillance
CONOPS	Concept of Operations
COP	Coordination Point
CPR	Correlated Position Report
CRT	Criterion
CTOT	Calculated Take-Off Time
DCB	Demand Capacity Balancing
dDCB	Dynamic Demand Capacity Balancing
DEMOP	Demonstration Plan
DEMOR	Demonstration Report
DFS	Deutsche Flugsicherung GmbH
DLR	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Center)
DMAN	Departure Manager
Dow	Description of Work
DPI	Departure Planning Information
DSNA	Direction des Services de la Navigation Aérienne

Acronym	Definition
EATMA	European ATM Architecture
E-AMAN	Extended / Enhanced Arrival Management
E-ATMS	European Air Traffic Management System
ECTL	EUROCONTROL - The European Organization for the Safety of Navigation
EDW	Edelweiss Airlines
EFD	ETFMS Flight Data
EMAS	Early Morning Arrival Stream
ETA	Estimated Time of Arrival
ETFMS	Enhanced Tactical Flow Management System
E-TMA	Extended TMA
ETO	Estimated Time over
EU	European Union
EXE	Exercise
FABEC	Functional Airspace Block Europe Central
FAIRSTREAM	FABEC ANSPs and Airlines SESAR Trials for Enhanced Arrival Management
FDPS	Flight Data Processing System
FDR	Fleet Delay Reordering
FIR	Flight Information Region
FMP	ATC Flow Management Position
FMS	Flight Management System
FOC	Flight Operation Centre
FPL	Flight Plan
GNSS	Global Navigation Satellite System
HMI	Human/Machine Interface
HPAR	Human Performance Assessment Report
HR	Human Resources
I4D	Initial 4D Trajectory
IAF	Initial Approach Fix
ICAO	International Civil Aviation Organisation
ID	Identifier
IFPS	Integrated Initial Flight Plan Processing System

Acronym	Definition
IFPZ	IFPS Zone
ILS	Instrument Landing System
INNOVE	Innovative Network Operations Environment
INTEROP	Interoperability Requirements
ISA	Instantaneous Self-Assessment
KPA	Key Performance Area
KPI	Key Performance Indicator
KUAC	Karlsruhe UAC
LACC	London ACC
LATC	London ATC
LFPG	ICAO code for Paris CDG airport
LFPO	ICAO code for Paris Orly airport
LH	Lufthansa
LoA	Letter of Agreement
LOC	Local Time
LSZH	ICAO code for Zurich airport
MCP	Mandatory Cherry Picking
METAR	Meteorological Aviation Routine Report
MF	Metering Fix
MP	Master Plan
MUAC	Maastricht Upper Area Control Centre
N/A	Not applicable
NASA-TLX	NASA Task Load Index
NATS	National Air Traffic Services
NDA	Non-Disclosure Agreement
NM	Network Management or Nautical Mile
NMOC	Network Manager Operations Centre
NMVP	Network Manager Validation Platform
NOK	Not OK (regarding an xStream objective)
NOP	Network Operations Portal
NOTAM	Notice To Air Men

Acronym	Definition
NSA	National Supervisory Authority
OAUO	Optimised Airspace User Operations
OBJ	Objective
OCC	Operational Control Center
OFA	Operational Focus Areas
OI	Operational Improvement
OLDI	On-Line Data Interchange
OPS	Operations
OSED	Operational Service and Environment Definition
PCP	Pilot Common Project
PI	Performance Indicator
PM	Project Manager
PMB	Project Management Board
PMO	Project Management Officer
POK	Partially OK (regarding an xStream objective)
R&D	Research and Development
RUAC	Reims UAC
RWY	Runway
SAR	Safety Assessment Report
SASHA	Situation Awareness for SHAPE Questionnaire
SEAC	SESAR European Airports Consortium
SecAR	Security Assessment Report
SESAR	Single European Sky ATM Research Programme
SIBT	Scheduled In-Block Time
SGA	Specific Grant Agreement
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SRM	Slot Revision Message
STA	Scheduled Time of Arrival
STAM	Short-term ATFM Measure
STAR	Standard Instrument Arrival
STCA	Short-Term Conflict Alert

Acronym	Definition
SUT	System Under Test
SWIM	System Wide Information Management
SWISS	Swiss International Air Lines Ltd
SWR	Swiss International Airlines Ltd
TBC	To Be Confirmed
TBD	To Be Defined
TCAS	Traffic Collision Avoidance System
TLDT	Target Landing Time
TMA	Terminal Area
TMQ	Tailor-Made Questionnaires
TOD	Top of Descend
TOT	Take Off Time
TP	Trajectory Prediction
TRL	Technology Readiness Level
TTA	Target Time of Arrival
TTG	Time To Gain
TTL	Time To Lose
TTO	Target Time Over (a fix-point)
TWR	Tower
UAC	Upper Area Control Centre
UDPP	User Driven Prioritization Process
UI	User Interface
UIR	Upper Flight Information Region
VLD	Very Large Scale Demonstration
VOR	Very High Frequency Omnidirectional Radio Range Beacon
WBS	Work Breakdown Structure
WP	Work Package
XMAN	Cross Border Arrival Management
ZRH	Zurich Airport

Table 3: List of acronyms

3 Very Large Demonstration (VLD) Scope

xStream PJ25 VLD had been conducted through a series of operational live trials, involving all the ATM actors described in the overall scope of the Extended Arrival Management:

- ANSPs – through the involvement of OPS staff from the FMP positions and ATCOs (DFS, DSNA, skyguide, NATS, ECTL, COOPANS),
- NM – through the involvement of NMOC OPS staff and operational systems for supporting data exchanges,
- AUs – through the application of the concepts of the demonstration to a series of scheduled flights, in coordination and synchronization with the other ATM actors with the support of Airline Team xStream (ATEAM) consortium (Lufthansa Group including SWISS, Air France Group, EasyJet, British Airways and Ryanair).

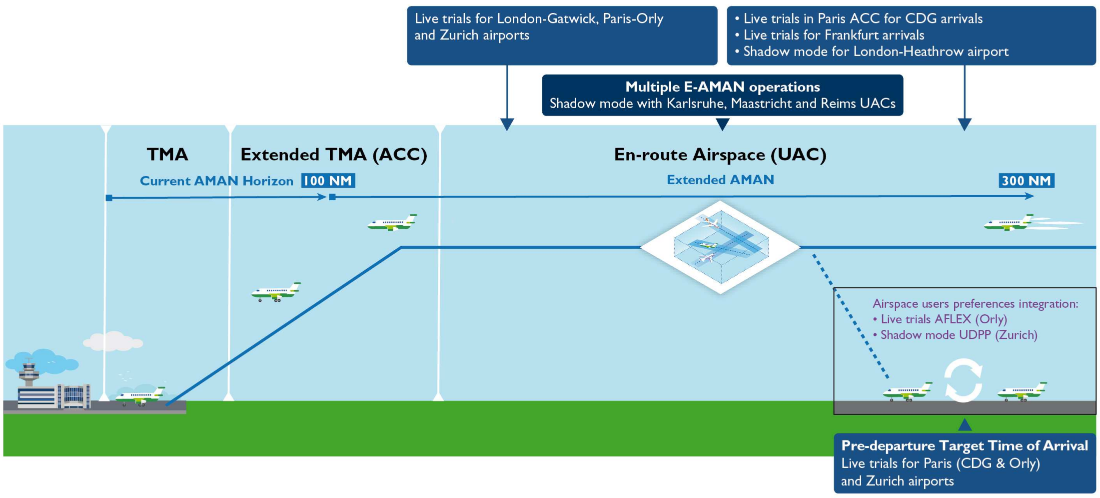
This VLD demonstrated that the concept elements and the supporting technical solutions are ready to function correctly at a wider scale and with a wider array of actors.

3.1 Very Large Demonstration Purpose

The xStream project aims at validating and assessing new arrival management tools in order to reduce the use of operational measures to absorb delays at low levels in TMA and improve flight efficiency. The project focused on four main areas:

- Extended AMAN between 200 to 350 NM.
- Handling of multiple inbound flows to multiple airports in the sectors of upstream ACCs.
- Improvement of Arrival Planning
- Airspace Users flexibility

Several solutions, adapted to the operational situation of each test site, are assessed to fulfil these objectives, thus leading to the construction of an Extended AMAN "toolbox" that may be used by other airports in the PCP. This is toolbox is further detailed in xStream CONOPS (Refer to document [R45] "xStream CONOPS Issue 1.1 dated October 21, 2019").



3.2 SESAR Solution(s) addressed by VLD

This section provides a description of the SESAR Solution(s) under the scope of the Demonstration Plan, with reference to the applicable EATMA version. It refers to the list of OI steps and enablers associated to the SESAR Solution as defined in the ATM MP Level 2.

SESAR Solution ID and Title	SESAR Solution Description	OI Steps ref. (coming from EATMA)	Enablers ref. (coming from EATMA)
SESAR1 Solution #5 Extended Arrival Management (AMAN) horizon	Operational procedures and technical specifications for the integration of the information from arrival management systems operating out to an extended distance to provide an enhanced and more consistent arrival sequence. The system helps to reduce holding by absorbing some of the queuing time further upstream well into En Route. Includes integration of traffic departing from within the AMAN horizon of the destination airport. In Step 1, the "newly" impacted En Route sectors are expected to contribute to the sequencing towards a single TMA.	TS-0305-A	APP ATC 111 ER ATC 163 PRO-245 SWIM-APS-12a SWIM-INFR-01a
SESAR1 Solution #8 Arrival Management into Multiple Airports	The system provides support to coordination of traffic flows into multiple airports to enable a smooth delivery to the runways. The "Center Manager" (CMAN) which accompanies the AMANs of the airports generates a combined planning for several arrival streams into different airports by calculating the sequence of aircraft flying towards an area where their routes intersect. By imposing an adequate spacing of the aircraft in that area, a Time To Lose (TTL) for the appropriate upstream E-TMA sector is calculated to meet this constraint. Both AMAN-TTL for the runway and TTL for the E-TMA sector are superimposed and presented to the upstream en-route sector controllers.	TS-0303	ER APP 109 PRO-125
SESAR Solution PJ07-02 (Airspace Users' Fleet	Airspace Users' Fleet Prioritization and Preferences (UDPP) sees the extension	AUO-0104	AOC-ATM-18 NIMS-21b

SESAR Solution ID and Title	SESAR Solution Description	OI Steps ref. (coming from EATMA)	Enablers ref. (coming from EATMA)
Prioritization and Preferences (UDPP))	of Airspace User capabilities, through the UDPP, allowing them to recommend a priority order request to the NM and appropriate airport authorities for flights affected by delays on departure, arrival and en-route, and to share preferences with other ATM stakeholders in capacity-constrained situations (CCS).		NIMS-25 NIMS-44
SESAR1 Solution #18 CTOT and TTA	Transition from CTOT to CTOT & TTA Consideration of TTA at Network Manager level for traffic planning activities (ATFCM measures) and distribution of the TTA through NOP in particular to the airport of destination for integration in the AMAN.	DCB-0208	ER APP ATC 17 AOC-ATM-11 AOC-ATM-13 AOC-ATM-20 NIMS-21a NIMS-38 SWIM-APS-03a SWIM-APS-04a SWIM-INFR-05a SWIM-NET-01a
SESAR1 Solution #46, SWIM Yellow Profile	To foster interoperability within the future European ATM Network (EATMA) as envisaged by SWIM, the SESAR programme developed a series of documents covering aspects such as concepts, service descriptions, templates, governance and a series of technical resources such as models. The SWIM Technological solution provides a coherent set of specifications providing essential requirements that are applicable to the standards used in the context of SWIM deployment. These documents are seen as the key elements in steering SWIM enabled systems for ensuring the interoperability; xStream will make use of Arrival Management Information Service.	IS-0901-A	SWIM-INFR-05a SWIM-SUPT-01a SWIM-SUPT-03a SWIM-STD-04
Solution #54: Flow based integration of arrival and departure management	Integrated Arrival and Departure management aims at increasing throughput and predictability at an airport by improved co-ordination between En Route/Approach and Tower	TS-0308	AERODROME-ATC-09a APP ATC 161

SESAR Solution ID and Title	SESAR Solution Description	OI Steps ref. (coming from EATMA)	Enablers ref. (coming from EATMA)
	controllers. Arrival and Departure flows to the same runway (or for dependent runways) are integrated by setting up fixed arrival departure pattern for defined periods. The successive pattern might be chosen by the operators or provided by an optimization algorithm considering arrival and departure demand. Departure flow to the runway is managed by pre-departure sequencing (integrating route planning) while arrival flow to the runway is managed by arrival metering		

Table 4: SESAR Solution(s) under Demonstration

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

A deviation is identified with Solution #18 “CTOT and TTA”.

Based on iStream conclusions, TTA will only be allocated in planning phase to short/medium hauls.

Those TTAs are not monitored and/or updated after take-off:

- Before departure, TTA is provided in addition to CTOT. This TTA is computed locally, for the FMP to develop its own strategy, taking into account local constraints, available capacity and Airspace Users inputs. TTO request is accepted by NM after having performed a network assessment. This updates the corresponding CTOT.
- Before take-off, flight crew may inform Tower ATC of their preferred TOT to respect TTO/TTA (within CTOT [-5;+10] tolerance). Between take-off and entry in Extended AMAN horizon, no specific action is required to adhere TTO.
- After take-off, flight crew try to adhere Flight Plan and they follow ATC instructions. Flights are then managed tactically when entering Extended AMAN horizon.

All these solutions contain mature elements of SESAR 1 for Target Time and Arrival Management concepts.

Exception of the above mentioned deviations are the trials in Frankfurt and Zurich for which airborne long haul flights got target times allocated involving the AU’s OCCs. The cockpit crews were advised to manage this throughout the entire flight.

3.3 Contribution to PCP

The project serves as proof of concept for the ATM Functionality AF#1 “Arrival Management extended to en-route airspace” as defined in the Pilot Common Project (PCP).

3.4 Summary of Demonstration Plan

3.4.1 Demonstration Plan Purpose

The purpose of xStream demonstration is to assess the maturity of Extended Arrival Management tools and concepts in high density areas, and their impacts on the following KPAs:

- Capacity: Capacity and complexity in TMA and en-route sectors,
- Cost efficiency: Airspace Users and ANS cost efficiency,
- Environment : Fuel efficiency and associated emissions savings,
- Flexibility: ATM System & Airport ability to respond to changes in planned flights and mission,
- Safety: Accidents/incidents with ATM contribution,

As a VLD, it has based its work upon concepts and tools developed in SESAR1 and previous projects, mainly:

- Solution #5: Extended AMAN horizon,
- Solution #8: Arrival management into multiple airports.
- P5.6.4, P5.6.7, FairStream, iStream and XMAN FABEC projects.

Part of other SESAR solutions has been also used to perform the trials:

- Solution #18: CTOT and TTA,
- Solution #46 : SWIM (System Wide Information Management)
- Solution #54: Flow based integration of Arrival and Departure Management
- Solution PJ07-02: UDPP (User Driven Prioritization Process)

The demonstrations have been performed on commercial flights landing at European major hubs during time periods when traffic load is exceeding capacity and ATFCM or Arrival Sequencing and Metering Area (ASMA) delays are significant.

To meet these objectives, 10 demonstrations exercises were performed within xStream, involving the following actors:

- ANSPs operating in the following airports: London-Heathrow & Gatwick, Paris CDG & Orly, Zurich, Frankfurt
- Large number of upstream ACCs around those platforms, amongst them Karlsruhe, Maastricht, Zurich, Geneva, Milan, Bordeaux, Reims, Paris, London, Prestwick and Shannon.
- Network Manager, operating as NMOC
- Airspace Users grouped in ATEAM consortium: Lufthansa Group, Air France, British Airways, EasyJet, and Ryanair.

The project has evaluated the consistency of these concepts, and has demonstrated how different extended AMAN tools can be adapted to the particularities of each operational context. It assessed also the impact on sector capacity, flight efficiency, as well as on all stakeholders working methods (crews, Air Traffic Control Operators (ATCOs), flow managers, etc.) and workload.

Regarding the "SESAR 2020 Transition Performance Framework", for measuring the performance impact of a SESAR Solution, two different situations have been assessed.

- One situation is a scenario that does not have the concept element (the reference scenario)
- A second situation that is the same as the first except it includes the new concept element (the Solution scenario).

Comparing the results from the two scenarios using a common set of key performance indicators showed the benefits that the particular concept element might bring if implemented.

3.4.2 Operating method description

Currently, a gap exists between:

- Flow management world (ATFCM), balancing traffic demand and airport/sector capacity by implementing ATFCM measures (i.e. regulations, scenarios, dDCB)
- Queue management (AMAN), building & enforcing an arrival sequence from top of descent to landing (typically 30 minutes before landing).

This situation is to be considered as sub-optimal, due to limited effectiveness of ATFCM regulations and the fact that no sequencing action is performed between the moment an aircraft takes off and its entrance into the AMAN horizon.

At a time when demand increases and runway and TMA/E-TMA capacities are limited by infrastructure or airspace capacity, new strategies are to be found. They shall deal with de-bunching of arrival flows and smoothing peaks in order to decrease ATC workload and safety issues, thus optimizing the existing capacity.

In the past years within the frame of SESAR1, some projects have addressed some concepts to bring closer Flow management and Queue management.

The last attempts of extended arrival management concept development are found in

- iStream,
- SESAR P5.6.4 and P5.6.7,
- XMAN FABEC project.

Those projects have explored the fields of Target Time of Arrival (TTA) from an ATFCM perspective and delay sharing advisories with en-route ACCs from a tactical arrival management viewpoint, but with some areas of improvement that are the focus of xStream:

- Extended AMAN between 200 to 350 NM: in the follow up of XMAN Project implementation, validate the maturity of E-AMAN solution for PCP deployment, and provide the toolbox for its implementation.
- Handling of multiple inbound flows to multiple airports in the sectors of upstream ACCs: with the extension of AMAN horizon, the cumulative effect of E-AMAN requests in the same sector may lead to a reduction of capacity, because of the competition between the flows, and induced conflicts. To prevent this, a CDM process has to be implemented to better predict E-AMAN activities, and assess upstream ACCs ability to process the requests.
- Improvement of Arrival Planning: in the follow-up of the iStream project, extend and automatize the use of locally computed TTAs to optimised ATFCM constraints. This process enables the definition of a collaborative process with Airspace Users to reduce the impact of ATFCM delays by allowing slot swapping and flight prioritisation (A-Flex and UDPP concepts).

The xStream/PJ25 project evaluates the extension of the AMAN horizon, ultimately leading to closing the gap between ATFCM and arrival queue management.

3.4.3 Summary of Demonstration Objectives and success criteria

Objectives for trials are summarized below:

Objective ID	Scenario ID/Exercise ID	EXE-VLD-06-001	EXE-VLD-06-002	EXE-VLD-06-003	EXE-VLD-07-001	EXE-VLD-07-002	EXE-VLD-07-003	EXE-VLD-08-001	EXE-VLD-08-002	EXE-VLD-08-003	EXE-VLD-09-002	EXE-VLD-09-003
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	X	X	X	X	X	X	X		X	X	X
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	X		X	X	X	X	X		X	X	
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic		X	X	X	X		X		X	X	
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.				(X)	(X)	X	(X)	X	X	X	
OBJ-VLD-04-002	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.			X		(X)	X	X		X		
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational improvements.	X	X		X	X		X				

Objective ID	Scenario ID/Exercise ID	EXE-VLD-06-001	EXE-VLD-06-002	EXE-VLD-06-003	EXE-VLD-07-001	EXE-VLD-07-002	EXE-VLD-07-003	EXE-VLD-08-001	EXE-VLD-08-002	EXE-VLD-08-003	EXE-VLD-09-002	EXE-VLD-09-003
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	X	X	X	X	X		X				X
OBJ-VLD-05-003	xStream operational improvements lead to a reduction of ATFCM measures.						X		(X)			
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users						X		X	X		

Table 5: Applicability of Objectives to Exercises; (X) = not planned but nevertheless covered in the assessments

3.4.4 Demonstration Assumptions

This section provides in the table below, the demonstration assumptions that had an impact on the demonstrations results and that are applicable for all demonstration trials.

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
1	Best effort for ATC & crews		For en-route units, ATC provides best effort to comply with speed advisories / TTL requests. Flight trials will require specific procedures for ATC but not for pilots.	Workload shall remain manageable by ATCO. Risk is to decrease en-route capacity if speed advisory is mandatory.	En-route	Safety Flexibility Capacity			ANSP.	
2	No airborne technical evolution		Transmission of instructions to crews will use existing ground-board links (such as ACARS).	Concept must be interoperable and not be costly for AUs.	En-route	Interoperability Cost Efficiency			ANSP AUs	
3	No revision of operating manual		Scenario design and implementation shall take into account existing ATCO operating manual and operations such as speed advisory, Time to lose, … Tasks will be briefed separately.	ATCO and FMP will receive training for trial participation. Tasks will be briefed separately.	N/A	Safety Interoperability Cost efficiency			ANSP	

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
4	Use of SWIM		Interfaces and data exchanges shall comply as much as possible with SESAR existing technologies such as those on SWIM to carry favour on interoperability and further integration.	Technology cost.		Interoperability Flexibility Cost Efficiency			ANSP	
5	Reuse of XMAN, iStream and FAIR STREAM outcomes		XMAN, iStream and FAIR STREAM outcomes (tools, CONOPS, Performance Assessment, procedures and instructions) shall be reused.	Speed up xStream scenario design and to enhance the implementation of xStream scenarios. Previous materials have a close link between ATFCM and extended AMAN and can be easily upgraded for xStream.		Cost Efficiency Flexibility			ANSP	
6	API service available		API service specifications are available for implementation in demonstration platforms.	Interoperability with existing systems and for further deployment.		Interoperability			ANSP NM	

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
7	Accuracy of ETFMS data		ETFMS data shall provide at least the same accuracy as EFD data for computing Trajectory Prediction and accurate sequencing.	EFDs are accurate enough to initiate sequencing in UAC. Preliminary study to be made with DSNA/DTI/PER to gain confidence in EFDs.		Predictability and punctuality Capacity Safety			NM	

Table 6: Demonstration Assumptions overview

Additional demonstration assumptions at exercise level will be captured in relevant appendixes.

3.4.5 Demonstration Exercises List

The full scope of xStream exercises is provided below:

Work Package	Location	Scenario ID	Scenario title
WP6	Heathrow & Gatwick airports	EXE-VLD-06-001	Deploy Heathrow & Gatwick Arr-Dep Timeline in Swanwick Terminal Control
		EXE-VLD-06-002	Gatwick XMAN 350NM
		EXE-VLD-06-003	Elements of Partners TP sharing with AMAN
WP7	Paris Orly and CDG airports	EXE-VLD-07-001	Extended AMAN in Paris-Orly
		EXE-VLD-07-002	COP sequencer for hotspot resolution
		EXE-VLD-07-003	Improved Arrival Planning Management and Airspace users preferences
WP8	Zurich airport	EXE-VLD-08-001	Extended Arrival Management (E-AMAN)
		EXE-VLD-08-002	Collaborative tool AU / ATC / NM (integrating AUs preferences)
		EXE-VLD-08-003	Improved Arrival Planning Management & NM integration
WP9	Multiple locations	EXE-VLD-09-002	Frankfurt Early Morning Arrival Stream Optimization
		EXE-VLD-09-003	Multiple XMAN operation in multiple ACC/UAC

Table 7: List of Demonstration Exercises

3.5 Deviations

3.5.1 Deviations with respect to the SJU Project Handbook

No deviation.

3.5.2 Deviations with respect to the Demonstration Plan

A deviation is to be reported for EXE-VLD-09-003 “Multiple XMAN operation in multiple ACC/UAC” which has been executed in shadow mode.

The exercise runs and scenarios were based on real time data and the exercise was conducted mainly at the operational sites of the involved partners.

The XMAN strategies that were tested were based on real XMAN data feeds into the XMAN Portal, but the resulting measures from applying the XMAN Strategies were not implemented and did not affect real traffic.

All other exercises have been implemented according to the baseline provided in the Demonstration Plan.

4 Demonstration Results

4.1 Summary of Demonstration Results

The results of the exercises listed in chapter 3.4.5 « Demonstration Exercises List » are summarised and consolidated in the tables below.

As applicable objectives, success criteria, assessment means and outcomes are very different for each performed demonstration exercise, the corresponding results of one single exercise are summarized in a separate table.

For more details on exercise results for specific metrics and assessments see appendices F-P. The results descriptions are also based on the reported results contained in these appendices.

Every table covers all the demonstration objectives applicable to the considered exercise with the corresponding success criteria addressed.

The final status of achievement of every single exercise is assessed in the last column of every table by using the following abbreviations:

- OK: Demonstration objective achieves the expectations (Exercise results completely fulfil the success criteria),
- NOK: Demonstration objective does not achieve the expectations (no assessment could be performed due to lack of data, exercise constraints or exercise results do not achieve success criteria),
- Partially OK (POK): Demonstration objective achieves the expectations to a certain extent. Justifications are provided in in the tables below.

In the following table the demonstration objective IDs in brackets highlight those objectives which were not foreseen for this exercise according to the demonstration plan but are nevertheless covered by the results.

4.1.1 WP06 - London Exercises

4.1.1.1 Exercise 6#1 (Gatwick Coupled AMAN-DMAN and early spacing policy definition)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: None Qualitative Assessment: According to filled questionnaires and feedback collected, safety is not compromised.	OK
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Predicted Arrival Delay Predicted Arrival Delay is reduced. Qualitative Assessment: According to qualitative assessment, nearly half of the respondents stated sufficient accuracy, further improvements were achieved.	OK
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational	CRT-VLD-05-001	Traffic Load, ATC Workload and Complexity in	Quantitative Assessment: None	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
	improvements.		Terminal Sectors are reduced.	Qualitative Assessment: According to filled questionnaires (ATCO workload and situation awareness related questions), the ATCO situation awareness was improved. Reasoning for POK: The impact on ATCO workload is seen sceptical. Further, some acceptance issues raised.	
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors do not exceed available capacity.	Not assessed, reasoning see appendix (therefore NOK)	NOK

4.1.1.2 Exercise 6#2 (Gatwick XMAN 350NM)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No incidents were reported in connection with xStream trials. Qualitative Assessment: None	OK
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic	CRT-VLD-03-001	Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.	Quantitative Assessment: a) Fuel Consumption Fuel consumption / CO_2 emissions have been reduced. Qualitative Assessment: None	OK
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational improvements.	CRT-VLD-05-001	Traffic Load, ATC Workload and Complexity in Terminal Sectors are reduced.	Quantitative Assessment: None Qualitative Assessment: According to collected feedback, XMAN reduced	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				ATCO workload by reducing the holding time in TMA.	
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors do not exceed available capacity.	Quantitative Assessment: None Qualitative Assessment: According to collected feedback, no unacceptable increase in workload was indicated.	OK

4.1.1.3 Exercise 6#3 (Heathrow XMAN 350-500NM - Shadow Mode)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: None Qualitative Assessment: According to collected feedback, no safety issues were raised.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual – planned No change could be determined. Qualitative Assessment: None Reasoning for NOK: No improvement as required by the Success Criterion could be determined here.	NOK
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic	CRT-VLD-03-001	Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.	Quantitative Assessment: a) Fuel consumption Fuel consumption would have been reduced when actions would have been applied. Qualitative Assessment: None	OK
OBJ-VLD-04-002	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None Qualitative Assessment: According to qualitative assessment, a theoretical	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				capacity increase could improve the maximum number flights handled by one ATCO per hour (either more flights per controller or fewer controllers for the same traffic).	
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors do not exceed available capacity.	Quantitative Assessment: None Qualitative Assessment: According to qualitative assessment, the potential to even reduce workload was indicated.	OK

4.1.2 WP07 - Paris Exercises

4.1.2.1 Exercise 7#1 (Orly XMAN)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: According to filled questionnaires (safety related questions) and other subjective feedback, safety was not compromised due to xStream operations.	OK
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Landing sequence predictability: Very slight improvement was measured for those trial days on which speed advisories were issued. Qualitative Assessment: None	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic	CRT-VLD-03-001	Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.	Quantitative Assessment: a) Fuel consumption Slight improvement of up to 4,75% of fuel saved within a circle of 100NM around ORY was determined. Qualitative Assessment: None	OK
(OBJ-VLD-04-001)	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Additional ASMA time Clear reduction of additional ASMA time was measured. b) Number of holding patterns flown in TMA Clear reduction of holding patterns flown in TMA was determined. Qualitative Assessment: None	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational improvements.	CRT-VLD-05-001	Traffic Load, ATC Workload and Complexity in Terminal Sectors are reduced.	Quantitative Assessment: a) Runway throughput No decrease was measured (PJ25 improvements did not produce a bottleneck in the TMA or upper sectors). b) Flight path diversity (Complexity Metric) No difference between reference and trials was determined. Qualitative Assessment: According to filled questionnaires (TMA capacity, ATCO workload and situation awareness related questions) and other feedback collected, workload and recognized traffic complexity decreased.	OK
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors do not exceed available capacity.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback from upstream ACCs, ATCO workload, complexity and situational	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				awareness was not negatively affected.	

4.1.2.2 Exercise 7#2 (COP Sequencer)

4.1.2.2.1 UJ Scenario

As a remark, the UJ Sector is part of the extended TMA Paris and therefore not considered as an enroute sector.

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: According to filled questionnaires (safety related questions), both ATCOs and FMPs confirmed that improvements to not compromise safety.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual - planned No change was detected. b) Landing sequence predictability Slight improvement was measured. Qualitative Assessment: According to Paris FMP, the recognized predictability improved.	OK
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic	CRT-VLD-03-001	Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.	Quantitative Assessment: a) Fuel consumption Possible fuel savings of up to 12.2% for the flight portion within the UJ sector were determined. Qualitative Assessment: None	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
(OBJ-VLD-04-001)	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Additional ASMA time A slight reduction of additional ASMA time was measured. b) Number of holding patterns flown in TMA No holding patterns were flown neither in reference nor in trial days. c) Flown distance between TOD and IAF No difference was determined. Qualitative Assessment: None	OK
(OBJ-VLD-04-002)	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback, the operational improvement does not produce extra costs for ANSPs.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational improvements.	CRT-VLD-05-001	Traffic Load, ATC Workload and Complexity in Terminal Sectors are reduced.	Quantitative Assessment: a) TMA throughput An increase of TMA throughput was determined compared to the reference. b) Traffic density Only very small changes visible, interpretation can be questioned. c) Flight path diversity (Complexity Metric) Only very small changes visible, interpretation can be questioned. d) Level dispersion at IAF Assessment was not possible Qualitative Assessment: According to filled questionnaires (TMA capacity, ATCO workload and situation awareness related questions) and subjective feedback, the benefit for ATCO workload and situation awareness was	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				clearly outlined. Complexity was not increased.	
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors don't exceed available capacity.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback from upstream ACCs, capacity and complexity in enroute sectors was not an issue.	OK

4.1.2.2.2 TE Scenario

As a remark, the TE Sector is part of the extended TMA Paris and therefore not considered as an enroute sector.

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Qualitative Assessment: According to filled questionnaires (safety related questions), both ATCOs and FMPs confirmed that improvements to not compromise safety.	
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual - planned No change between baseline and trials was found. b) Landing sequence predictability Insufficient samples to draw conclusions (due to data gaps). Qualitative Assessment: None Reasoning for NOK: No improvement as required by the success criterion could be determined here.	NOK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic	CRT-VLD-03-001	Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.	Quantitative Assessment: a) Fuel consumption Possible fuel savings of up to 12,5% for the flight portion within the UJ sector were determined. Qualitative Assessment: None	OK
(OBJ-VLD-04-001)	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Additional ASMA time A reduction of additional ASMA time was measured. b) Number of holding patterns flown in TMA No holding patterns were flown in reference and solution. c) Flown distance between TOD and IAF Assessment was not possible due to data availability.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Qualitative Assessment: None	
(OBJ-VLD-04-002)	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback received, operational improvements do not produce extra costs.	OK
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational improvements.	CRT-VLD-05-001	Traffic Load, ATC Workload and Complexity in Terminal Sectors are reduced.	Quantitative Assessment: a) TMA throughput No interpretable differences were determined. b) Traffic density Slight decrease was determined. c) Flight path diversity (Complexity metric) Clear decrease was determined.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				d) Level dispersion at IAF No interpretable differences were determined. Qualitative Assessment: According to filled questionnaires (TMA capacity, ATCO workload and situation awareness related questions) and subjective feedback, the benefit for ATCO workload and situation awareness was clearly outlined. Complexity was not rated to be decreased, capacity in general was rated to be unchanged or increased.	
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors don't exceed available capacity.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback from upstream ACCs, capacity and complexity in enroute sectors was not an issue.	OK

4.1.2.2.3 SKI Scenario

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: According to subjective feedback received, safety was not compromised.	OK
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Covered in UJ / TE Scenario	N/A
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic	CRT-VLD-03-001	Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.	Covered in UJ / TE Scenario	N/A
(OBJ-VLD-04-002)	xStream operational improvements are feasible while	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
	maintaining current level of ANSP cost efficiency.			Qualitative Assessment: According to subjective feedback received, the operational improvement does not produce extra costs.	
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational improvements.	CRT-VLD-05-001	Traffic Load, ATC Workload and Complexity in Terminal Sectors are reduced.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback received, the operational improvement led to arrival sequence optimization and reduction of complexity.	OK
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors do not exceed available capacity.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback received, capacity and complexity in enroute sectors was not an issue.	OK

4.1.2.3 Exercise 7#3 (Improved Arrival Planning)

4.1.2.3.1 CDG Scenario

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: None	OK
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual - planned No difference between baseline and solution was determined. b) Landing sequence predictability Clear improvement was measured. Qualitative Assessment:	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				None	
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Additional ASMA Time No change was determined. b) Number of holding patterns flown in TMA No holding patterns were detected on reference and trial days. Qualitative Assessment: None Reasoning for NOK: No improvement as required by the success criterion could be determined here.	NOK
OBJ-VLD-04-002	xStream operational improvements are feasible while	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
	maintaining current level of ANSP cost efficiency.			Qualitative Assessment: According to subjective feedback received, operational improvements do not produce extra costs.	
OBJ-VLD-05-003	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total ATFCM delay Total ATFCM delay increased due to intentional MCP regulations. However, this is not seen critical as it is part of the concept and benefits were clearly determined in other KPAs. Qualitative Assessment: According to the filled questionnaires, the benefit was clearly seen by supervisors regardless of additional delay due to MCP regulations. Reasoning for POK: No improvement as required by the success criterion could be determined here, but when using MCP regulations a small increase of ATFCM delay is unavoidable and quite natural.	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users	CRT-VLD-06-001	Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased	Covered in AFLEX Scenario	N/A

4.1.2.3.2 Orly Scenario

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: According to filled questionnaires (safety related questions), the operational improvement does not compromise safety.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual - planned No clear difference was determined. b) Landing sequence predictability No improvement could be determined. Qualitative Assessment: According to subjective feedback received, iAMAN improved predictability, especially in terms of incoming traffic load, capacity and arrival sequence. Reasoning for POK: No improvement as required by the success criterion could be determined quantitatively here. Qualitative assessment nevertheless indicates a perceived improvement.	POK
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Additional ASMA Time Not enough samples to draw conclusions.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Qualitative Assessment: According to subjective feedback received, the operational improvement does not create additional costs for AU.	
OBJ-VLD-04-002	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback received, the operational improvement does not create additional costs for ANSPs.	OK
OBJ-VLD-05-003	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total ATFCM delay A decrease of 6% on the average was determined. Qualitative Assessment: According to questionnaire results, the scenario is an enabler for increasing capacity.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users	CRT-VLD-06-001	Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased	Covered in AFLEX scenario.	N/A

4.1.2.3.3 E-TMA Scenario

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: According to filled questionnaires (safety related questions), the operational improvement does not compromise safety.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual - planned Slight improvement visible under certain conditions (depending on the type of regulation used). b) Landing sequence predictability No change determined. Qualitative Assessment: None	OK
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Additional ASMA time No change on average but less disperses for trials. b) Number of holding patterns flown in TMA. No holding pattern was detected during trials or reference days.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Qualitative Assessment: According to subjective feedback, no additional costs were created for AU.	
OBJ-VLD-04-002	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback received, the operational improvement does not produce extra costs.	OK
OBJ-VLD-05-003	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total ATFCM delay A decrease of Total ATFCM delay was determined. Qualitative Assessment: According to filled questionnaires (questions related to ATFCM delay), the operational improvement was rated beneficial.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users	CRT-VLD-06-001	Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased	Covered in AFLEX scenario	N/A

4.1.2.3.4 SKI Scenario

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: According to filled questionnaires (safety related questions), safety is not compromised by the operational improvement.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback received, iAMAN improved predictability, especially in terms of incoming workload and arrival sequence.	OK
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Covered in other EXE7#3 Scenarios	N/A
OBJ-VLD-04-002	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None Qualitative Assessment: According to subjective feedback received, operational improvements do not produce extra costs.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-05-003	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total ATFCM delay A decrease in total ATFCM delay was determined. Qualitative Assessment: According to filled questionnaires (questions related to ATFCM delay), the operational improvement was rated beneficial.	OK
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users	CRT-VLD-06-001	Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased	Covered in AFLEX scenario.	N/A

4.1.2.3.5 AFLEX Scenario

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: According to feedback received, the implemented improvements do not compromise safety.	OK
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Covered by other Exercise 7#3 scenarios	N/A
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Costs related to ATFCM delay It was determined that delay related costs are decreased for IMPROVEMENT requests, but increased for SWAP requests.	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Qualitative Assessment: According to received feedback, the new improvement leads to optimized processes while it does not produce additional process costs. Reasoning for POK: The improvement as required by the success criterion could not always be determined here (e.g. not for SWAP requests).	
OBJ-VLD-04-002	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None Qualitative Assessment: According to received feedback, the new improvements do not produce additional costs.	OK
OBJ-VLD-05-003	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total ATFCM delay Reduced for IMPROVEMENT requests, increased for SWAP requests. Qualitative Assessment: According to received feedback, AFLEX is an	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				efficient tool to optimize ATFCM regulations, taking AU needs into account. Reasoning for POK: The improvement as required by the success criterion could not always be determined here (e.g. not for SWAP requests).	
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users	CRT-VLD-06-001	Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased	Quantitative Assessment: None Qualitative Assessment: According to received feedback, AFLEX in general enables FMPs to take AU needs into account, which is a welcomed improvement.	OK

4.1.3 WP08 - Zurich Exercises

4.1.3.1 Exercise 8#1 (Zurich XMAN)

Note: this section will be completed with issue 2 of the DEMOR (November 2019).

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: No safety concerns were reported, neither by Reims ACC nor by Zurich ACC.	OK
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual - planned No change was determined. b) Landing sequence predictability Very slight improvement was determined, but should be confirmed again. Qualitative Assessment: None Reasoning for POK: Small improvement has been	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				determined, but it is close to or below accuracy of the method. Results need to be confirmed again in separate trials.	
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic	CRT-VLD-03-001	Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.	Quantitative Assessment: a) Fuel consumption per flight Improvement of up to 1% fuel saved for the flight portion within 30NM around Zurich airport was measured. However, due to accuracy of the method, this should carefully be interpreted as no change but real improvement is not excluded. b) Time per level Slight decrease for the time spent below FL80 was detected. Qualitative Assessment: None Reasoning for POK: Small improvement has been determined, but it is close to or below accuracy of the method. Results need to be confirmed again in separate trials.	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
(OBJ-VLD-04-001)	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Air transport time efficiency No significant difference. b) Air transport distance efficiency No significant difference. Qualitative Assessment: According to feedback, E-AMAN is judged to offer a great potential for the airspace user. Reasoning for POK: Quantitative assessment shows no improvement as required by the success criterion but improvement is indicated by qualitative feedback.	POK
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational improvements.	CRT-VLD-05-001	Traffic Load, ATC Workload and Complexity in Terminal Sectors are reduced.	Quantitative Assessment: a) Traffic density Traffic density was reduced (less bunching). b) Flight path diversity (Complexity Metric)	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Slight improvement was determined. Qualitative Assessment: None	
(OBJ-VLD-05-002)	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors do not exceed available capacity.	Quantitative Assessment: None Qualitative Assessment: According to feedback from Reims ACC, no workload increase or a loss of situation awareness occurred.	OK
OBJ-VLD-05-003	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total ATFCM delay No real gain regarding ATFCM delays could be determined due to multiple regulations caused by weather issues during solution dates. Qualitative Assessment: None	NOK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Reasoning for NOK: No improvement as required by the success criterion was determined here.	

4.1.3.2 Exercise 8#2 (User Driven Prioritization Process)

4.1.3.2.1 Simulation (2018)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Covered in Shadow Mode Trial (2019)	N/A
(OBJ-VLD-05-003)	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total UDPP delay (simulated equivalent to ATFCM delay) A reduction of UDPP delay was determined, but it has to be noted that some flights were shifted out	NOK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				of the time window under consideration. b) Average UDPP delay per flight (per airline) A reduction of UDPP delay was determined, but it has to be noted that some flights were shifted out of the time window under consideration. Impact on SWR flights was clearly visible while no impact was determined for EDW flights on average. Qualitative Assessment: None Reasoning for NOK: No improvement as required by the success criterion was reliably determined here.	
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users	CRT-VLD-06-001	Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased	Covered in Shadow Mode Trial (2019)	N/A

4.1.3.2.2 Shadow Mode Trial (2019)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Critical Passenger Connections: UDPP leads to a reduction of the number of critical passenger connections and consequently to a reduction of compensation costs. b) Total Operational Benefit: An improvement of up to 65% was achieved. Qualitative Assessment: According to the qualitative assessment, UDPP provides a huge financial benefit to airspace users.	OK
(OBJ-VLD-05-003)	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total UDPP delay : No change and no negative impact was determined (for UDPP the goal was not directly to reduce delay but to provide a possibility for AU to redistribute it over the own flights without negative impact in total). Qualitative Assessment:	NOK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				None Reasoning for NOK: No improvement as required by the success criterion was determined here.	
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users	CRT-VLD-06-001	Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased	Quantitative Assessment: None Qualitative Assessment: According to qualitative assessment, UDPP provides clear flexibility benefits to airspace users.	OK

4.1.3.3 Exercise 8#3 (Network Manager Integration)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment:	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				None	
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual - planned Clear reduction compared to baseline has been measured. b) Landing sequence predictability Clear improvement has been determined. c) Landing spacing gaps Predicted spacing gaps are more accurate compared to the baseline. d) Time difference ETO - TTO Measurements confirm that ETFMS flights' profiles were effectively updated thanks to the provided sequence.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Qualitative Assessment: According to the qualitative assessment, arrival predictability and punctuality is improved by NM Integration.	
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-002	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Air transport time efficiency Average flight time from entry fix to the runway was measured to be reduced compared to baseline. b) Air transport distance efficiency Average flight distance from entry fix to the runway was measured to be reduced compared to baseline. Qualitative Assessment: According to qualitative assessment, cost efficiency for AU is increased due to the optimized arrival routing.	OK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-04-002	xStream operational improvements are feasible while maintaining current level of ANSP cost efficiency.	CRT-VLD-04-003	ANSP personnel costs are maintained or reduced.	Quantitative Assessment: None Qualitative Assessment: According to qualitative assessment, the improvement did not cause extra costs for ANSP. No additional staff needed to be recruited.	OK
OBJ-VLD-05-003	xStream operational improvements lead to a reduction of ATFCM measures.	CRT-VLD-05-003	Flight delay caused by ATFCM is reduced.	Quantitative Assessment: a) Total ATFCM delay There was no decrease in ATFCM delay as MCP regulations were used, which intentionally introduce additional regulations and maybe delay for improving other KPAs (mainly predictability). b) Number of regulated flights per specific traffic volume Due to the use of MCP regulations, the number of regulated flights was increased naturally. c) Number of flights delayed by more than 15min per specific traffic volume The number of flights delayed by more than 15min	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				was reduced. Qualitative Assessment: None Reasoning for POK: The improvement as required by the success criterion was determined for specific indicators only (flights delayed by more than 15min) while the opposite is the case for other indicators (Total ATFCM delay).	
OBJ-VLD-06-001	xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users	CRT-VLD-06-001	Communication and Consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased	Quantitative Assessment: a) Performed / received requests ratio Assessment was not possible due to complexity issues. Qualitative Assessment: According to the qualitative assessment, the improvement allows early flexibility even before departure.	OK

4.1.4 WP09 - Frankfurt and Upper Airspace Exercises

4.1.4.1 Exercise 9#2 (Frankfurt Early Morning Arrival Stream Optimisation)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: a) Number of incident reports No safety incidents were reported in connection with xStream trials. Qualitative Assessment: According to feedback from operational staff and daily logs, no safety issues related to the trials occurred.	OK
OBJ-VLD-02-001	xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors	CRT-VLD-02-001	Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced	Quantitative Assessment: a) Time difference actual – planned: TTA - ALDT: Results point towards a satisfactory predictability. SIBT - AIBT: No clear difference visible.	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				TTO - ATO: Good achievement of target times at Metering Fixes (within +- 2 min.), but some outliers Estimated - Actual Flight Time from COP to RWY: Only ~ 2 minutes offset of average flying time between Metering Fix (COP) and RWY and the planned times. Qualitative Assessment: None Reasoning for POK: The improvement as required by the success criterion was indicated but not clearly determined.	
OBJ-VLD-03-001	xStream operational improvements provide benefits in terms of environmental sustainability of air traffic	CRT-VLD-03-001	Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.	Quantitative Assessment: a) Time per level Small reduction in flying time in level flight within the TMA for certain arrival flows	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				Qualitative Assessment: None Reasoning for POK: The improvement as required by the success criterion was determined for specific situations only (certain arrival flows).	
OBJ-VLD-04-001	xStream operational improvements increase cost efficiency from more efficient processes for AU.	CRT-VLD-04-001	Flight efficiency is increased and flight management / flight coordination costs are reduced.	Quantitative Assessment: a) Air transport time efficiency Slight improvement (~5%) for RWY07, slight negative impact (~3%) for RWY25. b) Air transport distance efficiency Slight improvement (~5%) for RWY07, slight negative impact (~2-3%) for RWY25. c) Time in level flight during approach Small reduction in flying time in level flight within the TMA d) Distance in level flight during approach Small reduction of distance in level flight within the	POK

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
				TMA Qualitative Assessment: None Reasoning for POK: The improvement as required by the success criterion was determined for specific situations only (RWY07).	
OBJ-VLD-05-001	ATC Capacity usage in TMA is optimized by xStream operational improvements.	CRT-VLD-05-001	Traffic Load, ATC Workload and Complexity in Terminal Sectors are reduced.	Quantitative Assessment: a) Runway throughput: No impact on average, but critical arrival peaks could be avoided. Qualitative Assessment: None Reasoning for POK: The improvement as required by the success criterion was determined for specific situations only (arrival peaks).	POK

4.1.4.2 Exercise 9#3 (Multiple XMAN Operations in multiple ACC/UAC)

Demonstration Objective ID	Demonstration Objective Title	Success Criterion ID	Success Criterion Description	Demonstration Results	Demo. Objective Status
OBJ-VLD-01-001	xStream operational improvements are respecting the current level of safety in air traffic management	CRT-VLD-01-001	The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents	Quantitative Assessment: None Qualitative Assessment: According to filled questionnaires (safety related questions) and collected feedback, the improvements do not compromise safety.	OK
OBJ-VLD-05-002	Available Enroute Sector Capacity allows application of xStream operational improvements.	CRT-VLD-05-002	Traffic Load, ATC Workload and Complexity in Enroute Sectors do not exceed available capacity.	Quantitative Assessment: None Qualitative Assessment: Filled questionnaires (capacity related questions) did not indicate any workload or capacity issue.	OK

4.2 Detailed analysis of Demonstration Results per Demonstration objective

This section provides a consolidated analysis of all the contributions of the different exercises that addressed the demonstration objectives. Detailed results are provided in the corresponding appendixes.

This section provides a general analysis of the results expanding the summary captured in section 3.1, including:

- Rationale of the results,
- Potential deviations with respect to the targets,
- Possible reasons and relationship between the results and the applicable assumptions.

4.2.1 OBJ-VLD-01-001 Results

OBJ-VLD-01-001: The safe management of traffic by ATC is not compromised New procedures do not cause critical incidents.

This objective was to show that xStream operational improvements are respecting the current level of safety in air traffic management.

The corresponding success criterion is fulfilled when the safe management of traffic by ATC is not compromised and new procedures do not cause critical incidents.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)
EXE-VLD-6-001 (Gatwick AMAN-DMAN)	OK
EXE-VLD-6-002 (Gatwick XMAN)	OK
EXE-VLD-6-003 (Heathrow XMAN)	OK
EXE-VLD-7-001 (Orly XMAN)	OK
EXE-VLD-7-002 (COP Sequencer)	OK
EXE-VLD-7-003 (Improved Arrival Planning)	OK
EXE-VLD-8-001 (Zurich XMAN)	OK
EXE-VLD-8-003 (NM Integration)	OK
EXE-VLD-9-002 (Frankfurt EMAS Optimization)	OK
EXE-VLD-9-003 (Multiple XMAN Operations in multiple ACC/UAC)	OK

Table 8: Summary of Demonstration Exercises Results for OBJ-VLD-01-001

4.2.2 OBJ-VLD-02-001 Results

OBJ-VLD-02-001: Differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced

This objective was to show that xStream operational improvements provide a better predictability and punctuality of air traffic in TMA / terminal sectors.

The corresponding success criterion is fulfilled when differences between planned / predicted and actual traffic flow at prominent points or at the runway are reduced.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)
EXE-VLD-6-001 (Gatwick AMAN-DMAN)	OK
EXE-VLD-6-003 (Heathrow XMAN)	NOK
EXE-VLD-7-001 (Orly XMAN)	OK
EXE-VLD-7-002 (COP Sequencer)	UJ Scenario: OK TE Scenario: NOK SKI Scenario: N/A
EXE-VLD-7-003 (Improved Arrival Planning)	CDG Scenario: OK Orly Scenario: POK E-TMA Scenario: OK SKI Scenario: OK AFLEX Scenario: N/A
EXE-VLD-8-001 (Zurich XMAN)	POK
EXE-VLD-8-003 (NM Integration)	OK
EXE-VLD-9-002 (EDDF EMAS Optimization)	POK

Table 9: Summary of Demonstration Exercises Results for OBJ-VLD-02-001

4.2.3 OBJ-VLD-03-001 Results

OBJ-VLD-03-001: Fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.

This objective was to show that xStream operational improvements provide benefits in terms of environmental sustainability of air traffic.

The corresponding success criterion is fulfilled when fuel efficiency of air traffic is increased while emissions (and noise pollution) are reduced.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)
EXE-VLD-6-002 (Gatwick XMAN)	OK

EXE-VLD-6-003 (Heathrow XMAN)	OK
EXE-VLD-7-001 (Orly XMAN)	OK
EXE-VLD-7-002 (COP Sequencer)	UJ Scenario: OK TE Scenario: OK SKI Scenario: N/A
EXE-VLD-8-001 (Zurich XMAN)	POK
EXE-VLD-9-002 (EDDF EMAS Optimization)	POK

Table 10: Summary of Demonstration Exercises Results for OBJ-VLD-03-001

4.2.4 OBJ-VLD-04-001 Results

OBJ-VLD-04-001: Flight efficiency is increased and flight management / flight coordination costs for the airspace users are reduced.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)
EXE-VLD-7-001 (Orly XMAN)	OK
EXE-VLD-7-002 (COP Sequencer)	OK
EXE-VLD-7-003 (Improved Arrival Planning)	CDG Scenario: NOK Orly Scenario: OK E-TMA Scenario: OK SKI Scenario: N/A AFLEX Scenario: POK
EXE-VLD-8-001 (Zurich XMAN)	POK
EXE-VLD-8-002 (UDPP)	Simulation: N/A Shadow Mode: OK
EXE-VLD-8-003 (NM Integration)	OK
EXE-VLD-9-002 (EDDF EMAS Optimization)	POK

Table 11: Summary of Demonstration Exercises Results for OBJ-VLD-04-001

4.2.5 OBJ-VLD-04-002 Results

OBJ-VLD-04-002: ANSP personnel costs are maintained or reduced.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)
EXE-VLD-6-003 (Heathrow XMAN)	OK
EXE-VLD-7-002 (COP Sequencer)	OK
EXE-VLD-7-003 (Improved Arrival Planning)	OK
EXE-VLD-8-003 (NM Integration)	OK

Table 12: Summary of Demonstration Exercises Results for OBJ-VLD-04-002

4.2.6 OBJ-VLD-05-001 Results

OBJ-VLD-05-001: Traffic Load, ATC Workload and Complexity in Terminal Sectors are reduced.

This objective was to show that ATC capacity usage in TMA is optimized by xStream operational improvements.

The corresponding success criterion is fulfilled when Traffic load, ATC workload or complexity in terminal sectors is reduced.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)
EXE-VLD-6-001 (Gatwick AMAN-DMAN)	POK
EXE-VLD-6-002 (Gatwick XMAN)	OK
EXE-VLD-7-001 (Orly XMAN)	OK
EXE-VLD-7-002 (COP Sequencer)	OK
EXE-VLD-8-001 (Zurich XMAN)	OK
EXE-VLD-9-002 (EDDF EMAS Optimization)	POK

Table 13: Summary of Demonstration Exercises Results for OBJ-VLD-05-001

4.2.7 OBJ-VLD-05-002 Results

OBJ-VLD-05-002: Traffic Load, ATC Workload and Complexity in Enroute Sectors do not exceed available capacity.

This objective was to show that available enroute sector capacity allows the application of xStream operational improvements.

The corresponding success criterion is fulfilled when Traffic load, ATC workload or complexity in enroute sectors do not exceed available capacity.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)

EXE-VLD-6-001 (Gatwick AMAN-DMAN)	NOK
EXE-VLD-6-002 (Gatwick XMAN)	OK
EXE-VLD-6-003 (Heathrow XMAN)	OK
EXE-VLD-7-001 (Orly XMAN)	OK
EXE-VLD-7-002 (COP Sequencer)	OK
EXE-VLD-8-001 (Zurich XMAN)	OK
EXE-VLD-9-003 (Multiple XMAN Operations in multiple ACC/UAC)	OK

Table 14: Summary of Demonstration Exercises Results for OBJ-VLD-05-002

4.2.8 OBJ-VLD-05-003 Results

OBJ-VLD-05-003: Flight delay caused by ATFCM is reduced.

This objective is mainly addressed by Arrival Planning Improvement trials (Pre-departure TTAs).

The corresponding success criterion is fulfilled when flight delay caused by ATFCM is reduced.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)
EXE-VLD-7-003 (Improved Arrival Planning)	CDG Scenario: POK Orly Scenario: OK E-TMA Scenario: OK SKI Scenario: OK AFLEX Scenario: POK
EXE-VLD-8-001 (Zurich XMAN)	NOK
EXE-VLD-8-002 (UDPP)	Simulation: NOK Shadow Mode: NOK
EXE-VLD-8-003 (NM Integration)	POK

Table 15: Summary of Demonstration Exercises Results for OBJ-VLD-05-003

4.2.9 OBJ-VLD-06-001 Results

OBJ-VLD-06-001: xStream operational improvements enable a more flexible management of arriving flights by aircraft operators / airspace users.

The corresponding success criterion is fulfilled when communication and consideration of Airspace user / Aircraft operator preferences as part of arrival management process is increased.

The following table summarizes the outcomes of the individual PJ25 exercises. The objective is either fulfilled (OK), partly fulfilled (POK), not fulfilled (NOK) or not applicable (N/A).

Objective covered in Exercise …	Status (OK / POK / NOK / N/A)
EXE-VLD-7-003 (Improved Arrival Planning)	CDG Scenario: N/A Orly Scenario: N/A E-TMA Scenario: N/A SKI Scenario: N/A AFLEX Scenario: OK
EXE-VLD-8-002 (UDPP)	Simulation: N/A Shadow Mode: OK
EXE-VLD-8-003 (NM Integration)	OK

Table 16: Summary of Demonstration Exercises Results for OBJ-VLD-06-001

4.3 Confidence in Results of Demonstration Exercises

4.3.1 Limitations and impact on the level of Significance

The general limitations with the following impact on the level of significance were identified in some exercises:

Type of Assessment	Description of Limitation	Impact on level of significance
Quantitative and Qualitative	Local conditions and procedures of ATC environment: As the exercises were performed as live trial in a real ATC environment the results are primarily valid for the appropriate ATC units and under consideration of local airspace structure, local ATC equipment, local procedures and local traffic picture.	Results may not be directly transferable to other ATS units, especially when they differ significantly in terms of airspace structure, ATC equipment, local procedures or traffic constellation. Implementing the same improvement elsewhere could result in a lower or also higher benefit than measured in the exercises.
	Exe 6#3, Exe8#2 and Exe9#3 were performed as shadow mode: When performing a live trial in shadow mode configuration, the new systems are using live data as input but no real action is taken on the air traffic. Therefore the effects of hypothetic actions can only be estimated.	The results for exercises performed as shadow mode trial may not fully reflect effects on the air traffic (effects may be over- or underestimated or side effects might not be visible). If possible, the exercises should be repeated as live trial to confirm the obtained results.

Type of Assessment	Description of Limitation	Impact on level of significance
	Consolidation: After introducing new procedures or equipment changes, the operators may need some time to get fully trained and acquainted with the new working methods and to fully recognize the new possibilities and opportunities. In an ideal case any trial involving performance measurements should be done after completion of such a phase. Due to technical or time constraints this was not always possible in PJ25.	In case the exercise and the assessment has been performed without such a consolidation phase the measured benefits may be smaller as not all possible beneficial actions might have been taken or unnecessary actions might have been taken in inappropriate situations. Controllers might still be sceptical against the new improvements.
	Magnitude of expected effects: As the magnitude of expected effects is relatively small compared to the magnitude of natural volatility of air traffic it might be difficult to measure them.	Results or feedback indicating no change might not necessarily mean that there is no improvement, it could also mean that the assessment was not accurate enough under live trial conditions.
	Specific conditions were excluded: In order to filter out the effect on ATM performance of specific conditions like OJT, unusual traffic situations etc., these conditions were filtered out.	Results are primarily valid for nominal conditions and may not be fully true for the conditions that have been excluded.
	Aborted trials: For technical or operational reasons, an abortion of the trial was sometimes unavoidable.	Aborted trials reduce the size of the dataset which is available for analysis. In case of a low number of planned trial days the significance might be endangered.
Quantitative	In some exercises not all flights participated in the trial (e.g. EXE8#1, EXE9#2).	The measured benefit may be smaller than it would have been with full flights participation.
	Data problems: As the exercises were performed as live trials, different reasons may lead to a lack of data or data gaps for analysis, e.g.: - failure of data recording, - significant changes in data format during the trial period due to software updates, - confidentiality issues.	Concerned performance indicators may have to be calculated with a reduced amount of data, which may lead to small sample sizes or a complete abandonment of this indicator.

Type of Assessment	Description of Limitation	Impact on level of significance
	Lack of opportunities: In case a new procedure or action is only applicable under specific conditions (e.g. a specific traffic constellation), these conditions usually cannot be enforced in a live trial. When these conditions do not occur naturally there is no opportunity to actually use the new system or procedure.	The measured benefit may be smaller than it would have been when appropriate conditions were happening regularly.
Qualitative	Low number of questionnaire returns / persons who provided feedback: In some exercises only a low number of returns were received (e.g. EXE8#1).	The remaining returns may not be representative or analysable.

Table 17: Summary of Exercise Limitations and Impacts on level of significance

If applicable to the appropriate exercise, more detail is provided in the corresponding exercise appendix.

4.3.1.1 Quality of Demonstration Exercises Results

The quality of the demonstration exercise results and their corresponding error range may be affected by the following factors:

Comparability issues:

- Due to the natural volatility of daily air traffic the collected datasets may not be fully comparable against each other or with the selected reference datasets due to slightly different frame conditions. This is considered as the main source for calculation errors and accuracy problems.

Complexity of air traffic:

- Air traffic is a very complex process, driven by a lot of known and unknown, measureable and non-measureable variables. Consequently, there is still a small risk that factors disturbing the trials or distorting the performance assessment results are fully understood. In the same way also the size of the error range cannot be (fully) quantified.

Limited repeatability:

- As a further consequence from the two points above, trials cannot be repeated in the same way as it would be possible for simulations as not all frame conditions or initial conditions can be controlled in live trials or mitigated by making assumptions. For this reason it will be hard to confirm obtained results in a repetition of the trial at another time.

Huge effort has been taken in PJ25 to compensate all these effects and to keep the quality of the exercise results at a high level as far as practicable (e.g. by applying the comparability checks described in Appendix E). Often this leads to a trade-off situation between comparability and sample size (stricter comparability checks quickly lead to small sample sizes and therefore to a limited significance or unreliability of the result).

As a conclusion, considering the effort spent, the quality of the results can be considered close to the maximum achievable under live trial conditions.

Further aspects concerning the individual exercises are highlighted in the appropriate appendixes.

4.3.1.2 Significance of Demonstration Exercises Results

As the individual exercises use different methods and indicators for making the assessment as well as trials are performed over different periods of time, a general statement regarding significance of all exercise results can hardly be made.

On a very high level, significance is considered to be - similar to the quality of the demonstration exercise results - close to the maximum achievable under live trial conditions.

Whenever possible, a maximum number of trial days as well as comparable reference days were used for quantitative assessment to ensure statistical significance.

In some cases the number of trial days was more than 100, which were compared also against more than 100 reference days. In case of questionnaires, statistical significance was often limited by the size of available staff (e.g. in case of FMPs).

But again, also in this case the significance is close to the maximum achievable under live trial conditions.

Further, especially for the live trials that were not performed in shadow mode configuration, the operational significance was at maximum. Therefore valuable feedback was collected in multiple exercises which pave the way towards an operational implementation.

Whenever appropriate, further details are provided in the respective exercise appendixes.

5 Conclusions and recommendations

5.1 Conclusions

5.1.1 Extended AMAN

Due to the complexity of a full implementation, compared to limited time of the VLD, the concept has only been implemented for a limited part of arrival flows to the demonstration sites:

- Zurich: One arrival flow, representing 25% of arrival flows with a 200 NM horizon,
- Paris-Orly: Two arrival flows, representing 80% of arrival flows, with a 200 NM horizon,
- Gatwick: Many flows, representing 75% of arrival flows with a horizon of 350 NM.

However, very promising results have been reported on the following KPAs, which show the huge benefit of extended AMAN procedures:

- Capacity/safety: reduction of TMA workload & congestion, while maintaining a safe management of traffic flows. On specific configurations, this enables capacity improvement in terminal area during traffic peaks.
- Predictability: improvement of predictability for the arrival sequence in the TMA, allowing a better anticipation of operations for Flow Managers and Supervisors.
- Environment: reduction of airborne holding and vectoring in low level airspace. Fuel savings have been evaluated up to 30kg per flight (which corresponds to 90 kg of CO_2 emissions).
- Almost all E-AMAN requests could be applied by upstream ACCs (up to 98% for Paris trials). This could be made because the number of requests was very limited in number and time. Therefore, neither operational problems, nor safety issues were reported by upstream ACCs.

Airlines reported a limited impact on their operational procedures.

Yet, as observed in a few cases, it is important that the speed instruction is repeated to the pilot consistently in the sectors following the one where it is first implemented, to avoid reacceleration.

The usage of airborne Target Times for all arrival flows for the Frankfurt demonstration did only result in very small benefits and indicated improvements for arrival flows which were approaching the TMA in the direction of the runway in use. Further assessment is needed to elaborate on tactical ATC processes to enable improvements also for arrival flows from other directions.

The fixing of target times 5hrs before landing constitutes a compromise - on one hand – between adapting the aircraft speed in an economic way and - on the other hand – to be able to deal with tactical circumstances like speed or routing changes which occur in upstream ACCs.

As the economic impact of en-route speed changes could not be calculated/estimated, it remained open for various airline stakeholders if there was an overall positive effect of the target time adherence to their operations.

5.1.2 Multiple E-AMAN operations

Multiple E-AMAN operation in certain airspace or sectors will become increasingly important in the core area of Europe, especially for ATS units UAC Maastricht, UAC Reims, UAC Karlsruhe and others. This will be specifically the case when all E-AMAN units are fully operational from 2024 on as required by the PCP regulation. The trial “multiple E-AMAN operation in multiple ACC/UAC” was specified in order to assess how multiple E-AMAN operation can be made compatible with safety and capacity targets.

The objectives of the exercise therefore were:

- Prove feasibility of working multi arrival constraints
- Elaborate and apply E-AMAN Strategies via CDM processes
- Identify measures to assess workload reduction/limitation
- Test the XMAN Portal as CDM Tool

The assessment of the trial offered the conclusions that

- Safety: The application of the E-AMAN Strategies allows to maintain safe operations
- Capacity: The application of E-AMAN Strategies allows to exploit the available capacity while maintaining E-AMAN operations to the highest degree possible

The trial showed strong evidence for the usefulness of the XMAN Portal, which was developed as a first prototype to support the collaborative process of E-AMAN strategy management to be tested under operational conditions.

5.1.3 Improved arrival planning

Improved arrival planning can be used in capacity constrained situations or not; e.g. for efficient arrival streaming in order to manage an airport’s overnight curfew closing and opening period.

5.1.3.1 In capacity constrained situation:

The use of pre-departure TTA, combined with a local analysis from FMP operator led to the following benefits on the improvement of arrival planning process:

- Predictability: improved for FMP and Supervisors. This has been particularly true for short hauls when using MCP.
- Capacity: ATFCM delay reduction by 5% on standard regulation (Paris area use case), while maintaining a safe management for ATCOs. The use of MCP led to a marginal ATFCM increase, but impacting fewer flights, and allowing Airspace Users to integrate their preferences in order to minimise the overall cost of delay.
- Safety: all the trials were performed while maintaining a high safety level, and with no incident reports.

AUs support this procedure and recognize its benefits.

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.

5.1.3.2 In non-capacity constrained situation

The use of local TTA assigned to a whole arrival flow led to the following benefits:

- Predictability: improved for FMP and Supervisors. The short haul flights' predictability has been enhanced when using MCP. The predictability of long-haul flights (when flights are outside IFPZ) has also been improved when using the time estimates directly from the flight crews.

- Safety: all the trials were performed while maintaining a high safety level and with no incident reports.
- Flexibility/ Airspace User Support/service: the integration of Airspace Users' preferences, especially when they are the main carrier based at a hub airport, can ensure their aircraft are streamed in order to arrive prior to an airport curfew, or immediately after the airport has opened.

The availability of an automated process for the coordination with NM (via B2B API service) was reported very efficient, and is to be made durable.

The ability to send pre-departure TTA and have a quick feedback of its acceptance by NM was well appreciated.

As well the possibility to send timely long haul flight arrival information was beneficial to improve the accuracy of flights outside IFPZ profiles.

However, limitations during the trial appeared (“Slot Zone”, new SRM coming after implemented TTAs, tool limits...) and there is some need to address these issues to enhance the API service implementation.

5.1.4 Airspace Users Preferences

For ATC, two aircraft have the same value, but for Airspace Users each flight has a different value.

During capacity constraint situations and the resulting flight delays, this fact becomes very important for Airspace Users.

For AUs it is nearly impossible to steer their own flights and their operations according to their needs during these situations.

The AUs preferences and priorities are closely linked to the value of each individual flight, which needs to be determined according to a variety of criteria such as passenger connections, aircraft rotation time, required maintenance, crew duty times and many others.

The two concepts trialled within xStream (A-Flex and UDPP shadow-mode) showed very positive results on the ability to integrate Airspace Users priorities in pre-departure process. Airspace Users reported that a few minutes gained on targeted flights saved passengers’ connections, thus reducing ATFCM delay costs.

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.

The UDPP concept provides theoretically an efficient solution to reallocate ATFCM delays in order to optimize arrivals according to Airspace User needs, reducing the impact on Airline operations without affecting other Airspace Users negatively.

With the use of UDPP, AUs are not only able to favour one single important flight, but also to improve the AU network in regards of decreasing reactive delays and solving proactive night-ban related problems.

These AU Preference Concepts provide Airspace Users with a more powerful possibility to optimise the arrival sequence, than using only the NM slot swap functionality.

UDPP and AFlex supplement each other, as AFlex is only applicable for a small regulation with impact on a smaller amount of flights and UDPP can therefore be used for a larger group of flights in a prolonged time window, as well as for severe regulations.

The consideration of airline preferences is therefore not only an advantage for AU operations, but also benefits the passengers.

5.2 Recommendations

5.2.1 Recommendations for industrialization and deployment

This section contains recommendations for industrialization and deployment phases. Recommendations are especially expected in case one or more demonstration exercises/objectives were unsatisfactory or in case of deviations from the planning. As for the conclusions, they are presented by focus area.

5.2.1.1 Extended AMAN

The multiple E-AMAN trials showed that different airports, different airspace and different ANSPs have different needs, it is sensible that there is no 'one size fits all' policy for an E-AMAN implementation.

However, there are many common features and this valuable experience can be passed to other stakeholder for their implementation:

- 70% of arrival flows should be eligible to E-AMAN measure for maximum efficiency. As a result, it is not necessary to have all upstream ACCs participating to E-AMAN regulation to measure operational benefits in terms of fuel efficiency, workload and complexity in E-TMA.
- The information of all participating actors, ACCs and Airspace Users, is a key factor of their involvement for the implementation of E-AMAN requests, and acceptance by crews. This includes updating corresponding LOAs, and information campaign to the pilots to recall the usage and purpose of the concept.
- Local parameters should be taken into account to adjust the E-AMAN horizon. These parameters include: in-horizon departures, low performance aircraft rate, and geographical aspects.
- The definition of an acceptable rate of E-AMAN requests per hour, between an airport and an ACC, facilitates procedure acceptance by ACCs. This will be particularly true when a large number of airports will be operating such procedures, in order to mitigate the impact on workload in upper airspace.
- The extension of E-AMAN horizon requires improvement of Estimated Time Overs. Network Manager data has been proven reliable enough at the demonstrated horizon, but has to be improved by other external sources to go beyond (local trajectory prediction, ADS-C, Extended Projected Profile, etc.).

The trials on airborne target times showed some additional recommendations, specific to this type of E-AMAN requests.

A final conclusion for implementation of the trial concept cannot be given based on the trial results, but operational recommendations could be derived.

A further assessment of ATC procedures is a prerequisite for further process development. The recommendations for an operational process are mentioned below:

- The usage of better ETA/ETO for airborne TTA/TTO calculation, in this case FMS data, is possible and can be even more automated in the future with technologies under development
- Provide automatic ways to transmit TTA/TTO to airborne flights, ACCs crossed by the flights, airline OCC and dispatch, thus allowing maximum transparency between all stakeholders
- Update ETFMS with transmitted TTA/TTO
- Incorporate aircraft capabilities and economical parameters, plus operational constraints (e.g. fix speed airspaces) in time determination process
- Provide continuous process to update ETA/ETO from flight deck

5.2.1.2 Multiple E-AMAN operations

With the advent of multiple E-AMAN operation in the core area of Europe it will become necessary to coordinate these especially between ATS units (e.g. UAC Maastricht, UAC Reims, UAC Karlsruhe) and the E-AMAN units.

A specific tool, the XMAN Portal, which can share situational awareness of the arrival situation at various airports and which is able to coordinate E-AMAN Strategies has shown its usefulness.

It is therefore recommended, that:

- The XMAN Portal be further developed and rolled out in the core area of Europe
- E-AMAN Strategies further developed to have a complete set of operational scenarios related to E-AMAN operation which can be applied as needed
- Combine XMAN Portal information with Flow Management information and Sector Load information to more precisely assess the impact of E-AMAN operations on sector capacity and workload
- Possibly provide also the Network Manager with the value-added E-AMAN information contained in the XMAN Portal.

5.2.1.3 Improved arrival planning

In Capacity constrained situations:

TTA usage in terms of ATFCM regulation optimization or MCP creation was proven to be beneficial to better match arrival capacity and demand and to better select the flights to be ATFCM-constrained.

The NM B2B services providing Arrival Planning Information should be implemented as part of operational B2B services. Some improvements could be made available in the future, to increase potential benefits of the concept:

- Extend the “Slot Zone”, i.e. the slot inside which a flight can be moved without a new impact assessment of Network Manager (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
- Provide latest & earliest possible TTA to be given to a flight,
- “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. This feature

will be particularly important when several ATS unit will be using the service.

In Non-capacity constrained situations:

- The usage of better ETA/ETO for airborne TTA/TTO calculation, in this case FMS data which should be more automated in the future with technologies under development
- Provide automatic ways to transmit TTA/TTO to airborne flights, ACCs crossed by the flights, airline dispatch, thus allowing maximum transparency between all stakeholders
- Update ETFMS with transmitted TTA/TTO thanks to the NM B2B API
- Provide automatic exchange between Airspace Users and ANSP/NM, so the Airspace Users can provide their preferences/priorities in the arrival sequence
- Incorporate aircraft capabilities and economical parameters, plus operational constraints (e.g. fix speed airspaces) in time determination process
- Provide continuous process to update ETA/ETO from flight deck

5.2.1.4 Airspace Users Preferences

xStream A-FLEX trials were based on manual tools for the coordination of AUs preferences.

In the future, the list of AU priorities and requests should be integrated in the Extended Arrival Manager used by FMP or Tower supervisors, to have a more automated process.

Airspace Users participating in this process should limit the number of requests per peak to three to four, so they are still manageable by the airport.

Airspace Users should be partners to agree on priority exchange strategies between different airlines.

To further aim with UDPP for industrialization and deployment it is recommended to conduct a live trial including an assessment of the entire network impact with UDPP.

In addition, a local trial using UDPP in daily operation is proposed to analyse the real-time benefits for AUs.

The impact of multiple AUs using UDPP should also be assessed in the future, to analyse dependencies of multiple regulated flight prioritisations and different constraint situations.

Multiple Airspace Users may establish partnerships to apply AFlex and UDPP processes jointly, for example exchange swaps or priorities on their respective flights.

This shall not impact the fairness of this procedure.

In the future AUs would like to see a functionality provided by NM, to share their AU preferences and prioritisations with ATM stakeholders (NM, ANSPs, Airports) and it should also be available and useful for AUs even with less flights and not being the hub carrier at a constrained airport.

5.2.2 Recommendations on regulation and standardisation initiatives

This section contains the impact on Regulation and Standardisation activities (either identification of impact to existing Regulation and/or Standardisation, or identification of needs for Regulation and/or Standardisation), including with clear link to Demonstration results.

Detail of Demonstration Exercises analysis is to be provided in Demonstration Exercise reports appendixes to this document.

5.2.2.1 Extended AMAN concept

The project showed that different parameters could be taken into account to define E-AMAN implementation for an airport.

Nonetheless, the following recommendations should be kept as "common principles" for E-AMAN operations.

These are important in order to ensure full support of upstream ACCs, for which it is important to have standard processes and data protocols regardless the airport operating an E-AMAN procedure:

- M0.04 reduction is compatible with most jet aircraft,
- Use ED-254 as the standard for data exchange. This format is more powerful than OLDI AMA and enables sharing the arrival sequence with different stakeholders, including Airspace Users. Therefore this standard should be promoted European wide.
- Develop E-AMAN feedback loop, so that in-between ACC are well aware of the status of the E-AMAN request, to raise awareness on enforced speed constraints, and avoid re-acceleration of an aircraft.
- Need to have an electronic transmission of delay/TTL/TTG/Speed between E-AMAN & UAC,
- Develop E-AMAN portal ("XMAN Portal") to coordinate E-AMAN service between airports and UACs (see Multiple AMAN operations recommendations),
- Incorporate TTA/TTO policy in standard interfaces or interfaces in development between ANSPs, flight deck and airline OCC.

5.2.2.2 Multiple E-AMAN operations concept

Provision of standardized E-AMAN information is key for having a common tool for the coordination of multiple E-AMAN operations.

Therefore the application of ED-254 "Arrival Sequence Service Performance Standard" should be promoted.

In general, data sharing between operational partners should be enhanced and possibly data sharing agreements should be in place to safeguard the reliable operational use of the data.

5.2.2.3 Improved arrival planning concept

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).

5.2.2.4 AU Preferences concept

xStream A-FLEX trials were based on manual tools for the coordination of AUs preferences. To increase the number of participating airspace Users and to facilitate the interoperability with different airports,

Airspace Users should be partners to agree on priority exchange strategies between different airlines.

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

5.2.3 Recommendations for updating ATM Master Plan Level 2

Not applicable.

6 Summary of Communications and Dissemination activities

6.1 Summary of communications and dissemination activities

The table below is providing a summary of the communication and dissemination achievements performed during the xStream VLD project.

Date	Communication action	Content
Sept 08, 2017	COM#1: xStream Press Release#1	SESAR website
October 2017	Presentation of xStream trials and objectives to Paris ACC operational and technical staff	TBD
March 2018	DSNA Presentation of xStream at WAC 2018	TBD
September 2018	xStream presentation to IATA meeting	TBD
Nov 2018	COM#2: xStream Press Release#2 incl. AU participation	SESAR website
March 2019	DSNA Presentation of xStream at WAC 2019	STELLAR
September 2019	Publication of a scientific paper at DASC conference in San Diego, California, USA	TBD
October 16, 2019	Publication on Eurocontrol website for the Implementation of XMAN Gatwick in MUAC	EUROCONTROL website
October 2019	WP8 “Zurich Implementation” UDPP Visitor Day at SWISS	STELLAR
December 2019	xStream Brochure	Under progress
November 2019	WP7 “Paris implementation” Video on COP SEQ trials	Youtube
December 2019	COM#3: xStream Press Release#3	Under progress SESAR website
November 21 & 22, 2019	xStream presentation within the Network Open Days.	STELLAR
November 27, 2019	WP9 presentation for German Airlines	Under progress
December 10, 2019	WP9 presentation for International Airlines at DFS Customer Forum	Under progress

Table 18: xStream communication and dissemination achievements

Nota:

- All the communication support are stored on STELLAR PJ25 website at the following location:

Folders
03 Shared material
2019-11-20-xStream-COM-Summary

6.2 Target Audience Identification

Communication activities specifically targeted:

- Operational staff involved in the project,
- Airspace users,
- Air navigation service providers (mainly those that will have potential extended AMAN activities in their AoR),
- SESAR Joint undertaking members,
- Institutional decision-makers (EU, national, international),
- Media (trade press, general).

Communication channels and media were adapted to target audience.

The table below summarizes the relationship between target and media.

	OPS Staff	AUs	ANSPs	SJU Members	Decision Makers	Media
Project logo	X	X	X	X	X	X
Internal newsletters and communication channels	X	X				
SJU website: dedicated xStream page		X	X	X	X	
Press release on SJU website		X	X	X	X	
Social media		X	X	X		
Flyers, fact sheets		X	X	X	X	
Corporate magazine in airports or airlines		X				X
Seminar/Visitor's day	X	X	X	X	X	
World ATM Congress	X	X	X	X		

6.3 Project High Level Messages

The different implementations within xStream conclude that the provided solutions:

- Improve flight efficiency and consequently reduce the CO2 emissions,
- Are mature enough for deployment in major European hubs,
- Have the capability for seamless operations within the Single European Sky.

7 References

7.1 SESAR framework

Content Integration

[R1] B.04.01 D138 EATMA Guidance Material

[R2] EATMA Community pages

[R3] SESAR ATM Lexicon

Content Development

[R4] B4.2 D106 Transition Concept of Operations SESAR 2020

System and Service Development

[R5] 08.01.01 D52: SWIM Foundation v2

[R6] 08.01.01 D49: SWIM Compliance Criteria

[R7] 08.01.03 D47: AIRM v4.1.0

[R8] 08.03.10 D45: ISRM Foundation v00.08.00

[R9] B.04.03 D102 SESAR Working Method on Services

[R10] B.04.03 D128 ADD SESAR1

[R11] B.04.05 Common Service Foundation Method

Performance Management

[R12] B.04.01 D108 SESAR 2020 Transition Performance Framework

[R13] B.04.01 D42 SESAR2020 Transition Validation

[R14] B.05 D86 Guidance on KPIs and Data Collection support to SESAR 2020 transition.

[R15] 16.06.06-D68 Part 1 –SESAR Cost Benefit Analysis – Integrated Model

[R16] 16.06.06-D51-SESAR_1 Business Case Consolidated_Deliverable-00.01.00 and CBA

[R17] Method to assess cost of European ATM improvements and technologies, EUROCONTROL (2014)

[R18] ATM Cost Breakdown Structure_ed02_2014

[R19] Standard Inputs for EUROCONTROL Cost Benefit Analyses

[R20] 16.06.06_D26-08 ATM CBA Quality Checklist

[R21] 16.06.06_D26_04_Guidelines_for_Producing_Benefit_and_Impact_Mechanisms

Validation

[R22] 03.00 D16 WP3 Engineering methodology

[R23] Transition VALS SESAR 2020 - Consolidated deliverable with contribution from Operational Federating Projects

[R24] European Operational Concept Validation Methodology (E-OCVM) - 3.0 [February 2010]

System Engineering

[R25] SESAR Requirements and V&V guidelines

Safety

[R26] SESAR, Safety Reference Material, Edition 4.0, April 2016

[R27] SESAR, Guidance to Apply the Safety Reference Material, Edition 3.0, April 2016

[R28] SESAR, Final Guidance Material to Execute Proof of Concept, Ed00.04.00, August 2015

[R29] SESAR, Resilience Engineering Guidance, May 2016

Human Performance

[R30] 16.06.05 D 27 HP Reference Material D27

[R31] 16.04.02 D04 e-HP Repository - Release note

Environment Assessment

[R32] SESAR, Environment Reference Material, alias, "Environmental impact assessment as part of the global SESAR validation", Project 16.06.03, Deliverable D26, 2014.

[R33] ICAO CAEP – "Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes" document, Doc 10031.

Security

[R34] 16.06.02 D103 SESAR Security Ref Material Level

[R35] 16.06.02 D137 Minimum Set of Security Controls (MSSCs).

[R36] 16.06.02 D131 Security Database Application (CTRL_S)

Communication and dissemination

[R37] SESAR 2020 Communication Guidelines 04.00.00, [dd/mm/yyyy]

Programme management

For what concerns the general collaboration between all the members of the programme:

[R38] SESAR 2020 Membership Agreement, 06/07/2016

[R39] SESAR 2020 Programme Management Plan, edition 01.00.00, TBD

For what concerns the definition of the solutions being addressed by the project, their initial maturity levels and the target maturity dates aimed for:

[R40] ATM Master Plan, data set 16, 25/05/2016

[R41] SESAR Maturity Report, edition [xxx, dd/mm/yyyy]

[R42] SESAR Release Strategy, edition [XXX, dd/mm/yyyy]

For what concerns the specific scope of work covered by this project and the general way of working expected from all projects in the SESAR 2020 programme:

[R43] SESAR 2020 Project Handbook, edition 01.00.00, [dd/mm/yyyy]

7.2 xStream framework

[R44] xStream Demonstration Plan issue 2.0 dated July 06, 2018

[R45] xStream CONOPS Issue 1.1 dated October 21, 2019

7.3 Reference Documents

The following documents were used to provide input / guidance / further information / other:

[R46] ED-78A Guidelines for approval of the provision and use of air traffic services supported by data communications.[1]

EDITION **ERREUR ! UTILISEZ L'ONGLET ACCUEIL POUR APPLIQUER SJUEDITIONSTYLE AU TEXTE QUE VOUS SOUHAITEZ FAIRE APPARAITRE ICI.**

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[1] *The EUROCAE ED-78A has been used as an initial guidance material. ED-78A is useful, but is not an applicable document, because it mostly addresses the V4-V5 phases, whilst the SESAR R&D programme is focussed on development (V1-V2-V3, and because of its partial compliance with safety regulatory requirements).*

Appendix A Safety Assessment Report (SAR)

Safety plans are considered to be part of the exercise preparation. As such the exercise-leads had the responsibility to meet the safety requirements and to provide safety plans as part of the normal preparation of operational demonstrations or operational implementations where applicable.

Safety Plan assessment and evaluation were performed with relevant NSAs and EASA where required.

A.1.1 Introduction

The safety methodology used in the xStream project is compliant with SESAR Safety Reference Material (Ref D26) and its Guidance (Ref D27).

As a Very Large Demonstration, exercises were performed with live traffic in a close to operational environment. Therefore, safety assurance was part of the exercise preparation and a pre-requisite to any trial. As such, the exercise-leads had the responsibility to meet the safety requirements and to provide safety plans as part of the normal preparation of operational demonstrations or operational implementations where applicable.

As for any change to the ATM functional system, each xStream exercise was performed with safety as the primary concern. ANSPs ensured that hazard identification, risk assessment and mitigation were systematically conducted and documented for each demonstration.

Obviously, in accordance with IR 1035/2011:

- Each ANSP has approved safety assurance processes and procedures for the implementation of changes. These processes are approved by their NSA.
- Each ANSP has documented a specific process to be followed when the NSA advises that they wish to review a planned safety related change. In this case, NSA approval is needed to begin the demonstration.

It was also assumed that regulatory changes have already been identified before V3 and therefore should not appear during the project life. Therefore, safety assurance within VLD will be performed in the same regulatory framework as for any change.

A.1.2 Safety Plan

Within this VLD, safety plans were documented by each ANSPs using their own process and templates. They shall specify:

- The scope and boundaries of the safety case
- The safety assurance objectives related to the change
- The resources needed to execute the safety plan. Note: For xStream, no dependencies are foreseen with other SESAR 2020 projects.
- The safety organisation for the VLD project
- The schedule of the safety activities
- The need for specific regulatory arrangements.
- Depending hazards severity classification, safety plan are often part of the safety case.

<u>Nota:</u>

- For xStream, no specific regulatory arrangements are foreseen.

A.1.3 Safety case

Within this VLD, safety cases were documented by each ANSPs using their own process and templates. Standard methodology applied:

- Determination of the scope, boundaries and interfaces of the constituent part being considered, as well as the identification of the functions that the constituent part is to perform and the environment of operations in which it is intended to operate
- Determination of the safety objectives to be placed on the constituent part, that is to say: identification of credible hazards and failure conditions, assessment of effects and their severity, and determination of their tolerability.
- Derivation of a risk mitigation strategy to comply with safety objectives.
- Verification that all identified safety objectives have been met.

Complete argument was documented before the beginning of each trial and approved by each ANSP through standard process.

A.1.4 Reporting deviation from V3

As a VLD project, assumption was that the majority of common safety requirements were documented in Solution data-packs (Safety Assurance Report).

While documenting the safety case, project members ensured that the safety assessment at V3 is fully accounted for and sufficient.

No deviations were reported with V3 material.

A.1.5 SaR conclusions

The demonstrations went as planned as in Safety cases. No safety problem occurred during the demonstrations.

Appendix B Security Assessment Report (SecAR)

Not applicable.

Security plans are considered to be both part of the exercise preparation and of the organizations involved. As such the exercise-leads had the responsibility to meet the security requirements and to provide security plans as part of the normal preparation of operational demonstrations or operational implementations where applicable.

Security Plan assessment and evaluation were performed with relevant NSAs and EASA where required. It is expected that any Safety Plan assessment is in line with ISO27001 series of standards and has taken account of the SESAR 1 WP16.6.2 process.

Appendix C Human Performance Assessment Report (HPAR)

Not applicable

Appendix D VLD progress towards TRL-7

Self-assessment questionnaire to be provided as an appendix D.

Airline Team xStream(ATEAM) Consortium

===== End of xStream DEMOR Document ====