Step 1 EFPL Validation Report

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Task contributors	
EUROCONTROL, LUFTHANSA SYSTEMS, SABRE	

Abstract

The Extended flight plan (EFPL) is an extension of the ICAO 2012 FPL and allows the exchange of trajectory information between Aircraft Operators (FOC) and ATM in the short-term planning phase through SWIM-based B2B services.
Three exercises VP-311, VP-616 and VP-713 (from V2 to V3 maturity levels) were performed to explore the feasibility of the EFPL data exchange between airspace users and the Network Manager, looking in particular onto flight plan validation process, DCB traffic prediction and human performance aspects. These exercises were performed in close cooperation with Airspace users and computerised flight plan service providers (CFSPs) from WP11.
This report summarizes the results of these exercises and presents overall conclusions and recommendations.

Authoring & Approval

Prepared By - *Authors of the document.*		
Name & Company	Position & Title	Date
WP11 Project		
[redacted] LUFTHANSA SYSTEMS	[redacted]	23/08/2016
[redacted] SABRE		13/04/2016
[redacted] SABRE		13/04/2016
P07.06.02 Project		
[redacted] INNOVATE	[redacted]	17/08/2016
[redacted] EUROCONTROL		17/08/2016
[redacted] EUROCONTROL		17/08/2016
[redacted] EUROCONTROL		17/08/2016
[redacted] EUROCONTROL		17/08/2016
[redacted] EUROCONTROL		17/08/2016
[redacted] EUROCONTROL		17/08/2016
[redacted] INNOVATE		17/08/2016
[redacted] EUROCONTROL		17/08/2016

Reviewed By - *Reviewers internal to the project.*		
Name & Company	Position & Title	Date
P07.06.02 Project Members		
[redacted] INDRA	[redacted]	12/09/2016
[redacted] THALES		12/09/2016
[redacted] ENAV		12/09/2016
[redacted] ENAIRE		12/09/2016
[redacted] INDRA		12/09/2016
[redacted] NATS		12/09/2016
P07.06.02 EUROCONTROL Contributors		
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] EUROCONTROL		12/09/2016
[redacted] EUROCONTROL		12/09/2016
[redacted] EUROCONTROL		12/09/2016
[redacted] EUROCONTROL		12/09/2016
[redacted] EUROCONTROL		12/09/2016
[redacted] EUROCONTROL		12/09/2016
[redacted] EUROCONTROL		12/09/2016

Reviewed By - *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	Position & Title	Date
Airspace Users		

Reviewed By - *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	Position & Title	Date
[redacted] AIR FRANCE	[redacted]	12/09/2016
[redacted] AIR FRANCE	[redacted]	12/09/2016
[redacted] EASYJET	[redacted]	12/09/2016
[redacted]	[redacted]	12/09/2016
[redacted] AUSTRIAN	[redacted]	12/09/2016
[redacted] TURKISH AIRLINE	[redacted]	12/09/2016
[redacted] AUSTRIAN	[redacted]	12/09/2016
[redacted] EL AL	[redacted]	12/09/2016
[redacted] DHL	[redacted]	12/09/2016
[redacted] SKYGUIDE	[redacted]	12/09/2016
[redacted] DLH	[redacted]	12/09/2016
[redacted] EASYJET	[redacted]	12/09/2016
[redacted] ELAL	[redacted]	12/09/2016
[redacted] DASSAULT AVIATION	[redacted]	12/09/2016
[redacted] TAP	[redacted]	12/09/2016
[redacted] TAP	[redacted]	12/09/2016
[redacted] DLH	[redacted]	12/09/2016
[redacted] IATA	[redacted]	12/09/2016
[redacted] TURKISH AIRLINE	[redacted]	12/09/2016
[redacted] TAP	[redacted]	12/09/2016
[redacted] BRITISH AIRWAYS	[redacted]	12/09/2016
[redacted] EASYJET	[redacted]	12/09/2016
[redacted] DHL	[redacted]	12/09/2016
[redacted] NOVAIR	[redacted]	12/09/2016
[redacted] LUFTHANSA	[redacted]	12/09/2016
[redacted] HOP	[redacted]	12/09/2016
[redacted] GERMANWINGS	[redacted]	12/09/2016
[redacted] NOVAIR	[redacted]	12/09/2016
[redacted] THOMAS COOK	[redacted]	12/09/2016
WP11 PROJECT		
[redacted] AIRBUS	[redacted]	12/09/2016
[redacted] SABRE	[redacted]	12/09/2016
[redacted] AIRBUS	[redacted]	12/09/2016
[redacted] LUFTHANSA SYSTEMS	[redacted]	12/09/2016
[redacted] LUFTHANSA SYSTEMS	[redacted]	12/09/2016
[redacted] SABRE	[redacted]	12/09/2016
[redacted] LUFTHANSA SYSTEMS	[redacted]	12/09/2016
OTHER PROJECTS		
[redacted] EUROCONTROL	[redacted]	12/09/2016

Reviewed By - *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	**Position & Title**	**Date**
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] SICTA	[redacted]	12/09/2016
[redacted] DGAC	[redacted]	12/09/2016
[redacted]	[redacted]	12/09/2016
[redacted] ALENIA	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] INOVEA for EUROCONTROL	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted]	[redacted]	12/09/2016
[redacted] DGAC	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] NATS	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
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[redacted] EUROCONTROL	[redacted]	12/09/2016
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[redacted] AIRBUS	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] IFATCA	[redacted]	12/09/2016
[redacted] EUROCONTROL	[redacted]	12/09/2016
[redacted] NATS	[redacted]	12/09/2016

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Approved for submission to the SJU By - *Representatives of the company involved in the project.*		
Name & Company	**Position & Title**	**Date**
[redacted] EUROCONTROL	[redacted]	16/09/2016

[redacted] INDRA	[redacted]	15/09/2016
[redacted] THALES		16/09/2016
[redacted] EUROCONTROL		16/09/2016
[redacted] ENAV		16/09/2016
[redacted] ENAIRE		15/09/2016
[redacted] NATS		15/09/2016

Rejected By - *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date

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Executive summary

This validation report presents the results from the validation activities that have been performed in SESAR I from end 2012 to 2016 (Release 5) to address the Extended Flight Plan concept (EFPL) corresponding to the Solution #37 and part of Business and Mission Trajectory Management project (P07.06.02) for Step 1. The distribution and the use of EFPLs by ATC units is out of the scope of the solution #37 and therefore not addressed in this report.

These validation activities aimed at exploring the feasibility of the EFPL (Extended Flight Plan) data exchange between airspace users and the Network Manager. Several aspects were focussed on in these exercises:

- Flight planning processes: to assess the impact of the EFPL format on the NM flight plan acceptance rates, to assess the impact of the EFPL on the dispatchers workload, to investigate technical differences between the flight planning and NM systems, and to assess the feasibility to use the FIXM format for the exchange of EFPL data.
- DCB traffic predictability: to assess how the implementation of EFPL would improve DCB predictability.

For this purpose, two E-OCVM V2 validation exercises have been performed (EXE-07.06.02-VP-311 from November 2012 until April 2013 & EXE-07.06.02-VP-616 from November 2013 until April 2014) followed by one E-OCVM V2/V3 validation exercise (EXE-07.06.02-VP-713 from September 2015 until June 2016).

These validation exercises were conducted in close cooperation with Computerised Flight Plan Service Provider (from WP11.01) involving AUs and NM operators. The Network Management Validation Platform (NMVP) was used, fed by EFPLs generated by FOC flight planning system prototypes delivered by P11.01.01.

During the offline exercise EXE-07.06.02-VP-311, EFPLs were stored in files and treated in post-operations phase, whereas during exercise EXE-07.06.02-VP-616 and EXE-07.06.02-VP-713, EFPLs were exchanged via online B2B services. EXE-07.06.02-VP-713 was a step forward in the achievement of V3 maturity since EFPLs were sent by operational AUs flight planning systems in shadow mode.

As main conclusion from these validation activities, operational and technical feasibility of the use of the extended flight plan in NM operations has been proven both at the level of flight planning and flow management. Main other outcomes are as follows:

- Main critical safety requirements have been validated. In particular, the exercises have demonstrated that the EFPL does not create risks in some safety critical processes like flight plan distribution to ANSPs and identification of potential overloads in DCB.
- Some immediate benefits have been demonstrated both at the level of flight planning and flow management in terms of increased transparency and trajectory alignment, less FPL rejections or increased traffic predictability in some specific areas.
- In term of Key Performances Areas, quantified benefits are only available for the KPA cost-effectiveness linked to the reduction of occurrences of flight plan rejections and manual corrections by IFPS operators. For the other KPAs, the benefits quantitatively measured are limited at this stage. However, it is highlighted by all stakeholders that the exercise has not addressed some promising use-cases allowing to improve flight efficiency. In particular, the EFPL provides to Airspace users with fine-tuned means to plan trajectories avoiding flight

planning constraints or ATFCM regulations leading to more optimised filed 2D routes and/or vertical profiles.

- The technical feasibility of EFPL dedicated services has been proven.
- Standardisation needs have been covered and the migration to FIXM - the format for the future ICAO FPL - has been tested successfully.

From these results, two types of recommendation can be derived from the outcomes of the exercises:

- Recommendations regarding the first implementation step are:
    - To perform pre- operational live trials (V4) with candidate airlines in order to:
        - Minimise the risk of new flight plan rejections during the initial learning phase;
        - Further validate some aspects of the EFPL benefit mechanisms, and in particular the possibility for AUs to optimise todays filed 2D routes and 3D profiles and improve flight efficiency;
        - Identify the best options in terms of EFPL data to be used by the NM systems in order to optimise traffic predictability improvements;
        - Assess in coordination with concerned ASNPs the impact of EFPLs on flight plan distribution and traffic predictability in some specific areas.
    - To further specify and implement NM HMI improvements in order to support IFPS operators in the management of Extended Flight Plans.

- Regarding further steps of the EFPL implementation, the recommendation is to plan additional SESAR validations in SESAR 2020 in order to:
    - Assess the feasibility and benefits for AUs to better integrate ATC constraints (Profile Tuning Restrictions) in the AU planned trajectory included in the EFPL;
    - Clarify the requirements in terms of more detailed error messages provided by NM to the AUs in the reply for an invalid EFPL;
    - Validate EFPL distribution services and the use of EFPL data in ATC systems and processes;
    - Investigate the use of the Extended Flight Plan for the management of ATFCM regulations and the determination of TTOs/TTAs.

1 Introduction

1.1 Purpose of the document

This document provides a synthesis of the validation activities carried out for the Extended Flight Plan (EFPL) for SESAR Step 1. EFPL work comes under SESAR project 07.06.02, Optimized Airspace User Operations, which is part of OFA 03.01.04 "Business and Mission Trajectory.

The Network Operations validation strategy [8] and the Integrated Roadmap Dataset 14 [9] have been used to guide this document.

This document is issued jointly by EUROCONTROL DNM and DSR teams, in close cooperation with Computerised Flight plan systems providers (from P11.01.01). Individual validation and demonstration reports on which the synthesis is based have been produced by each CFSP partner (Refer to [6] for Lufthansa Systems Report and [7] for SABRE Report).

1.2 Intended readership

This document is intended for the people who prepared and performed the validation exercises and for those who analysed and consolidated the results. The intended audience is listed below:

- P07.06.02 project members;
- SWP7.2 for coordination and consolidation of validation activities within WP7;
- P11.01.01 for the overall consistency and standardization in the definition of the Business/Mission Trajectory Management;
- P11.01.04 for the definition and the development of Airspace User prototypes (FOC processes and Systems);
- Projects included in the OFA03.01.04;
- Trajectory Management Framework ENB regarding exercises addressing improved Network/ATC coordination through the Flight Object;
- P13.02.03 and P07.06.01 projects for exercises having a direct link to DCB processes (.e.g. TTAs, STAM) and the NOP;
- P08.01.01 for the SWIM compliance verification;
- WP3 for the implementation of the Validation Platform;
- 16.06.0x and B05 for Benefit and Impact Mechanisms;
- And more generally, the SESAR JU community.

1.3 Structure of the document

The document is structured as follows:

- Section one gives a short introduction to the document;
- Section two provides the context to the validation activities;
- Section three briefly explains how the planned validation exercises were carried out;
- Section four presents a summary of the results;
- Section five presents the conclusions and recommendations for the whole of Step 1;
- Section six presents the individual validation exercise reports for Step 1.

329 1.4 Glossary of terms

Term	Definition	Source

Airspace User	An Airspace User is an organization operating aircraft (in terms of aerial vehicle). The organization includes the pilots of the aircraft.
	Airspace Users include:
	▪ Civil airspace users: airlines (i.e. those engaged in commercial air transport like passenger, mail and cargo services), aerial work, air taxi operators, business aviation, private air transport, sporting and recreational aviation etc.;
	▪ Military airspace users: military forces that operate under the sole authority of a state government.
	▪ Two classifications of flight operations are considered:
	  ▪ ICAO-compliant manned or unmanned flight operations;
	  ▪ ICAO non-compliant manned or unmanned flight operations.
	ICAO-compliant flight operations are those conducted in accordance with ICAO provisions (e.g. SARPs, PANS).
	Civil airspace users realise ICAO-compliant manned or unmanned flight operations whereas military airspace users realise usually ICAO non-compliant manned or unmanned flight operations. Military airspace users realise ICAO-compliant manned or unmanned flight operations when they operate State aircraft using civil air traffic rules.
		WP11.1 (Refers to ICAO Doc 7300 and Doc 9626)

EFPL setup	The EFPL setup relates to a technical setup of the flight planning system that enables the filing of EFPLs to an NM system and the reception of related reply messages.	WP11.1
Error Propensity	A generic term referring to the probability of the human operator perform an action (intended or unintended) that results in an undesired outcome.	Human Performance Experts
ETFMS	ETFMS is a EUROCONTROL NM system which calculates the traffic demand - in every sector of the NM Area of Operations, using the flight plan information received from the Aircraft Operators (AOs) via the Initial Flight Plan Processing System (IFPS) - and compares it with the ATC (sector) capacity available.	NM Website
Extended Flight Plan (EFPL)	Is a flight plan that includes ▪ The ICAO flight plan; ▪ The 4D trajectory; ▪ Flight specific performance data. The EFPL will be provided to the ATM system in XML format.	P07.06.02 Step 1 OSED

Term	Definition	Source
FIXM 4D Message	A flight plan message in XML format used to send the EFPL in FIXM format to ANSPs/ NM.	WP11.1
Flight Operations Centre (FOC)	The Flight Operations Centre (FOC) system supports Airspace Users, performing manned or unmanned flight operations of civil aircraft (as defined by ICAO), in the management of these operations. The FOC Technical System represents the 'Flight Operations' domain as part of the whole operations of the airspace user. The domain 'Flight Operations' covers all activities that deal with the flights operated by the Airspace Users. These activities refer to the medium- and short-term planning and the execution phases of the flights.	WP11.1 (Refers to ICAO Doc 7300 and Doc 9626)
Flight Plan Receptor	The flight plan receptors are NM, an ANSP or airport that provide air traffic services.	WP11.1
Flight Specific Performance Data (FSPD)	The climbing and descending capabilities of the aircraft specific to the flight, taking into account the performance of the airframe that is used to operate the flight as well as any other parameters that may influence it, such as engine settings and status, cost factor applied by the operator	7.6.2 OSED
FOC Trajectory	This is the trajectory that was calculated by the AU/ FOC. This trajectory will be described in 4 dimensions. During the generation of such FOC trajectory the AU/ FOC will considerer as much/ all relevant elements that have influence onto the trajectory. These are – for example: ▪ Meteorological data ▪ Aircraft performance ▪ Aircraft Equipment ▪ Payload ▪ Route Network and Regulations ▪ Business Rules ▪ Safety Requirements (e.g. LROPS; Terrain Clearance) ▪ NOTAMs	WP11.1
Human Factors (HF)	HF is used to denote aspects that influence a human's capability to accomplish tasks and meet job requirements. These can be external to the human (e.g. light & noise conditions at the work place) or internal (e.g. fatigue). In this way, "Human Factors" can be considered as focussing on the variables that determine Human Performance.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance

TERM	DEFINITION	SOURCE
HUMAN PERFORMANCE (HP)	HP is used to denote the human capability to successfully accomplish tasks and meet job requirements. In this way, "Human Performance" can be considered as focussing on the observable result of human activity in a work context. Human Performance is a function of Human Factors (see above). It also depends on aspects related to Recruitment, Training, Competence, and Staffing (RTCS) as well as Social Factors and Change Management.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP ACTIVITY	A HP activity is an evidence-gathering activity carried out as part of Step 3 of the HP assessment process. An HP activity can relate to, among others, task analyses, cognitive walkthroughs, and experimental studies.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP ASSESSMENT	A HP assessment is the documented result of applying the HP assessment process to the SESAR project-level (i.e. WP4-15 projects). HP assessments provide the input for the HP case.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP ASSESSMENT PROCESS	The HP assessment process is the process by which HP aspects related to the proposed changes in SESAR are identified and addressed. The development of this process constitutes the scope of Project 16.04.01. It covers the conduct of HP assessments on the project-level as well as the HP case building over larger clusters of projects.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP ARGUMENT	An HP argument is an HP claim that needs to be proven through the HP Assessment Process.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP BENEFIT	A HP benefit relates to those aspects of the proposed ATM concept that are likely to have a positive impact on human performance.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP CASE	A HP case is the documented result of combining HP assessments from projects into larger clusters (e.g. Operational Focus Areas, deployment packages) in SESAR.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP ISSUE	A HP issue relates to those aspects in the ATM concept that need to be resolved before the proposed change can deliver the intended positive effects on Human Performance.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance

Term	Definition	Source
HP impact	A HP impact relates to the effect of the proposed solution on the human operator. Impacts can be positive (i.e. leading to an increase in Human Performance) or negative (leading to a decrease in Human Performance).	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP recommendations	HP recommendations propose means for mitigating HP issues related to a specific operational or technical change. HF recommendations are proposals that require additional analysis (i.e. refinement and validation). Once this additional analysis is performed, HF recommendations may be transformed into HF requirements.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
HP requirements	HP requirements are statements that specify required characteristics of a solution from an HF point of view. HP requirements should be integrated into the DOD, OSED, SPR, or specifications. HF requirements can be seen as the stable result of the HF contribution to the project, leading to a redefinition of the operational concept or the specification of the technical solution.	16.06.05.D06 1 - SESAR Human Performance Reference Material - Guidance
ICAO 2012 Flight Plan	Is a type of flight plan that is defined by ICAO in PANS-ATM Doc. 4444. It is used to file a flight to impacted ANSPs. It includes the following information: ▪ Aircraft identification; ▪ Flight rules and type of flight; ▪ Number and type of aircraft and wake turbulence category; ▪ Equipment and capabilities; ▪ Departure aerodrome and time; ▪ Route; ▪ Destination aerodrome and total estimated elapsed time, destination alternate aerodromes; ▪ Other information; and ▪ Supplementary information.	ICAO
IFPS	IFPS is a centralised flight plan processing and distribution service established under the authority of the EUROCONTROL Network Manager (NM). This service allows users to construct, transmit or when necessary to correct, flight plan and associated update messages. IFPS ensures also distribution of accepted flight plans and modifications to all relevant Air Traffic Services Units.	NM Website
Initial Reference Business/Mission Trajectory (iRBT/RMT	In Step1 an Initial Reference Business/Mission Trajectory is the result of the collaborative planning process that revises the iSBT/SMT (as defined in AUO-0203-A) and is published as the initial Reference Business/Mission Trajectory (iRBT/RMT), at the moment when due to the proximity of the Execution Phase, the Aircraft Operator cannot accept any more changes on the iSBT/SMT. The iRBT/RMT contains all data included in the (last) agreed iSBT/SMT, in particular the TTO/TTA".	7.2 Network DOD

Term	Definition	Source
Initial Shared Business/Mission Trajectory (iSBT/SMT)	In step1, the SBT/SMT will not be fully implemented yet and will only incorporate flight intentions (in the medium-term planning) which are progressively refined with incoming information from the Airspace users to become an extended flight plan in the short term period including trajectory data (UP4DT/ReqMT).	7.2 Network DOD
Lido/Flight	Lido/Flight is a flight planning system provided by Lufthansa Systems GmbH & Co. KG.. It covers all aspects of the flight operations like trajectory generation and planning, aircraft performance calculation and flight crew briefing.	Lufthansa Systems
Offline exercise	Validation exercise based on replaying previously recorded data (hence not in real time).	7.6.2 VALP
Reference Scenario (RS)	Scenario including traffic and operational environment and without the SESAR operational improvements that are the subject of the validation, matched in time with the Solution Scenario.	Guidance on KPIs and Data Collection Version 1 (**Error! Reference source not found.**)
Shadow mode exercise	Validation Exercise where the validation platform is fed in real time with operational data (in parallel to the operational platform).	7.6.2 VALP
Situation Awareness	The accurate perception of what has happened, what is currently happening, and what is therefore likely to happen next.	Human Performance Experts
Soft constraints	Soft constraints are constraints that are currently used by NM to modify trajectories coming from the AU. In most cases they are based on Letter of Agreements or Profile Tuning Restrictions. They will not lead to rejects as they are of tactical nature and will not be applied in every case during the execution.	P07.06.02
Solution Scenario (SS)	Scenario including traffic and operational environment and SESAR operational improvements that is the subject of the validation.	Guidance on KPIs and Data Collection Version 1 (**Error! Reference source not found.**)
Take-off Weight (TOW)	The total weight of the aircraft at the first 4D Point of the Filed Trajectory which is at ADEP	7.6.2 OSED
Target Start-up Approval Time (TSAT)	The time provided by ATC taking into account TOBT, CTOT and/or the traffic situation that an aircraft can expect to receive start up / push back approval. Note: The actual start up approval (ASAT) can be given in advance of TSAT.	Airport CDM

TERM	DEFINITION	SOURCE
TRAJECTORY (4D)	A set of consecutive segments linking waypoints and/or pseudo points computed by airline/aircraft or ground tools (pseudo/FMS or TP) to build the lateral transitions (e.g. fly by / fly over) and the vertical profile. Each point is defined by a longitude, latitude, a level and a time, with associated estimates, and constraints when and where required.	B4.2
UNJUSTIFIED ACKNOWLEDGE	This refers to any ICAO flight plan accepted by IFPS or the IFPUV although it is based on a 4D trajectory that is not in accordance to any constraint or restriction.	WP11.1
UNJUSTIFIED REJECT	This refers to any ICAO flight plan rejected by IFPS or the IFPUV although it is based on a 4D trajectory that in accordance to all constraint or restriction.	WP11.1
WORKLOAD	The effort invested by the human operator into task performance. It varies with personal ability, skill, training and experience.	Human Performance Experts

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1.5 Acronyms and Terminology

Term	Definition
4D	4 dimensional
A/C	Aircraft
ACC	Air Traffic Control Centre
ADD	Architecture Definition Document
ADEP	Aerodrome of Departure
ADES	Aerodrome of Destination
ADEXP	ATS Data Exchange Presentation
ADR	Airspace Data Repository
AFTN	Aeronautical Fixed Telecommunication Network
AFUA	Advanced Flexible Use of Airspace concepts
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIRAC	Aeronautical Information Regulation and Control
AIS	Aeronautical Information Service
AMC	Airspace Management Cell
ANSP	Air Navigation Service Provider
AO	Aircraft Operators
AOC	Airlines Operations Centre
AOLO	Aircraft Operator Liaison Officer
ASM	Airspace Management
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATFCM	Air Traffic Flow and Capacity Management
ATM	Air Traffic Management
ATMRPP	Air Traffic Management Requirements and Performance Panel – ICAO working group.
ATS	Air Traffic Services
ATSU	Air Traffic Services Unit
AU	Airspace User
B2B	Business to Business web services
BADA	Base of Aircraft DAta
BDT	Business Development Trajectory
BMT	Business Mission Trajectory
CASA	Computer Assisted Slot Allocation
CDR	Conditional Route

TERM	DEFINITION
CFMU	Central Flow Management Unit
CFN	Commercial Flight Number
CFSP	Computerised Flight Plan Service Provider
CHG	Flight plan CHanGe message
CHMI	CFMU Human Machine Interface
CLN	Flight plan CanceLlatioN message
CONOPS	CONcept of OPerationS
CPR	Correlated Position Report
CRAM	Conditional Route Availability Message
CRCO	Central Route Charges Office
CSV	Comma Separated Values
CTOT	Calculated Take Off Time
DCB	Demand and Capacity Balancing
DDR	Demand Data Repository
DLA	Flight plan DeLAy message
DMA	Dynamic Mobile Area
DMEAN	Dynamic Management of European Airspace Network
DNM	EUROCONTROL Directorate of Network Management
DOD	Detailed Operational Description
E-ATMS	European Air Traffic Management System
EAUP	European Airspace Use Plan
ECAC	European Civil Aviation Conference
ECHG	Modification message of the Extended FPL
EDLA	Extended DLA message
EET	Estimated Elapsed Time
EFD	Electronic Flight Data
EFPL	Extended Flight Plan
EFPLM	Extended Flight Plan Message It is a message containing the ICAO FPL data, the trajectory of the flight described in a 4D Trajectory form and the Performance Data instantiated for that flight.
EIBT	Estimated In Block Time
ENB	Enabler
EOBT	Estimated Off Block Time
E-OCVM	European Operational Concept Validation Methodology
ETFMS	Enhanced Tactical Flow Management System
FAB	Functional Airspace Block

TERM	DEFINITION
FDC	Flight Data Contributor
FDMP	Flight Data Manager Publisher
FDP	Flight Data Processing
FDPS	Flight Data Processing System
FDU	Flight Data User
FF-ICE	Flight and Flow Information for a Collaborative Environment
FIXM	Flight Information Exchange Model
FL	Flight Level
FLS	Flight Suspension message
FLY4D	Consortium led by Airbus with Airbus Defense and Space, Honeywell, Lufthansa Systems and Sabre Airline Solutions
FMP	Flow Manager Position
FOC	Flight Operations Centre
FO	Flight Object
FOS	Flight Object Server
FPD	Flight Performance Data
FPL	Flight Plan
FPR	Flight Plan Repository
FPS	Flight Planning System
FSA	First System Activation (message)
FTP	File Transfer Protocol
GAT	General Air Traffic
ICAO	International Civil Aviation Organization
IFPS	Integrated Initial Flight Plan Processing System
IFPU	IFPS Unit
IFPUV	IFPS unit for Validation
IFR	Instrument Flight Rules
INTEROP	Interoperability Requirements
IOP	Interoperability
iRBT	Initial implementation of the Reference Business Trajectory in Step1
IRS	Interface Requirements Specification
iSBT	Initial implementation of the Shared Business Trajectory in Step 1
KPA	Key Performance Area
KPI	Key Performance Indicator
LoA	Letter of Agreement
LT	Long Term

Term	Definition
LTM	Local Traffic manager
MT	Medium Term
MTOW	Maximum Take-Off Weight
NM	Network Manager
NMC	Network Manager Cell
NMF	Network Management Function
NMOC	Network Manager operation Centre (ex CFMU)
NMVP	Network Management Validation Platform
NOP	Network Operations Plan
OAT	Operational Air Traffic
OFA	Operational Focus Areas
OFP	Operational Flight Plan
OI	Operational Improvement
ORM	Operational Replay Message
OSED	Operational Service and Environment Definition
OUC	Operational Use-Case
PANS-ATM	Procedures for Air Navigation Services – Air Traffic Management
PI	Performance Indicator
PTR	Profile Tuning Restriction
PQI	Profile Quality Index
RAD	Route Availability Document
RBT	Reference Business/Mission Trajectory
ROI	Return on Investment
RPL	Repetitive Flight Plan
RR	Re-Routing
RTA	Required Time of Arrival
RVSM	Reduced Vertical Separation Minima
SARPs	Standards and Recommended Practices
SBT	Shared Business/Mission Trajectory
SDM	Service Delivery Management
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SID	Standard Instrument Departure
SIMEX	SIMulation and EXperiment for ATFCM processes
SJU	SESAR Joint Undertaking (Agency of the European Commission)

TERM	DEFINITION
SJU WORK PROGRAMME	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SPR	Safety and Performance Requirements
STAR	Standard Arrival Route
SUT	System Under Test
SWIM	System Wide Information Management
TAD	Technical Architecture Description
TOBT	Target Off-Block Time
TOC	Top-Of-Climb
TOD	Top-Of-Descent
TOW	Take-Off Weight
TS	Technical Specification
TSAT	Target Start-up Approval Time
TTA / TTO	Target Time of Arrival / Target Time of Over flight
TTOT	Target Take Off Time
TV	Traffic Volume
UPT	User Preferred Trajectory
UUP	Updated airspace Use Plan
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VP	Verification Plan
VR	Verification Report
VS	Verification Strategy
WP	Work Package

2 Context of the Validation

2.1 Concept Overview

Nowadays, neither ANSPs, nor the Network Manager, nor the airports have a clear picture of the 4D trajectories that are planned by the airspace users, this is mainly caused by the fact that the data that is currently provided by the airspace users is only briefly describing the trajectory that is intended to be flown. This data – included into the so-called ICAO 2012 flight plan – only describes the routing over ground, the intended flight level and speed changes, as well as some information related to the aircraft, its equipment and type of flight. But it does not include an accurate 4D trajectory as it would be required to effectively perform the tasks of each flight plan receptor. Therefore, receiving ATM stakeholders have to interpolate a 4D trajectory based on this data and are forced to make assumptions wherever required to close the gaps that result from the ICAO FPL.

Therefore, the need was raised to be able to more accurately exchange flight plan related data between the airspace users and all other ATM stakeholders. The Extended flight plan (EFPL) allows the exchange of trajectory information - in addition to ICAO 2012 flight plan information - between Aircraft Operators' Flight Operations Centre (FOC) and ATM in the short-term planning phase through SWIM-based B2B services. The extended flight plan is an extension of the ICAO 2012 FPL. New information from the airspace users encompasses:

- The AO 4D trajectory (filed trajectory) as calculated by the FOC flight planning system in support to the generation of the operational flight plan. The 4D trajectory information is not limited to 4D points. It contains additional elements for each point of the trajectory such at speeds, and aircraft mass;
- (Optionally) flight specific performance data: this represents the initial unconstrained climb profile of the aircraft specific to the flight's take-off gross mass respectively the final and unconstrained descend profile of the aircraft specific to the flight's expected landing mass.

The Extended flight plan is submitted by the Airspace User to the European Network Manager (NM) flight plan management service. The NM takes as input the filed 4D trajectory in the Extended Flight Plan and when relevant applies some changes (e.g. letters of agreement) to produce a trajectory that can be viewed as the most accurate prediction integrating accurate information from the AU and ATC constraints . This resulting trajectory is called the accepted trajectory and is the reference trajectory to check the compliance of the flight plan with published ATM constraints. The accepted trajectory and the ATC constraints applied by NM to the trajectory are provided to the AU as part of the NM feedback to the AU EFPL submission. The following diagram illustrates the exchange of information[1].

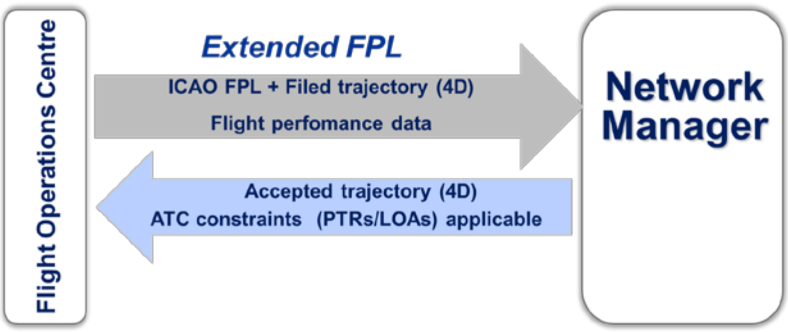

Figure 1: Extended Flight Plan information exchanges

[1] This corresponds to the description of a first step implementation, not to the target concept implementation.

A further step into the direction of commissioning the EFPL is related to a global standardization. This could be achieved by the use of FIXM as vehicle for the exchange of the EFPL related information.

Further information in regard to the concept behind the Extended Flight Plan can be found in the P07.06.02 Step 1 Business Trajectory OSED [11] and in the P11.01.02 Step 1 OSED [12].

2.2 Summary of Validation Exercise/s

This section provides an overview of the activities that have been undertaken in order to assess the impact of exchanging 4DT information with the airspace user during the planning, pre-departure, phase of flight.

As defined in the SESAR Integrated Data Set 15 (DS15) [9], ten OI steps were identified within OFA 03.01.04 "Business and Mission Trajectory" in step 1, but only two of them (AUO-0203-A, AUO-0223) are linked to EFPL. Furthermore, this validation also addressed the OI step DCB-0103-A allocated to OFA05.03.07 "Network Operations Planning" as it has been defined as transversal activity. The table below (see Table 1) describes how the project contributed to the OIs for the Business trajectory in step 1.

OI REF.	OI NAME	CONTRIBUTION TO THE OIS SHORT DESCRIPTION
AUO-0203-A	EFPL in NM processes	Initial implementation of the Shared Business Trajectory in advanced Step 1 through the standardisation of flight intent capture in medium term planning phase and the exchange of 4D Trajectory information (including flight performance data) in short-term planning. Requirements for flight performance data are developed both from a network/DCB perspective (project 7.6.2) and ANSP perspective (project 5.5.2)
AUO-0223	*Harmonised and improved integration of airspace and ATC constraints/procedures in trajectories calculated by FOCs and NM*	*The integration of LOAs like ATC constraints in the Trajectory calculated by the FOC (this part was planned but has not been assessed (see deviations in Section 3.2.2)*
DCB-0103-A (Allocated to OFA05.03.07 "Network Operations Planning")	Collaborative NOP for Step 1	The collaborative NOP in Step 1 will improve predictability through better network situation awareness (richer, more relevant and up-to-date information).

Table 1: List of relevant OIs addressed

Each OI step constitutes one or several concept 'features', which are independent operational improvements. The features are described in Table 2. For a detailed explanation of the Step 1 concept refer to the OSED [11].

OI REF.	FEATURES
AUO-0203-A	Extended Flight Plan used in Flight Planning
	Extended Flight Plan used in DCB
AUO-0223	Harmonised and improved integration of airspace and ATC constraints/procedures in trajectories calculated by FOCs
DCB-0103-A	Collaborative NOP for Step 1

Table 2: Concept features

To investigate these OI Steps in Step 1, the Validation Roadmap was defined (spread out over a five-year period, from 2012 to 2016 (see diagram below Figure 2).

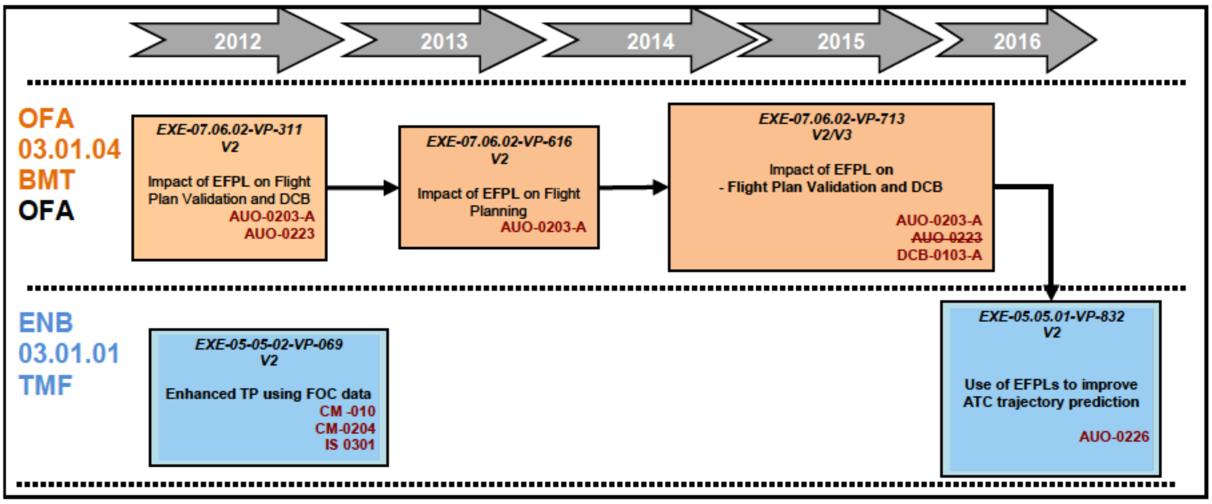

Figure 2: Validation Roadmap related to the EFPL in Step 1.

As described above, three Validation exercises were conducted within the scope on OFA03.01.04 in close cooperation with computerised flight plan systems providers (CFSPs) from WP11.

- **EXE-07.06.02-VP-311 (e-OCVM V2) from November 2012 until April 2013.**

  This validation exercise was conducted in close cooperation with Lufthansa Systems (CFSP from WP11.1). It has partly assessed both operational and technical feasibility of EFPL implementation and associated performance gains and focused on the network aspects (i.e. flight planning and DCB processes). The NMVP platform (including prototypes of IFPS and ETFMS) was used, fed by extended flight plans generated by FOC flight planning system prototypes delivered by WP11.1 (Lufthansa Systems). AUs Operational data (Augsburg Airways, British Airways, Deutsche Lufthansa and Lufthansa CityLine) were provided off-line to the NMVP, which was used in replay mode.

- **EXE-07.06.02-VP-616 (e-OCVM V2) from November 2013 until April 2014.**

This exercise investigated also the Extended Flight Plan concept, took into account the results from the EXE-07.06.02-VP-311 and addressed remaining issues that allowed the feature to go up to V3 maturity level. This validation exercise was conducted in close cooperation with Lufthansa Systems and SABRE (CFSPs from WP11.1). The same platform was used (with some release updates at CFSP side and NM side to integrate recommendations from EXE-07.06.02-VP-311) but FOC flight planning system prototypes were connected to the NMVP via B2B web services. Contrary to EXE-07.06.02-VP-311, EXE-07.06.02-VP-616 used input ghost flights and not operational ones, so the evaluation of traffic predictability accuracy was not relevant and this exercise focused on Flight Planning process assessment and technical aspects such as assessing EFPL data exchange via B2B.

- **EXE-07.06.02-VP-713 (e-OCVM V2/V3) from September 2015 until March 2016** split into two sub-exercises corresponding to two different maturity levels:

  - **EXE-07.06.02-VP-713 Part-A**: Short Term Implementation of the EFPL (V3 maturity level) This sub-exercise evaluated the EFPL implementation within conditions as close as possible to the operational environment. Two different types of sessions were run:

    - **Gaming** sessions on test traffic where Flight Planning Systems used at CFSP premises were connected to the NMVP at NM Side. The objective was mainly to assess the impact on the work of FOC staff and IFPS operators and validate further Human performance aspects. This session involved 13 flight dispatchers from 11 different airlines representing different type of airspace user business models (mainline airlines, charter airlines, cargo airlines, regional airlines, and low cost airlines).

    - **Shadow Mode** sessions at AUs premises on real traffic with two main objectives: evaluate the impact of the current EFPL implementation on flight plan filing/validation process in operational conditions and validate that the current EFPL improves or at least does not degrade DCB traffic prediction. These sessions involved 11 airlines, representing different business models (mainline airlines, charter airlines, cargo airlines, regional airlines, and low cost airlines). For this trial, the flight planning systems used operationally by the participating airlines (Lido/Flight from Lufthansa Systems) were enabled to provide the EFPL to the Network Manager Validation Platform (NMVP) in addition to the ICAO 2012 flight plan that is filed to the NM OPS system. During this trial, about 15.000 EFPL messages[2], which were based on operational flights, were provided to the NMVP for quantitative analysis. Some qualitative analysis activities were performed at NM side.

      This Shadow Mode Session was followed by several Replay Sessions which took shadow recorded data as a basis to build different solution scenarios.

  - **EXE-07.06.02-VP-713 Part-B**: Medium Term Implementation of the EFPL (V2 Maturity level)

    This part of the exercise was planned with twofold objectives:

    - To further Investigate the operational feasibility and the benefits of integrating PTRs in AU calculated trajectory;

    - To assess the feasibility to use FIXM to support the operational scenarios.

    Due to several constraints and limitations (see deviations in Section 3.2.2), this trial was limited to a technical verification of the use of FIXM as vehicle for the exchange of the EFPL related information. This exercise was related to the filing, retrieval and validation processes of the EFPL and was intended to confirm that the EFPL related information as

[2] This figure includes Creation, Delay, Update and Cancel messages.

integrated into the FIXM V3.0 EFPL extension is adequate to cover the technical aspects of the EFPL data exchange. This part is a further step into the direction of commissioning the EFPL is related to a global standardization

One Validation exercise EXE-05.05.01-VP-832, run from end 2015 to September 2016 and defined in the context of ENB03.01.01 TMF "Trajectory Management Framework and System Interoperability with air and ground data sharing", assessed EFPL impact on ATC. It was conducted in the context of P05.05.02 project but had a close dependency since EFPLs collected during the VP-713 exercise runs were provided as input data to the TMF exercise: This exercise will not be developed in this Validation report. Refer to document [23].

To illustrate which concept elements were to be validated in which activity, refer to Table 3.

OI Step	Feature	V2 Exercises		V2/V3 Exercise
		EXE-07.06.02-VP-311 (Release 2)	EXE-07.06.02-VP-616 (Release 3)	EXE-07.06.02-VP-713 (Release 5)
AUO-0203-A	Extended Flight Plan used in Flight Planning	✓	✓	✓ V3 (Part-A)
	Extended Flight Plan used in DCB	✓		✓ V3 (Part-A)
AUO-0223	Harmonised and improved integration of airspace and ATC constraints/procedures in trajectories calculated by FOCs (New OI in DS15)	✓		✓[3] V2 (Part-B)
DCB-0103-A	Collaborative NOP for Step 1			✓ V3 (Part-A)

Table 3: Relevant concept features per validation exercise

A summary of each Validation exercise is given below (respectively Table 4, Table 5 and Table 6). For detailed descriptions of these, refer to the Section [6].

[3] This part was planned but has not been assessed (see deviations in Section 3.2.2). Only FIXM technical verification was performed.

Validation Exercise ID and Title	**EXE-07.06.02-VP-311: Enhance Current Flight Planning Processes (I) – V2**
Leading organization	EUROCONTROL
Validation exercise objectives	**e-OCVM V2** exercise to evaluate the operational feasibility of this new EFPL validation process as well as the impact of additional information provided by EFPL data on network predictability.
Rationale	Enrichment of the current Flight Plan filing process in Short Term Planning Phase allowing Flight Plan originators to provide calculated 4D Trajectory and aircraft performance specific to the flight (Part 1)
Supporting DOD / Operational Scenario / Use Case	DOD (see [10] §4.2.2.2) Scenario: Medium/Short Term planning Use cases: UC-NP-01/ UC-NP-02 / UC-NP-03 / UC-NP-04
OFA addressed	**OFA03.01.04**: Business and Mission Trajectory
OI steps addressed	**AUO-0203-A**: EFPL in NM processes **AUO-0223**: Harmonised and improved integration of airspace and ATC constraints/procedures in trajectories calculated by FOCs and NM.
Enablers addressed	**NIMS-21A**: Initial Flight Planning management enhanced to support 4D for Step 1 **AOC-ATM-20**: Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services
Applicable Operational Context	Flight Planning Operations ATC/DCB Operations Flight Operations
Expected results per KPA	**Capacity**: - Improved network capacity management due to better network predictability. - Reduced capacity buffers. **Fuel Efficiency:** - Executed trajectory closer to the airframe's performance optimum. - Positive impact on the fuel consumption **Cost effectiveness (ATCO+NM oper.) & AU Cost effectiveness::** - Reduced workload for flight plan originators and IFPS operators due to flight data misinterpretation that need manual correction. - Fewer occurrences of Flight Plan rejections requiring FPL refilling. **Predictability:** - Executed trajectory closer to AO's preferences due to the better knowledge of flight intent. - Lower delays due to better network capacity management. **Safety:** - Increased safety in ATSU due to better network predictability.
Validation Technique	Fast time simulation
Dependent Validation Exercises	EXE-07.06.02-VP-616

Table 4: EXE-07.06.02-VP-311 Summary

VALIDATION EXERCISE ID AND TITLE	EXE-07.06.02-VP-616: ENHANCE CURRENT FLIGHT PLANNING PROCESSES (II) – V2
LEADING ORGANIZATION	EUROCONTROL
VALIDATION EXERCISE OBJECTIVES	**e-OCVM V2** exercise to: - Confirm the potential benefit in terms of reduction of flight plan rejections; - Evaluate the feasibility to align the FOC and the NM trajectories; - Demonstrate the suitability and technical feasibility of the SWIM B2B service in support to EFPL submission.
RATIONALE	Enrichment of the current Flight Plan filing process in Short Term Planning Phase allowing Flight Plan originators to provide calculated 4D Trajectory and aircraft performance specific to the flight (Part 2)
SUPPORTING DOD / OPERATIONAL SCENARIO / USE CASE	DOD (see [10] §4.2.2.2) Scenario: Medium/Short Term planning Use cases: UC-NP-01/ UC-NP-02 / UC-NP-03 / UC-NP-04
OFA ADDRESSED	**OFA03.01.04**: Business and Mission Trajectory
OI STEPS ADDRESSED	**AUO-0203-A**: EFPL in NM processes
ENABLERS ADDRESSED	**NIMS-21A**: Initial Flight Planning management enhanced to support 4D for Step 1 **AOC-ATM-20**: Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services **SWIM-APS-03a**: Provision of ATFCM Information Services for Step 1
APPLICABLE OPERATIONAL CONTEXT	Flight Planning Operations ATC/DCB Operations Flight Operations
EXPECTED RESULTS PER KPA	**Capacity**: - Improved network capacity management due to better network predictability. - Reduced capacity buffers. **Fuel Efficiency:** - Executed trajectory closer to the airframe's performance optimum. - Positive impact on the fuel consumption **Cost effectiveness (ATCO+NM oper.) & AU Cost effectiveness::** - Reduced workload for flight plan originators and IFPS operators due to flight data misinterpretation that need manual correction. - Fewer occurrences of Flight Plan rejections requiring FPL refilling. **Predictability:** - Executed trajectory closer to AO's preferences due to the better knowledge of flight intent. - Lower delays due to better network capacity management. **Safety:** - Increased safety in ATSU due to better network predictability.
VALIDATION TECHNIQUE	Gaming + fast time simulation
DEPENDENT VALIDATION EXERCISES	EXE-07.06.02-VP-311 EXE-07.06.02-VP-713

Table 5: EXE-07.06.02-VP-616 Summary

Validation Exercise ID and Title	**EXE-07.06.02-VP-713: EFPL usage in flight planning, DCB and ATC operations – V3/V2**
Leading organization	EUROCONTROL
Validation exercise objectives	• **E-OCVM V3**: Validate in operational conditions (e.g shadow mode, EFPLs sent for "real flights" by Airspace users) of the operational feasibility of the use of EFPL in NM Flight Plan Validation and DCB processes. • **E-OCVM V2**: Refinement of operational concepts and supporting enablers in order to make the FOC able to create a 4D Trajectory that can directly be used (w/o further changes) by NM. This exercise is a continuity of the two previous exercises "Enhance Current Flight Planning Processes" and should be considered as Part III.
Rationale	Enrichment of the current Flight Plan filing process in Short Term Planning Phase allowing Flight Plan originators to provide calculated 4D Trajectory and aircraft performance specific to the flight (Part 3)
Supporting DOD / Operational Scenario / Use Case	DOD (see [10] §4.2.2.2) Scenario: Medium/Short Term planning Use cases: UC-NP-01/ UC-NP-02 / UC-NP-03 / UC-NP-04
OFA addressed	**OFA03.01.04**: Business and Mission Trajectory
OI steps addressed	**AUO-0203-A**: EFPL in NM processes **AUO-0223**: Harmonised and improved integration of airspace and ATC constraints/procedures in trajectories calculated by FOCs and NM. **DCB-0103-A**: Collaborative NOP for Step 1
Enablers addressed	**NIMS-21A**: Initial Flight Planning management enhanced to support 4D for Step 1 **AOC-ATM-20**: Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services **SWIM-APS-03a**: Provision of ATFCM Information Services for Step 1 **SWIM-APS-04a**: Consumption of ATFCM Information Services for Step 1
Applicable Operational Context	Flight Planning Operations ATC/DCB Operations Flight Operations
Expected results per KPA	**Capacity**: - Improved network capacity management due to better network predictability. - Reduced capacity buffers. **Cost effectiveness (ATCO+NM oper.) & AU Cost effectiveness:** - Reduced workload for flight plan originators and IFPS operators due to flight data misinterpretation that need manual correction. - Fewer occurrences of Flight Plan rejections requiring FPL refilling. **Network Predictability:** - Executed trajectory closer to AO's preferences due to the better knowledge of flight intent. - Lower delays due to better network capacity management. **Predictability:** - Thanks to increase information exchanged between NM and the AU, AU flight planning systems will have a better view of constraints/procedures (e.g. LOAs) in 4D trajectory calculation. *The following expected results will not be directly assessed by the exercise*

VALIDATION EXERCISE ID AND TITLE	EXE-07.06.02-VP-713: EFPL USAGE IN FLIGHT PLANNING, DCB AND ATC OPERATIONS – V3/V2
	Fuel Efficiency: *- Executed trajectory closer to the airframe's performance optimum.* *- Positive impact on the fuel consumption* ***Safety:*** *- Increased safety in ATSU due to better Network predictability.* ***Airport Capacity:*** *- Increased Airport capacity due to more precision in the trajectory leading to better adherence to the planned trajectory then scheduled time of arrival. Less deviation shall increase more reliable sequence of arrival.* ***Punctuality:*** *- Better predictability of the depart time as a result of backtrack computation of a better flight duration and turn around.* ***Civil – Military Cooperation and Coordination*** *- Improve AFUA benefit due to the gain of precision with better profile computation.*
VALIDATION TECHNIQUE	Shadow mode (+ Replays) and Gaming
DEPENDENT VALIDATION EXERCISES	EXE-07.06.02-VP-311 EXE-07.06.02-VP-616

Table 6: EXE-07.06.02-VP-713 Summary

2.2.1 Summary of Expected Exercise/s outcomes

Table 7 below lists the expectation per stakeholder groups and identifies the corresponding exercises.

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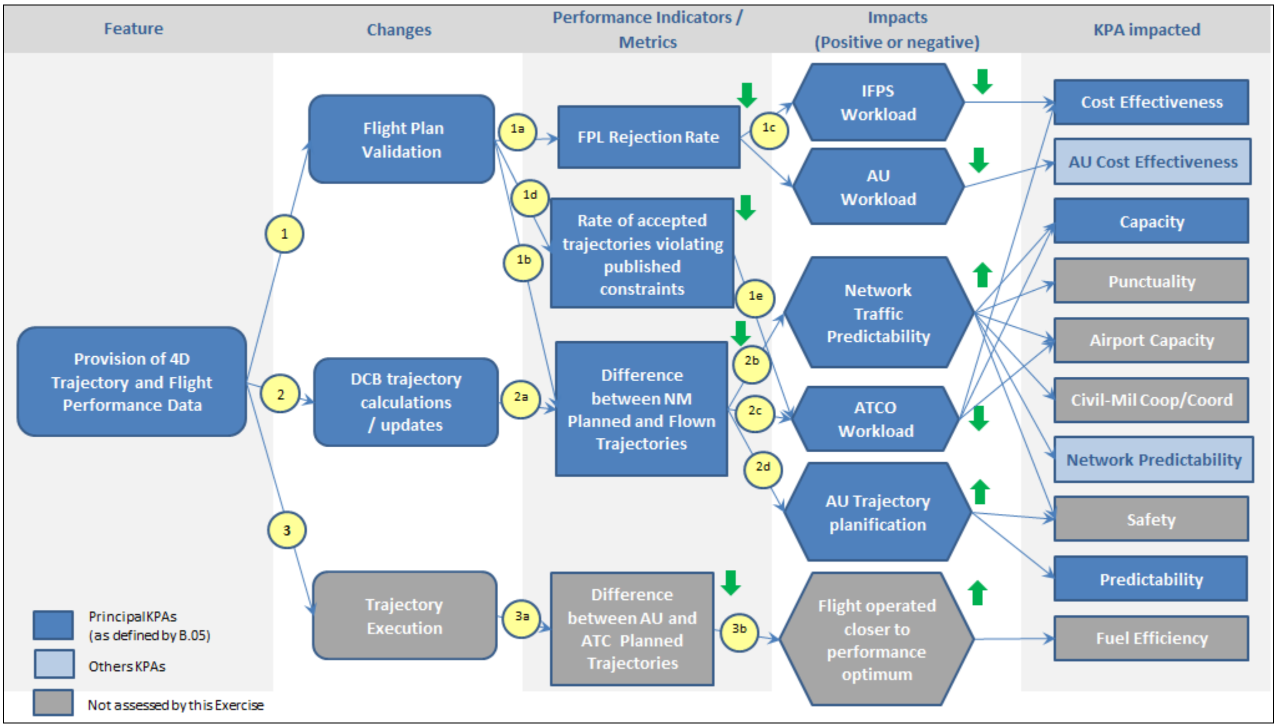
Stakeholder	External / Internal	Involvement	Why it matters to stakeholder	Performance expectations	Exercise Identifier
Airspace users	Internal	Agreement on EFPL data provision (by CFSP). Provisioning of EFPL data in shadow mode and gaming sessions	Cost reduction associated to improved FPL filing efficiency and workload reduction	Reduction of false flight plan rejection and clearer picture on why a flight plan was rejected by IFPS	EXE-07.06.02-VP-311 EXE-07.06.02-VP-616 EXE-07.06.02-VP-713
			Cost reduction associated to improved flight efficiency	Reduction of divergence between intended and flown profiles	EXE-07.06.02-VP-713
			Operational feasibility of EFPL implementation Investment cost effectiveness	Benefits of improved operation outweigh the cost of implementation and operation of the concept.	EXE-07.06.02-VP-713
		Use of extended flight plan data	Workload reduction, local DCB	Enhanced network predictability	EXE-07.06.02-VP-713
CFSPs	Internal	Provision of extended flight plan data. Develop systems evolutions required and support prototypes utilization	Define the 4DT format used to exchange 4DT data, create a basis for making the airspace less complex and constrained by publishing more precise trajectory data. Be in a position to demonstrate ROI of associated systems evolutions to customers.	Reduction of FPL filing rejection rate, obtain a more clear response in case of a flight plan reject and a clear picture why the executed trajectory deviates from the planned trajectory	EXE-07.06.02-VP-311 EXE-07.06.02-VP-616 EXE-07.06.02-VP-713
ANSPs	Internal	Use of extended flight plan data	Workload reduction, local DCB	Enhanced network predictability	EXE-07.06.02-VP-713
Network Manager	Internal	Develop systems evolutions required and support prototypes utilization	Cost reduction associated to improved FPL filing efficiency and workload reduction	Reduction of flight plan rejection rate	EXE-07.06.02-VP-311 EXE-07.06.02-VP-616 EXE-07.06.02-VP-713
			Workload reduction, DCB, customers satisfaction	Enhanced network predictability	EXE-07.06.02-VP-713
ICAO / Standardisation bodies	External	Agreement on EFPL format	Ensure adequacy of FPL data exchange future standards definition	Validation results, support to standardisation	EXE-07.06.02-VP-713

485 *Table 7: Expected Exercises outcomes*

2.2.2 Benefit mechanisms investigated

Improving interoperability between AOs/CFSPs and the Network Manager is expected to bring benefits in the various areas (or use cases). Figure 3 illustrates the benefit mechanism:



Feature Description: the provision of additional data (4D trajectory and flight specific performance data) improves the interoperability of flight data between Airspace Users and NM. It enables a better description and understanding of AUs' flight intents.	
(1)	These additional data will impact the initial flight plan validation process as the trajectory considered to check the compliance of the FPL with published constraints will be strongly impacted.
(2)	Initial DCB calculation (at the reception of the EFPL) and subsequent trajectory updates will use both the 4D trajectory and flight specific performance data (when available) included in the EFPL.
(3)	During the trajectory execution, the NM (and the ATSUs) are better informed of AUs' intentions and preferences thanks to the more detailed description capabilities offered by EFPL.
(1a)	EFPL 4D trajectory will allow AUs to provide a more accurate description of their flight intentions. A significant proportion of ICAO flight plan rejected today would be accepted using EFPL.
(1b)	AUs' 4D trajectory submitted in the EFPL will be used by the NM systems as the initial planned trajectory.
(1c)	Less flight plan rejections translate directly into less associated workload, both for IFPS operators (NM) and for AUs' staff in charge of correcting/submitting FPLs. An increased cost-effectiveness can then potentially be expected (provided that the reduced workload results into fewer staff being allocated to these tasks).
(1d)	Thanks to much more detailed knowledge of the trajectory planned by the AU, the rate of FPL accepted for which the trajectory planned by the AU violates some published constraints (e.g. airspace closure) will be reduced.
(1e)	An accepted FPL for which the planned AU trajectory infringes some published constraints increases the probability of tactical ATCO interventions (e.g instruction to avoid a closed airspace). So reducing the rate of such FPLs will contribute to decrease ATCOs workload.
(2a)	DCB planned trajectory will use more detailed flight information from the FOC (4D trajectory, performance data) instead of using generic aircraft performance data.

(2b)	Knowing and taking into account a more accurate description of both the AUs' flight intents and the flight specific performance should enable the use of a planned trajectory closer to that which will actually be flown, thus increasing NM prediction of the traffic. Enhanced traffic prediction allows reduced capacity buffers and overall improves capacity management both at network and local levels. On ATSUs' side, a better predictability translates into reduced risks of over-delivery, hence to increased safety. An improved network capacity management is expected to lead to a reduction of delays, thus to increased efficiency. A better predictability of the depart time is expected as a result of backtrack computation of a better flight duration and turn around. AFUA benefit is improved due to the gain of precision with better profile computation. The capability to describe more accurately flight intents also reduces inefficiencies associated to limitations imposed by the description format currently used. The expected increased traffic prediction can thus be seen as enabling improvements in operating methods, which in turn would lead to capacity and safety increases. These will consequently not be directly measurable within P07.06.02 but are expected to be assessed by other projects (the project 5.5.2 has already performed a V2 validation as well as a CBA for the use of FOC data (part of the elements included in the Extended Flight plan) by ATC).
(2c)	Increased traffic prediction will allow improving efficiency of DCB and traffic complexity management processes resulting in better smoothing of ATCOs workload.
(2d)	Thanks to increase information exchanged between NM and the AU, AU flight planning systems will have a better view of constraints/procedures (e.g. LOAs) in 4D trajectory calculation, AUs are aimed to improve the predictability of flights, i.e. bring the estimated trajectory of the flight calculated in the planning phase as close as possible to the real trajectory of the flight in the execution phase. Such improvement may have a significant impact on Predictability and Safety.
(3a)	The additional data and their intended use allow better describing and respecting AUs' intents.
(3b)	The resulting trajectory should thus be executed closer to the airframe's performance optimum and may have a significant impact on the fuel consumption, thus it positively impacts the flight efficiency.

Figure 3: Benefit mechanism related to EFPL Concept

2.2.3 Summary of Validation Objectives and success criteria

The link between validation objectives, success criteria, corresponding scenarios and operational requirements is described in detailed in Section 3 of the referring Validation Plans (refer to [14] and [15]). However, the summary of validation objectives and corresponding success criteria, sorted by feature, is presented in this document in the following sections.

Note: Validation exercises addressing EFPL concept were defined in two steps (first for VP-311 and VP-616 exercises described in Validation Plan [14] and secondly for VP-713 exercise described in Validation Plan [15]). Between these two steps, OIs were refined. For these two reasons, new validation objectives were created for VP-713 exercise; some of them integrate validation objectives coming from VP-311 and VP-616 exercises.

As a reminder, the naming convention used for the Validation objectives is presented in Table 8 below.

OI Ref.	Features		Validation objectives defined in	
	Name	Description	VP-311 & VP-616	VP-713
AUO-0203-A	Flight Planning	Extended Flight Plan used in Flight Planning	OBJ-07.06.02-VALP-**0001.xxxx**	OBJ-07.06.02-VALP-**713A.1xxx**
	DCB traffic Prediction	Extended Flight Plan used in DCB Traffic prediction	OBJ-07.06.02-VALP-**0002.xxxx**	OBJ-07.06.02-VALP-**713A.2xxx**
AUO-0223	Constraint integration	Harmonised and improved integration of airspace and ATC constraints/procedures in trajectories calculated by FOCs		OBJ-07.06.02-VALP-**713B.xxxx**
DCB-0103-A	NOP	Collaborative NOP for Step 1		OBJ-**07.06.01**-VALP-xxxxx.xxxx

Table 8: Validation objective naming convention

2.2.3.1 Validation Objectives related to "Flight Planning" feature

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
OBJ-07.06.02-VALP-0001.0100	Evaluate the EFPL validation process	CRT-07.06.02-VALP-0001.0101	Stakeholders (AUs and NM) are confident with the new process and agree on EFPL acceptance/rejection rules.	X	X		Reformulated in VP-713 as OBJ-07.06.02-VALP-713A.1020 & OBJ-07.06.02-VALP-713A.1030
OBJ-07.06.02-VALP-0001.0200	Evaluate the EFPL impact on the acceptance/rejection rate of flight plans (during their initial validation).	CRT-07.06.02-VALP-0001.0201	The rate of EFPL acceptances, rejections and occurrences of manual treatments (with corresponding reasons) is evaluated, providing the elements to assess the impact of the introduction of the EFPL on flight planning operating costs.	X	X		
OBJ-07.06.02-VALP-0001.0300	Evaluate the EFPL impact on the conformance to airspace/route usage rules	CRT-07.06.02-VALP-0001.0301	The rate of EFPL acceptances, rejections and occurrences of manual treatments (with corresponding reasons) is evaluated, providing the elements to assess the impact of the conformance to airspace/route usage rules of EFPL implementation.	X	X		
OBJ-07.06.02-VALP-0001.0350	Evaluate the feasibility of using the AO4D trajectory to validate the Flight Plan	CRT-07.06.02-VALP-0001.0351	Trajectories comparisons are successfully performed and differences are characterised over a statistically significant sample.		X		
OBJ-07.06.02-VALP-0001.0500	Evaluate the feasibility of a mixed mode of operation.	CRT-07.06.02-VALP-0001.0501	Validation results provide enough information to assess the feasibility of a mixed mode of operation.		X		

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
OBJ-07.06.02-VALP-0001.0600	Assessment on the impact on AOC staff and IFPS operators	CRT-07.06.02-VALP-0001.0601	Validation results provide information on the modification of the work of the AOC staff in charge of flight plan filing and/or that of IFPS operators, which would result from EFPL introduction: e.g. modification of their role, workload.		X		Split in two Validation Objectives in VP-713 as: OBJ-07.06.02-VALP-713A.1020 OBJ-07.06.02-VALP-713A.1030
OBJ-07.06.02-VALP-713A.1010	Impact of EFPL on FPL Validation Process	CRT-07.06.02-VALP-713A.1011	The number of wrongly rejected current ICAO Flight Plans due to a misinterpretation of flight intents is reduced. Accepted EFPLs while ICAO have been rejected are judged as valid by IFPS Operators experts.			X (Part-A)	Created for VP-713
		CRT-07.06.02-VALP-713A.1012	The number of wrongly accepted current ICAO Flight Plans due to a misinterpretation of flight intents is reduced. Rejected EFPLs while ICAO have been accepted are judged as valid by IFPS Operators experts.				
		CRT-07.06.02-VALP-713A.1013	The difference between AO 4D trajectory (filed trajectory) and IFPS 4D trajectory (accepted trajectory) is reduced in terms of Time and vertical profiles.				
OBJ-07.06.02-VALP-713A.1020	Impact of EFPL on FOC staff	CRT-07.06.02-VALP-713A.1021	The workload of FOC Staff is not increased compared to current operating method where ICAO FPL is used.			X (Part-A)	Created for VP-713
		CRT-07.06.02-VALP-713A.1022	The FOC Staff is able to maintain a good Situation Awareness level using EFPL compared to current operating method where ICAO FPL is used.				
		CRT-07.06.02-VALP-713A.1023	The error propensity of FOC Staff is not increased compared to current operating method where ICAO FPL is used.				

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
		CRT-07.06.02-VALP-713A.1024	The Flight Planning negotiation process (communication) for FOC Staff is acceptable compared to current operating method where ICAO FPL is used.				
		CRT-07.06.02-VALP-713A.1025	The new operating methods support FOC Staff in performing their tasks in an efficient way.				
		CRT-07.06.02-VALP-713A.1026	The HMI supports efficiently the FOC Staff in preparing the EFPL.				
OBJ-07.06.02-VALP-713A.1030	Impact of EFPL on IFPS operators	CRT-07.06.02-VALP-713A.1031	The workload of IFPS operators is not increased compared to current operating method where ICAO FPL is used.			X (Part-A)	Created for VP-713
		CRT-07.06.02-VALP-713A.1032	The IFPS operators are able to maintain a good Situation Awareness level using EFPL compared to current operating method where ICAO FPL is used.				
		CRT-07.06.02-VALP-713A.1033	The error propensity of IFPS operators is not increased compared to current operating method where ICAO FPL is used.				
		CRT-07.06.02-VALP-713A.1034	The FPL negotiation process (communication) for IFPS is acceptable compared to current operating method where ICAO FPL is used.				
		CRT-07.06.02-VALP-713A.1035	The new operating methods support IFPS operators in performing their tasks in an efficient way.				
		CRT-07.06.02-VALP-713A.1036	<The HMI supports efficiently the IFPS operators in handling the EFPL.				

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
OBJ-07.06.02-VALP-713A.1060	Feasibility of EFPL Updates	CRT-07.06.02-VALP-713A.1061	Operational feasibility of FPL modification (Delay, Change and Cancel) is confirmed with the introduction of the EFPL: all the modification (Delay, Change and Cancel) are taken into account with the introduction of the EFPL, which means that to each ICAO modification reply corresponds an EFPL modification reply).			X (Part-A)	Created for VP-713
		CRT-07.06.02-VALP-713A.1062	The system solution for managing EFPL modification is accepted by all affected actors.				
		CRT-07.06.02-VALP-713A.1063	The information provided by EFPL (modifications introduced with respect to ICAO FPL) is relevant for the tasks to be performed by all actors.				
OBJ-07.06.02-VALP-713A.1070	Feasibility of the mixed mode of operation	CRT-07.06.02-VALP-713A.1071	The HMI supports efficiently the IFPS operators in mixed mode operations.			X (Part-A)	Created for VP-713
		CRT-07.06.02-VALP-713A.1072	The workload of IFPS operators is not increased due to mixed mode of operations.				
		CRT-07.06.02-VALP-713A.1073	IFPS operators are able to maintain a good situation awareness level in mixed mode of operations.				
		CRT-07.06.02-VALP-713A.1074	The error propensity of IFPS operators is not increased due to mixed mode of operations.				
		CRT-07.06.02-VALP-713A.1075	ICAO Update messages (Change, Delay and Cancel) are applied correctly in NM Systems when they follow an EFPL message for the same flight.				

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
OBJ-07.06.02-VALP-713A.1090	Confidentiality	CRT-07.06.02-VALP-713A.1091	Flight Performance data and ToW are not accessible to other AUs via the CHMI and the NOP Portal.			X (Part-A)	Created for VP-713
OBJ-07.06.02-VALP-713A.1100	Impact on Flight Plan distribution to ATC	CRT-07.06.02-VALP-713A.1101	No difference or differences explained and accepted by ANSPs are identified between the ATC distribution list based on ICAO FPLs and the ATC distribution list based on EFPLs.			X (Part-A)	Created for VP-713

Table 9: Validation Objectives and success criteria related to "Extended Flight Plan used in Flight Planning"

2.2.3.2 Validation Objectives related to "DCB Traffic Prediction" feature

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
OBJ-07.06.02-VALP-0002.0100	Identify extended flight plan content	CRT-07.06.02-VALP-0002.0101	Validation results allow assessing how useful the new pieces of information are, such as the TOW and climb and descent profiles.	X			Integrated in VP-713 as: OBJ-07.06.02-VALP-713A.2010
OBJ-07.06.02-VALP-0002.0200	Assessment of EFPL impact on the traffic predictability	CRT-07.06.02-VALP-0002.0201	Comparisons of predicted vs. occupied counts show a statistically significant difference between the reference (FPL) and solution (EFPL) scenarios.	X	X		Integrated in: → OBJ-07.06.02-VALP-713A.2010
OBJ-07.06.02-VALP-0002.0300	Evaluate EFPL impact on the reliability of the 4D Trajectory recalculation	CRT-07.06.02-VALP-0002.0301	Validation results provide significant quantitative information on a difference of reliability between these two calculated 4D Trajectories.	X	X		Integrated in: → OBJ-07.06.02-VALP-713A.2010
OBJ-07.06.02-VALP-0002.0400	Evaluate 4D Trajectories respective accuracies	CRT-07.06.02-VALP-0002.0401	Validation results provide significant quantitative information on a difference of reliability between these two types of 4D Trajectories.		X		Integrated in: → OBJ-07.06.02-VALP-713A.2010
OBJ-07.06.02-VALP-0002.0500	Determine updates conditions	CRT-07.06.02-VALP-0002.0501	Conditions and thresholds (e.g. on take-off weight) associated to EFPL transmission updates have been identified.		X		
OBJ-07.06.02-VALP-0002.0600	Profile Tuning Restrictions availability	CRT-07.06.02-VALP-0002.0601	Validation results provide significant quantitative information making it possible to compare rejection rates depending on whether or not Profile Tuning Restrictions have been taken into account when filing flight plans.		X		Integrated in: OBJ-07.06.02-VALP-713B.1010
OBJ-07.06.02-VALP-0002.0700	Consequences of a mixed mode environment on demand and capacity balancing.	CRT-07.06.02-VALP-0002.0701	Validation results provide significant information making it possible to assess whether operating with 4D trajectories based on different sources introduces any bias.		X		Integrated in: OBJ-07.06.02-VALP-713A.2050

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
OBJ-07.06.02-VALP-713A.2010	4D calculated Trajectories respective accuracies	CRT-07.06.02-VALP-713A.2011	The use of EFPL data in DCB traffic predictions has no negative impact in general on the following factors: 1) traffic planned to cross TVs, 2) entry times in TVs; 3) occupancy times in TVs and has a positive impact on at least one of them.			X (Part-A)	Created for VP-713
		CRT-07.06.02-VALP-713A.2012	Assess the proportion of the traffic for which the AO 4D trajectory (filed trajectory) can be used without modifications with regards ETFMS calculated 4D trajectory.				
OBJ-07.06.02-VALP-713A.2030	Impact of EFPL late updates on predictability	CRT-07.06.02-VALP-713A.2031	The 4D trajectories, calculated by DCB, taking into account last update information are closer to the flown trajectories.			X (Part-A)	Created for VP-713
OBJ-07.06.02-VALP-713A.2040	AO 4D (filed trajectory) and NM 4D Trajectories accuracies without PTRs	CRT-07.06.02-VALP-713A.2041	With the implementation of EFPL, DCB Prediction is improved both in areas where PTRs are applied and in areas where PTRs are not applied.			X (Part-A)	Created for VP-713
OBJ-07.06.02-VALP-713A.2050	Consequences of the global mixed mode on DCB	CRT-07.06.02-VALP-713A.2051	Validation results provide significant information making it possible to assess whether operating with 4D trajectories based on different sources introduces any bias.			X (Part-A)	Created for VP-713
		CRT-07.06.02-VALP-713A.2052	On a selection of TVs, validation results allow to compare the same traffic taking into account ICAO FPL only on the one hand and a mixed of ICAO FPL and EFPL on the other hand. This comparison will be done in terms of Flight Lists, Traffic Counts and Occupancy counts.				
OBJ-07.06.02-VALP-713A.2060	Impact on ATFCM / regulated flights	CRT-07.06.02-VALP-713A.2061	The impact of EFPL (compared to ICAO FPL) on the number of flights impacted by regulations is acceptable.			X (Part-A)	Created for VP-713

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
		CRT-07.06.02-VALP-713A.2062	The impact of EFPL (compared to ICAO FPL) on delays is acceptable.				
OBJ-07.06.02-VALP-713A.2070	Impact on the reliability of the 4D Trajectory recalculation	CRT-07.06.02-VALP-713A.2071	Validation results provide significant qualitative information on a difference of reliability between these two calculated 4D Trajectories.			X (Part-A)	Removed and integrated in OBJ-07.06.02-VALP-713A.2010

Table 10: Validation Objectives and success criteria related to "Extended Flight Plan used in DCB"

2.2.3.3 Validation Objectives related to "Constraint Integration & FIXM Implementation" feature

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
OBJ-07.06.02-VALP-713B.1010	Operational feasibility of soft ATC constraint integration	CRT-07.06.02-VALP-713B.1011	The process/scenario is applicable (manually) on a number of flights/city-pairs covering as much as possible the diversity of the "types" of LOAs".			X (Part-B)	Created for VP-713
		CRT-07.06.02-VALP-713B.1012	The decision criteria to apply PTRs are clarified for the studied cases.				
		CRT-07.06.02-VALP-713B.1013	The CFSP experts are confident that such a scenario can be at least partly automated in the future to avoid increase of operator workload.				
		CRT-07.06.02-VALP-713B.1014	The AUs/CFSPs experts agree with the process or at least consider that the information provided as feedback by IFPS (PTRs, accepted trajectory) is useful - in some cases - in their decision processes.				
OBJ-07.06.02-VALP-713B.1020	FIXM Implementation feasibility	CRT-07.06.02-VALP-713B.1021	The use of FIXM EFPL extension operates successfully.			X (Part-B)	Created for VP-713
		CRT-07.06.02-VALP-713B.1022	The different types of trajectory exchanged and defined in the FIXM extension are agreed between NM and CFSPs.				
OBJ-07.06.02-VALP-713B.2010	PTRs Impact on Predictability	CRT-07.06.02-VALP-713B.2011	The validation provides a quantitative measure of the benefit to apply some selected PTRs to better predict flight EETs, vertical profile and fuel consumption.			X (Part-B)	Created for VP-713
		CRT-07.06.02-VALP-713B.2013	The validation shows that the cases identified represent potentially a significant proportion of the ECAC traffic (e.g. more than 3% of the traffic).				

Table 11: Validation Objectives and success criteria related to "Harmonised and improved integration of constraints in FOC trajectories"

2.2.3.4 Validation Objectives related to "NOP" feature

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
OBJ-07.06.01-VALP-GEN1.0100	Assess that any change in stakeholders operational plans can be transmitted to the NOP and the Network Plan can be updated accordingly.	CRT-07.06.01-VALP-GEN1.0103	The Network Manager is able to capture EFPL 4D trajectory information originated by AU and update the NOP accordingly.			X (Part-A)	Generic Objectives
		CRT-07.06.01-VALP-GEN1.0104	The NOP has been successfully updated when operating in global mix mode; i.e.; EFPLs and ICAO update messages. Supports OBJ-07.06.02-VALP-713A-2050. Satisfied by CRT-07.06.02-VALP-713A.1072.				
OBJ-07.06.01-VALP-GEN1.0200	Assess that all partners involved in operations can have easy access to any NOP update with potential impact on their operations.	CRT-07.06.01-VALP-GEN1.0203	NOP publishes the necessary data and updates for the AU to build their 4D trajectory (for example publication of PTRs and RAD			X (Part-A)	Generic Objectives
		CRT-07.06.01-VALP-GEN1.0204	The NOP supports the Mixed mode of operations by publishing (via SWIM-B2B and or in the situation display) AO 4D trajectories (filed trajectories), ICAO flight plans and derived NM calculated trajectories.				
		CRT-07.06.01-VALP-GEN1.0205	NOP provides confidentiality of commercially sensitive data (Flight Performance data and ToW). Satisfied by CRT-07.06.02-VALP-713A-1091.				
OBJ-07.06.01-VALP-EFPL.0100	Assess that EFPL 4D trajectory information contributes to the elaboration of the Network	CRT-07.06.01-VALP-EFPL.0101	Assess the level of contribution to the traffic predictability of each element of the EFPL. Satisfied by CRT-07.06.02-VALP-713A-2011.			X (Part-A)	Supporting VP-713 DCB /Traffic Predictability Objectives

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Defined in			Comment
				VP-311	VP-616	VP-713	
	Operation Plan with improved network predictability.	CRT-07.06.01-VALP-EFPL.0102	The 4D trajectories, calculated by DCB, taking into account last update information are closer to the flown trajectories. Satisfied by CRT-07.06.02-VALP-713A-2031.				
OBJ-07.06.01-VALP-EFPL.0200	Assess that EFPL 4D trajectory information contributes to the elaboration of the Network Operation Plan with improved DCB assessment/predictions	CRT-07.06.01-VALP-EFPL.0201	The NOP has received 4D trajectory information from an EFPL, which has been used to better assess traffic demand (with entry traffic counts, Occupancy counts and Flight Lists) supporting the Network Manager in the enhancement of DCB assessment. Satisfied by CRT-07.06.02-VALP-713A-2052.			X (Part-A)	Supporting VP-713 DCB /Traffic Predictability Objectives
		CRT-07.06.01-VALP-EFPL.0202	The impact of EFPL (compared to ICAO FPL) on delays is acceptable or delays are reduced. Satisfied by CRT-07.06.02-VALP-713A-2062.				
		CRT-07.06.01-VALP-EFPL.0203	The impact of EFPL (compared to ICAO FPL) on the number of flights impacted by regulations is acceptable. Satisfied by CRT-07.06.02-VALP-713A-0261.				

Table 12: Validation Objectives and success criteria related to "NOP"

2.2.3.5 Choice of metrics and indicators

Two types of information can be obtained from the validation exercises: qualitative and quantitative. "Qualitative" information refers to subjective measurements while "Quantitative" information is related to objective measurements.

- Qualitative data have been obtained from human actors during the run of the simulation scenarios and is based on expert's judgement assessment using individual questionnaire, briefing/debriefing sessions, and over the shoulders observations. This was done during the gaming session involving a number of flight dispatchers. In this part of the exercise the human assessment of the concept was in the foreground. The complete document that has been produced for the human assessment of the EFPL concept can be found in Appendix A.
- Quantitative data have been obtained from system data recorded during each run of the shadow mode exercise. The main quantitative metrics that have been produced can be classified in two groups:
    - Metrics linked to Flight Planning process;
    - Metrics linked to trajectory prediction.

2.2.3.5.1 Metrics linked to "Flight Planning"

The main Metrics used to measure the Flight Planning Process:

- FPL Acceptance rate and number of valid flight plans
- FPL Rejection rate and number of invalid flight plans
- #FPL messages where EFPL has been accepted and ICAO FPL rejected
- #FPL messages where EFPL has been rejected and ICAO FPL accepted
- # Errors per error name and per error kind
- ATC Distribution List

The analysis consisted in comparing these metrics for the reference scenario (ICAO FPL) with the ones calculated for the solution scenario (EFPL).

2.2.3.5.2 Metrics linked to "DCB traffic Prediction"

ETFMS is the main centralised DCB system managed by NM. Among other features, ETFMS includes traffic prediction functions – including both individual trajectory prediction and workload indicators (e.g. traffic & occupancy counts). – in support to DCB decision. The traffic predictability assessment addresses principally the impact of the EFPL on the traffic prediction function of ETFMS.

The metrics related to DCB traffic prediction were defined with respect to DCB needs. Two types of analysis were performed:

- ETFMS Individual Trajectory prediction analysis - a study of the impact of EFPL on the accuracy of trajectory prediction in ETFMS. The main metrics used were related to:
    - Points profiles comparison (Time/Distance per flight phase, Entry Time/Level in a sector, TOC/TOD, Climbing/Descending gradient, SID/STAR, …)
    - Sectors crossed comparison.

  The analysis was based on the comparison of trajectories calculated by ETFMS for different scenarios. The assessment of the benefits of one trajectory *vs.* another one was done according to the following process:

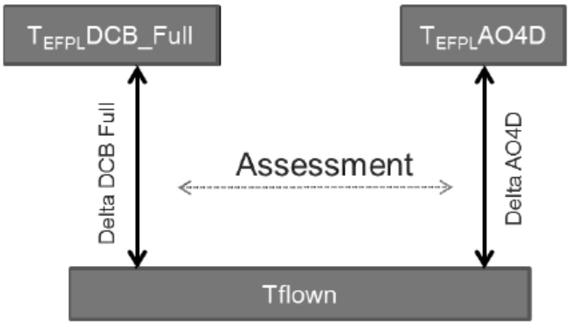


Figure 4: Comparison & assessment method of two 4D trajectories

In the example above, two 4D trajectories are compared: the T_{EFPL}DCB_full (the one calculated by DCB system from an EFPL) with the T_{EFPL}AO4D (the one provided by the AO). Both trajectories are compared individually to the flown trajectory. The gap (or delta) of each one with the flown trajectory is determined and then both gaps are compared and evaluated to determine which one is "closer" to the flown trajectory.

- Traffic/occupancy counts analysis - a study of the impact of EFPL on traffic and occupancy counts calculated by ETFMS.

2.2.4 Summary of Validation Scenarios

In the following tables are reported the scenarios used in the different exercises as defined in the corresponding VALP (refer to [14] for VP-311, & VP-7-616, [15] for VP-713 Part-A).

Scenario ID	Scenario Title	Scenario Description
Scenarios for Flight Planning		
SCN-07.06.02-VALP-R001.0000	Reference on Flight planning	The trajectory is calculated on the basis of ICAO's FPL field 15 and of standard BADA performance tables.
SCN-07.06.02-VALP-0001.0001	Solution AO4D	The IFPS prototype uses the 4D Trajectory provided in the EFPL (in addition to the ICAO FPL part).
SCN-07.06.02-VALP-0001.0002	Solution FPD	The IFPS prototype builds a 4D Trajectory based on the 2D route given in the field 15 and on the flight specific performance data provided in the EFPL.
Scenarios for DCB Traffic Prediction		
SCN-07.06.02-VALP-R002.0000	Reference on Trajectory prediction	The ETFMS prototype calculates the trajectory on the basis of ICAO's FPL field 15 and of standard BADA performance tables.
SCN-07.06.02-VALP-0002.0001	Solution AO4D	The ETFMS prototype uses the 4D Trajectory provided in the EFPL (in addition to the ICAO FPL part).
SCN-07.06.02-	Solution FPD	The ETFMS prototype builds a 4D Trajectory based on the 2D route

SCENARIO ID	SCENARIO TITLE	SCENARIO DESCRIPTION
VALP-0002.0002		given in the field 15 and on the flight specific performance data provided in the EFPL.

Table 13: Reference & Solution Scenarios for VP-311

SCENARIO ID	SCENARIO TITLE	SCENARIO DESCRIPTION
Scenarios for Flight Planning Validation		
SCN-07.06.02-VALP-R001.0000	Reference on Flight planning	The trajectory is calculated on the basis of ICAO's FPL field 15 and of standard BADA performance tables.
SCN-07.06.02-VALP-0001.0101	Solution IFPS-$_{wo}$PTR-	The IFPS prototype builds a 4D Trajectory based on EFPL data provided by CFSPs without applying PTRs.
SCN-07.06.02-VALP-0001.0102	Solution IFPS-PTR-	The IFPS prototype builds a 4D Trajectory based on EFPL data provided by CFSPs applying PTRs.
SCN-07.06.02-VALP-0001.0103	Solution IFPS-LightPayload	The IFPS prototype builds a 4D Trajectory using the EFPL provided by CFSPs which is calculated based on Light Payload.
SCN-07.06.02-VALP-0001.0104	Solution IFPS-HeavyPayload	The IFPS prototype builds a 4D Trajectory using the EFPL provided by CFSPs which is calculated based on Heavy Payload.
SCN-07.06.02-VALP-0001.0105	Solution IFPS-3h	The IFPS prototype builds a 4D Trajectory using the EFPL provided by CFSPs which is calculated based on data known 3 hours before take-off.
SCN-07.06.02-VALP-0001.0106	Solution IFPS-30mn	The IFPS prototype builds a 4D Trajectory using the EFPL provided by CFSPs which is calculated based on data known 30 minutes before take-off[4].

Table 14: Reference & Solution Scenarios for VP-616

SCENARIO ID	SCENARIO TITLE	SCENARIO DESCRIPTION
SCN-07.06.02-VALP-713A.0000	Baseline	Airspace Users send ICAO Flight Plans and NM calculates 4D trajectories based on ICAO Flight Plans information as basis for the current operations for flight planning and ETFM (DCB). The ICAO FPL is used as reference for Flight Planning purposes and the flown trajectory for DCB ones. This is the baseline scenario based on the current operational environment.

[4] The payload was adapted by 2% to simulate the trajectories that would result due to the deviation of the planned payload and the actual payload

Scenario ID	Scenario Title	Scenario Description
SCN-07.06.02-VALP-713A.0002	Reference	Same as above except that ICAO FPLs are processed on the NMVP Platform in order to build the reference scenario in the same environment as the solutions scenarios and make things comparable. The ICAO FPL will be used as reference for Flight Planning. This is the reference scenario which the solution scenarios has been assessed to.
SCN-07.06.02-VALP-713A.0010	Solution Full	Airspace Users send EFPL and NM calculates 4D trajectories based on all EFPL information (AO4D trajectory, ToW, Performance Data) taking into account LOAs PTRs. This solution scenario enabled to assess the global benefit of the EFPL with regard to the current ICAO based process.
SCN-07.06.02-VALP-713A.0020	Solution $_{wo}$CDP	Airspace Users send EFPL and NM calculates 4D trajectories based on the AO4D trajectory and ToW from EFPL (without taking into account Flight Performance data) and taking into account LOAs PTRs. This solution scenario enabled to assess the specific benefit of the provision of AO4D and the ToW,
SCN-07.06.02-VALP-713A.0040	Solution $_{wo}$PTR	Airspace Users send EFPL and NM calculates 4D trajectories based on all EFPL information without taking into account LOAs PTRs. This solution scenario enabled to assess the specific impact of the LOA PTRs.
SCN-07.06.02-VALP-713A.0050	Solution Mixed Mode	All ICAO FPLs from the Operational environment are taken into account; and when a corresponding EFPL exists the ICAO FPL is substituted by the EFPL. This scenario allows having the entire traffic (not only the traffic related to the AUs participating to Validation). It is required to validate mixed mode of operations and the impact on regulations. This solution scenario enabled to assess a mixed mode of operations (EFPL & ICAO together),

Table 15: Reference & Solution Scenarios for VP-713 Part-A

VP-713 Part-B scenarios were not defined in the VALP. The test cases have been developed with the objective of processing the same messages with and without FIXM, and then comparing the filing status, accepted trajectory, and returned IFPS errors.

Test Case		Expected Result
Validate EFPL	Valid FIXM EFPL	1. NM validates the EFPL, returns the reply with valid status 2. Consumer receives the reply and considers the EFPL valid
	Invalid FIXM EFPL	1. NM returns the invalid reply 2. Consumer receives the reply and considers the EFPL invalid
	Compare FIXM EFPL and EFPL	1. NM validates the EFPL, returns the reply with valid status 2. Consumer receives the reply and considers the EFPL valid 3. The comparison of the EFPL validate request with the FIXM EFPL validate request issued above does not give a difference 4. The comparison of the EFPL validate reply with the FIXM EFPL validate reply issued above does not give a difference
Create EFPL	Valid FIXM EFPL	1. NM accepts the EFPL, returns the reply with valid status 2. Consumer receives the reply and considers the EFPL valid 3. The EFPL is visible as valid in the CHMI, both the AO (when retained) and the NM trajectories are plotted
	Invalid FIXM EFPL	1. NM returns the reply with Rejected status 2. Consumer receives the reply and considers the EFPL invalid 3. The EFPL is visible in the invalid list in CHMI
	Invalid Queued for Correction	1. NM returns the reply with Invalid_Queued_for_Correction status 2. Consumer receives the reply and considers the EFPL invalid 3. The EFPL is visible in the invalid list in CHMI
	Compare FIXM EFPL and EFPL	1. NM accepts the EFPL, returns the reply with valid status 2. Consumer receives the reply and considers the EFPL valid 3. The comparison of the EFPL validate request with the FIXM EFPL validate request issued above does not give a difference 4. The comparison of the EFPL validate reply with the FIXM EFPL validate reply issued above does not give a difference
Retrieve EFPL	Valid FIXM EFPL	1. NM returns the EFPL with the Accepted trajectory 2. Consumer receives the reply The comparison of the Accepted Trajectory returned by the Create EFPL reply, with the retrieved Trajectory gives the same values
	Invalid FIXM EFPL	1. NM returns the EFPL with invalid status 2. Consumer receives the reply and considers EFPL invalid

Table 16: VP-713 Part-B Test cases

2.2.5 Summary of Assumptions

The following table lists the assumptions which were identified for each exercise.

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
Assumptions for EXE-07.06.02-VP-311 and EXE-07.06.02-VP-616										
ASS-07.06.02-EFPL-0001	EFPL data consistency	Ground Tools / Technology	Within an EFPL, the whole data set is supposed to be consistent.	Inconsistencies would mean that the AU system producing the EFPL is faulty, and would introduce biases in exercises' results (e.g. by generating artificially high rejection rates in the validation process).	N/A	Interoperability	Expert opinion			Medium
ASS-07.06.02-EFPL-0002	PTRs disabled on IFPS	Ground Tools / Technology	PTRs should not considered by IFPS for the trajectory validation	Avoid discrepancies as PTRs not taken into account by CFSPs systems because not published for this exercise.	N/A	Interoperability	Expert opinion / past ex . results			Medium
ASS-07.06.02-EFPL-0003	Trajectory prediction	Ground Tools / Technology	Good level of maturity of trajectory prediction algorithm	The implementation of the evolution of the trajectory prediction in NM prototypes should be at a sufficient good level of maturity to allow operational conclusions on predictability	N/A	Interoperability	Expert opinion			Medium
Assumptions for EXE-07.06.02-VP-713										
ASS-07.06.02-713A-0001	EFPL data consistency	Ground Tools / Technology	Within an EFPL, the whole data set is supposed to be consistent.	Inconsistencies would mean that the AU system producing the EFPL is faulty, and would introduce biases in exercises' results (e.g. by generating artificially high rejection rates in the validation process).	N/A	Operational & Technical feasibility	Expert opinion			Medium
ASS-07.06.02-713A-0002	Navigational data consistency	Ground Tools / Technology	Within AU and NM systems, the whole data set is supposed to be consistent.	Inconsistencies would mean that the EFPL provided by the AU cannot be assessed by NM systems.	N/A	Operational & Technical feasibility	Expert opinion			Medium

Table 17: Validation Assumptions List

2.2.6 Choice of methods and techniques

The validation activities that were carried out during the different exercises used the same platform at different level of development. For all of them, EFPLs were generated by the FOC flight planning system prototypes (provided by WP11.1) and were computed by the Network Manager Validation Platform (NMVP). However, each exercise made use of different methods.

- For EXE-07.06.02-VP-311, the NMVP platform (NM17.0 release) was used, fed by EFPLs in csv format generated by FOC flight planning system prototypes. IFPS and ETFMS prototypes were both used offline in standalone.
- EXE-07.06.02-VP-616 was a gaming exercise where the FOC flight planning system prototypes were connected to the NMVP platform (NM17.5 release) via B2B Services.
- During EXE-07.06.02-VP-713 Part-A, gaming and shadow mode methods were run using the NMVP platform (NM19.5 Release), fed by extended flight plans generated by FOC flight planning system prototypes[5] through B2B Services. The NMVP was also used in replay mode to further analyse the raw data logged during the shadow-mode trial.
- During EXE-07.06.02-VP-713 Part-B, analytical modelling method was used, by creating a representative set of flight plan messages covering valid and invalid flight plans, sent by the FOC flight planning system prototype to NMVP through both NM EFPL and FIXM EFPL service interfaces. The requests and replies were saved to be analysed by comparing the results obtained by using both interfaces.

All the quantitative metrics were calculated from the output data files generated during the runs. For EXE-07.06.02-VP-311 and EXE-07.06.02-VP-713, some additional post-processing tools (such as NEST) were also used to support:

- The comparative assessment between the various 4D trajectories;
- The various counts related to the traffic in its airspace environment.

Table 18 below summarizes the Methods and Techniques used during the different exercises. For detailed information, refer to corresponding Section 6.

[5] The flight planning systems were operational versions Systems. Only the EFPL generation was part of a prototype.

SUPPORTED METRIC / INDICATOR	PLATFORM / TOOL	METHOD OR TECHNIQUE
EXE-07.06.02-VP-311 (see §6.1)		
Flight planning validation Metrics	NMVP IFPS 17.0 (prototype with EFPL) LSY Flight Planning prototype (No direct connection)	Offline Standalone
DCB traffic prediction Metrics	NMVP ETFMS 17.0 (prototype with EFPL) NEST	Offline Standalone
EXE-07.06.02-VP-616 (see §6.1)		
Flight planning validation Metrics	NMVP IFPS 17.5 (prototype with EFPL) LSY Flight Planning prototype (B2B Connection) SABRE Flight Planning prototype (B2B Connection)	Gaming Exercise
EXE-07.06.02-VP-713 Part-A (see §6.2.1.10)		
Flight planning validation Metrics	NMVP IFPS 19.5 (prototype with EFPL) LSY Flight Planning prototype (B2B Connection) SABRE Flight Planning prototype (B2B Connection)	Gaming Exercise
	NMVP IFPS 19.5 (prototype with EFPL) LSY Flight Planning operational systems with EFPL extension SABRE Flight Planning operational systems with EFPL extension	Shadow Mode
DCB traffic prediction Metrics	NMVP ETFMS 19.5 (prototype with EFPL) NEST	Shadow Mode / Replays
EXE-07.06.02-VP-713 Part-B (see §6.2.1.10)		
FIXM Metrics - One-by-one comparison of the NM EFPL XML and FIXM EFPL acceptance rate. - One-by-one comparison of the Nm EFPL XML and FIXM EFPL validity reply message content	NMVP IFPS 19.5 (prototype with FIXM EFPL extension) LSY Flight Planning prototype with FIXM extension	Analytical modelling

Table 18: Methods and Techniques

2.3 Exercises Execution

The following table summarizes the exercises execution and analysis dates.

Exercise ID	Exercise Title	Actual Exercise execution start date	Actual Exercise execution end date	Actual Exercise start analysis date	Actual Exercise End date
EXE-07.06.02-VP-311	Enhance Current Flight Planning Processes (Part 1)	24/11/2012	15/02/2013	01/02/2013	30/09/2013
EXE-07.06.02-VP-616	Enhance Current Flight Planning Processes (Part 2)	01/11/2013	15/01/2014	01/01/2014	31/05/2014
EXE-07.06.02-V-P713 Part-A	Enhance Current Flight Planning Processes (Part 3) – Part-A Short Term implementation	Session 1 21/09/2015 Session 2 23/03/2016	25/03/2016 24/03/2016	01/10/2015	31/07/2016
EXE-07.06.02-VP-713 Part-B	Extended flight plan exchange in the FIXM EFPL	18/01/2016	19/01/2016	01/06/2016	30/06/2016

Table 19: Exercises execution/analysis dates

2.3.1 Validation Exercises List and dependencies

The list of validation exercises and the dependencies between them are described in Section 2.2 (see Figure 2: Validation Roadmap related to the EFPL in Step 1.).

3 Conduct of Validation Exercises

3.1 Exercises Preparation

Each validation exercise was conducted completely separate. Platform development, configuration and acceptance were completed to reach M7 milestone.

Prototypes (FOC Systems from Lufthansa Systems and Sabre Airline Solutions and NM Systems from EUROCONTROL) were adapted to enable the defined features.

For the execution of EXE-07.06.02-VP-616 exercise, a B2B connection to the NMVP was established between CFSPs and NM Systems. For EXE-07.06.02-VP-713, connections between FOC Systems at AU premises and NM Systems were created to allow exchanges via B2B services.

During the validation exercise definition, there were meetings with project participants, airspace users and Human performance experts to collect the necessary feedback to define the validation scenarios, prepare questionnaires, define data log requirements, …

More details on the preparation can be found in the relevant sections (refer to 6.1 for EXE-07.06.02-VP-311 / EXE-07.06.02-VP-616 and 6.2.2.1 for EXE-07.06.02-VP-713).

3.2 Deviations from the planned activities

3.2.1 Deviations with respect to the Validation Strategy

Due to EXE-07.06.02-VP-311 conclusions:

- EXE-07.06.02-VP-616, initially identified as E-OCVM V3 exercise, was re-categorised as E-OCVM V2 exercise;
- As a consequence, a new E-OCVM V3 exercise (EXE-07.06.02-VP-713) was created.

3.2.2 Deviations with respect to the Validation Plan

Table 20 indicates the major deviations between the validation plan and that which was carried out in a validation exercise. For complete descriptions of the deviations refer to the individual validation reports in section 6.

EXERCISE	MAJOR DEVIATIONS
EXE-07.06.02-VP-311	No major deviation.
EXE-07.06.02-VP-616	▪ The first session was used for verification activities because the platform was not ready. ▪ Contrary to the first plans, EXE-07.06.02-VP-616 used as input ghost flights and not operational ones. So, the evaluation of traffic predictability accuracy has not been possible, as well as the impact on operational activities. Only analysis related to flight plan validation process was relevant. Therefore, some validation objectives were not achieved: ▫ OBJ-07.06.02-VALP-0001.0500 ▫ OBJ-07.06.02-VALP-0001.0600 ▫ OBJ-07.06.02-VALP-0002.0400 ▫ OBJ-07.06.02-VALP-0002.0500 ▫ OBJ-07.06.02-VALP-0002.0700

EXERCISE	MAJOR DEVIATIONS
	▪ CFSPs Flight planning systems didn't implement the PTRs as they are currently implemented within NM systems. Therefore, EXE--07.06.02-VP-616 didn't assess the impact of PTRs on operations and the following validation objective was not assessed: ▫ OBJ-07.06.02-VALP-0002.0600
EXE-07.06.02-VP-713 Part-A	▪ The scope was significantly reduced due to workload and technical difficulties. Therefore, some validation objectives have not been assessed: ▫ OBJ-07.06.02-VALP-713A.2030 ▫ OBJ-07.06.02-VALP-713A.2040 ▫ OBJ-07.06.02-VALP-713A.2060 ▪ The Shadow Mode exercise was extended to collect more data and allow the participation of Sabre (which faced technical problems during the first session). A second session was thus organised from 23rd to 24th of March 2016 for this purpose but unfortunately the two Sabre customer airlines didn't participate (see section 6.2.2.3.2.2).
EXE-07.06.02-VP-713 Part-B	AUO-0223 OI has not been addressed. This was due to the fact that the effort of prototype development was too big to ensure the availability of certain prototypes in time. As a result: ▪ this Part-B focussed on verification activities mainly (FIXM implementation); ▪ The impact of PTRs on operations was not addressed. The following validation objectives have not been assessed: ▫ OBJ-07.06.02-VALP-713B.1010 ▫ OBJ-07.06.02-VALP-713B.2010

Table 20: Major deviation with respect to the validation plan

4 Exercises Results

The exercise results section has been structured around four main parts:

- Summary of exercise results (Validation objective achievement status overview);
- Main results on Validation objectives related to Concept, Human performance and Operational / Technical feasibility;
- Main results on Key Performance Area;
- Main results impacting standardisation initiatives.

4.1 Summary of Exercises Results

This section gives an overview of the level of achievement of all validation objectives.

The assessment of the results against the validation objective is stated, in the Table below, according to the following status:

- OK: validation objective achieves the expectations (exercise results achieve majority of success criteria);
- NOK: validation objective does not achieve the expectations (exercise results do not achieve majority of success criteria).

As the final decision on OK and NOK is not always obvious, we introduced a tricolour schematic in the exercise results column.

We also introduced a grey colour to represent a validation objective which has not been assessed.

	OK
	Either OK or NOK with issues explained
	NOK
	Not assessed

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Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-311	OBJ-07.06.02-VALP-0001.0100	**Evaluate the EFPL validation process**	CRT-07.06.02-VALP-0001.0101	Stakeholders (AUs and NM) are confident with the new process and agree on EFPL acceptance/rejection rules.	This objective was not totally addressed during VP-311 exercise. This objective have been reformulated in VP-713 as OBJ-07.06.02-VALP-713A.1020 & OBJ-07.06.02-VALP-713A-1030	NOK
EXE-07.06.02-VP-311	OBJ-07.06.02-VALP-0001.0200	**Evaluate the EFPL impact on the acceptance/rejection rate of flight plans (during their initial validation).**	CRT-07.06.02-VALP-0001.0201	The rate of EFPL acceptances, rejections and occurrences of manual treatments (with corresponding reasons) is evaluated, providing the elements to assess the impact of the introduction of the EFPL on flight planning operating costs.	The results demonstrated the potential benefit in terms of reduction of flight plan rejections. A significant proportion of ICAO flight plan rejected today would be accepted using EFPL	OK
EXE-07.06.02-VP-311	OBJ-07.06.02-VALP-0001.0300	**Evaluate the EFPL impact on the conformance to airspace/route usage rules**	CRT-07.06.02-VALP-0001.0301	The rate of EFPL acceptances, rejections and occurrences of manual treatments (with corresponding reasons) is evaluated, providing the elements to assess the impact of the conformance to airspace/route usage rules of EFPL implementation.	In spite of positive observations, the results obtained were not considered significant enough in this respect. One of the main reasons is that the Airspace usage rules are not clearly defined in current operations.	NOK
EXE-07.06.02-VP-311	OBJ-07.06.02-VALP-0002.0100	**Identify extended flight plan content**	CRT-07.06.02-VALP-0002.0101	Validation results allow assessing how useful the new pieces of information are, such as the TOW and climb and descent profiles.	This validation objective was partially validated. Assessment has shown that climbing profiles in particular are useful to improve times predictions. Assessment of improvement form the use of TOW has not been performed. Further investigations have been done in VP-713 (validation objective OBJ-07.06.02-VALP-	NOK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
					713A.2010).	
EXE-07.06.02-VP-311	OBJ-07.06.02-VALP-0002.0200	Assessment of EFPL impact on the traffic predictability	CRT-07.06.02-VALP-0002.0201	Comparisons of predicted vs. occupied counts show a statistically significant difference between the reference (FPL) and solution (EFPL) scenarios.	The analysis performed during VP-311 has not shown statistically significant differences. Further investigations have been done in VP-713 (validation objective OBJ-07.06.02-VALP-713A.2010).	NOK
EXE-07.06.02-VP-311	OBJ-07.06.02-VALP-0002.0300	Evaluate EFPL impact on the reliability of the 4D Trajectory recalculation	CRT-07.06.02-VALP-0002.0301	Validation results provide significant quantitative information on a difference of reliability between these two calculated 4D Trajectories.	This validation objective was partially validated. The exercise has demonstrated that Flight specific Performance Data allow to significantly improve trajectory prediction accuracy in terms of times in particular. The exercise has also demonstrated that the AO4D trajectory - as currently generated in operations – needs to be adapted before being usable by ETFMS as such. Further investigations have been done in VP-713 (validation objective OBJ-07.06.02-VALP-713A.2010).	NOK
EXE-07.06.02-VP-616	OBJ-07.06.02-VALP-0001.0100	Evaluate the EFPL validation process	CRT-07.06.02-VALP-0001.0101	Stakeholders (AUs and NM) are confident with the new process and agree on EFPL acceptance/rejection rules.	This objective was not totally addressed during VP-616 exercise. This objective have been reformulated in VP-713 as OBJ-07.06.02-VALP-713A.1020 & OBJ-07.06.02-VALP-713A-1030	NOK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0001.0200**	**Evaluate the EFPL impact on the acceptance/rejection rate of flight plans (during their initial validation).**	CRT-07.06.02-VALP-0001.0201	The rate of EFPL acceptances, rejections and occurrences of manual treatments (with corresponding reasons) is evaluated, providing the elements to assess the impact of the introduction of the EFPL on flight planning operating costs.	The results demonstrated the potential benefit in terms of reduction of flight plan rejections. A significant proportion of ICAO flight plan rejected today would be accepted using EFPL.	OK
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0001.0300**	**Evaluate the EFPL impact on the conformance to airspace/route usage rules**	CRT-07.06.02-VALP-0001.0301	The rate of EFPL acceptances, rejections and occurrences of manual treatments (with corresponding reasons) is evaluated, providing the elements to assess the impact of the conformance to airspace/route usage rules of EFPL implementation.	In spite of positive observations, the results obtained were not considered significant enough in this respect. One of the main reasons is that the Airspace usage rules are not clearly defined in current operations.	**NOK**
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0001.0350**	**Evaluate the feasibility of using the AO4D trajectory to validate the Flight Plan**	CRT-07.06.02-VALP-0001.0351	Trajectories comparisons is successfully performed and differences are characterised over a statistically significant sample.	The exercise has shown the feasibility to use the AO 4D trajectory (filed trajectory) to validate the flight plan. The exercise has also shown the need in transition phase for NM to adapt the vertical profile of the AO 4D trajectory to integrate some ATC constraints/procedures (e.g. PTRs).	**OK**
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0001.0500**	**Evaluate the feasibility of a mixed mode of operation.**	CRT-07.06.02-VALP-0001.0501	Validation results provide enough information to assess the feasibility of a mixed mode of operation.	Such assessment couldn't be performed. This Validation objective has not been assessed.	**NOK**

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0001.0600**	**Assessment on the impact on AOC staff and IFPS operators**	CRT-07.06.02-VALP-0001.0601	Validation results provide information on the modification of the work of the AOC staff in charge of flight plan filing and/or that of IFPS operators, which would result from EFPL introduction: e.g. modification of their role, workload.	Such assessment couldn't be performed. This Validation objective has not been assessed. This objective has been split in two validation objectives in VP-713 as OBJ-07.06.02-VALP-713A.1020 & OBJ-07.06.02-VALP-713A-1030.	**NOK**
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0002.0200**	**Assessment of EFPL impact on the traffic predictability**	CRT-07.06.02-VALP-0002.0201	Comparisons of predicted vs. occupied counts show a statistically significant difference between the reference (FPL) and solution (EFPL) scenarios.	The analysis performed during VP-616 has not shown statistically significant differences. Further investigations have been done in VP-713 (validation objective OBJ-07.06.02-VALP-713A.2010).	**NOK**
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0002.0300**	**Evaluate EFPL impact on the reliability of the 4D Trajectory recalculation**	CRT-07.06.02-VALP-0002.0301	Validation results provide significant quantitative information on a difference of reliability between these two calculated 4D Trajectories.	This validation objective was partially validated. The exercise has demonstrated that Flight specific Performance Data allow to significantly improve trajectory prediction accuracy in terms of times in particular. The exercise has also demonstrated that the AO4D trajectory - as currently generated in operations – needs to be adapted before being usable by ETFMS as such. Further investigations have been done in VP-713 (validation objective OBJ-07.06.02-VALP-713A.2010).	**NOK**

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0002.0400**	**Evaluate 4D Trajectories respective accuracies**	CRT-07.06.02-VALP-0002.0401	Validation results provide significant quantitative information on a difference of reliability between these two types of 4D Trajectories.	Such assessment couldn't be performed. This Validation objective has not been assessed. This objective has been integrated in VP-713 as OBJ-07.06.02-VALP-713A.2010.	**NOK**
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0002.0500**	**Determine updates conditions**	CRT-07.06.02-VALP-0002.0501	Conditions and thresholds (e.g. on take-off weight) associated to EFPL transmission updates have been identified.	Such assessment couldn't be performed. This Validation objective has not been assessed.	**NOK**
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0002.0600**	**Profile Tuning Restrictions availability**	CRT-07.06.02-VALP-0002.0601	Validation results provide significant quantitative information making it possible to compare rejection rates depending on whether or not Profile Tuning Restrictions have been taken into account when filing flight plans.	Such assessment couldn't be performed. This Validation objective has not been assessed. However, some first results are available from studies outside SESAR[6]	**NOK**
EXE-07.06.02-VP-616	**OBJ-07.06.02-VALP-0002.0700**	**Consequences of a mixed mode environment on demand and capacity balancing.**	CRT-07.06.02-VALP-0002.0701	Validation results provide significant information making it possible to assess whether operating with 4D trajectories based on different sources introduces any bias.	Such assessment couldn't be performed. This Validation objective has not been assessed. This objective has been integrated in VP-713 as OBJ-07.06.02-VALP-713A.2050.	**NOK**

[6] Some assessments performed recently outside SESAR have demonstrated the limited impact of PTRs on flight plan acceptance rates. At DCB side, the VP311 exercise has shown that the integration of PTRs in the predicted trajectory is a prerequisite since PTRs have strong and positive impact on the prediction of sectors crossed by a flight.

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.1010**	**Impact of EFPL on FPL Validation Process**	CRT-07.06.02-VALP-713A.1011	The number of wrongly rejected current ICAO Flight Plans due to a misinterpretation of flight intents is reduced.	Sending flight plans as EFPLs has reduced the number ICAO flight plan messages that were invalid due to a different interpretation of flight intents by IFPS by up to 22%. The minimum recorded during the session was a reduction of 12%. As on all days of the session a reduction has been recorded, this criteria is considered as achieved.	**OK**
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1010	Impact of EFPL on FPL Validation Process	CRT-07.06.02-VALP-713A.1012	The number of wrongly accepted current ICAO Flight Plans due to a misinterpretation of flight intents is reduced.	While the additional invalid flight plans compared to the current operations have reduced the overall EFPL pass rate compared to the current FPL pass rate in operations, they may be regarded as representing a benefit from a safety point of view. They were indeed flight plans for flights that, although their calculated trajectory was planned to enter published constraints (RAD, closed CDR2 routes), were accepted as ICAO 2012 FPLs by IFPS, based on its own calculated trajectory, without knowledge of the actual planned trajectory of the flight. Such flight plans are expected to be filed as EFPLs with a valid trajectory and as a result do not contribute to a reduction of the overall EFPL pass rate. Otherwise they will be rejected by the IFPS and therefore the number of wrongly accepted flight plans due to a different interpretation of the flight intent will be reduced which demonstrates that the success criteria for this objective has been achieved.	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1010	Impact of EFPL on FPL Validation Process	CRT-07.06.02-VALP-713A.1013	The difference between AO 4D trajectory (filed trajectory) and IFPS 4D trajectory (accepted trajectory) is reduced in terms of Time and vertical profiles.	Alignment in Altitude: EFPL introduction allows to significantly reduce the difference between AO 4D trajectory (filed trajectory) and IFPS 4D trajectory (accepted trajectory) in terms of vertical profile. However, the alignment remains incomplete. The main differences result from the PTRs that are not implemented in most AUs flight planning systems whereas NM systems adapts the vertical profiles of the 4D trajectories included in the EFPLs to cope with those restrictions. Alignment in Time: Internally in the NM systems, the elapsed times on the common points between the AO4D and the Accepted Trajectory are the same.	
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.1020**	**Impact of EFPL on FOC staff**	CRT-07.06.02-VALP-713A.1021	The workload of FOC Staff is not increased compared to current operating method where ICAO FPL is used.	FOC staff did not perceive their workload as increased compared to current operations. The majority of dispatchers considered their workload would be the same or even reduced during EFPL operations.	**OK**
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Impact of EFPL on FOC staff	CRT-07.06.02-VALP-713A.1022	The FOC Staff is able to maintain a good Situation Awareness level using EFPL compared to current operating method where ICAO FPL is used.	The majority of the dispatchers expressed that they expect their Situation Awareness during EFPL operations would be the same or better. However, positive answers were motivated by the fact that they expect that once the concept is already integrated in operations they will have an improved interface that will support them in the visualization of flight plan changes from the NM.	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Impact of EFPL on FOC staff	CRT-07.06.02-VALP-713A.1023	The error propensity of FOC Staff is not increased compared to current operating method where ICAO FPL is used.	During the gaming exercise dispatchers did not perceive that the introduction of EFPL will negatively affect their probability to commit mistakes while processing FPLs. But some answers suggested that some flight dispatchers misinterpreted the question towards the handling and content of reject replies.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Impact of EFPL on FOC staff	CRT-07.06.02-VALP-713A.1024	The Flight Planning negotiation process (communication) for FOC Staff is acceptable compared to current operating method where ICAO FPL is used.	Not addressed. Even if the majority of the participants joining the gaming session of EXE-07.06.02-VP-713-A confirmed that this negotiation (communication) process was acceptable, we have to conclude that a negotiation (communication) as intended to be implemented for the iterative SBT definition process, or currently used in operations to solve flight plan validity issues has not been evaluated for this validation exercise.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Impact of EFPL on FOC staff	CRT-07.06.02-VALP-713A.1025	The new operating methods support FOC Staff in performing their tasks in an efficient way.	The answers concerning this question were contradictory and not conclusive, 8 in a total of 17 flight dispatchers reported that the operating methods did not support them in performing their tasks in the most efficient way.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Impact of EFPL on FOC staff	CRT-07.06.02-VALP-713A.1026	The HMI supports efficiently the FOC Staff in preparing the EFPL.	The HMI supported most flight dispatchers in preparing the EFPL. However, most of them also suggested that they would like to see improvements to be implemented in order to improve their performance.	
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.1030**	**Impact of EFPL on IFPS operators staff**	CRT-07.06.02-VALP-713A.1031	The workload of IFPS operators is not increased compared to current operating method where	During the validation exercise IFPS Operators considered that the level of workload during EFPL operations didn't change significantly in respect to ICAO FPL. However, they mentioned	**OK**

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
				ICAO FPL is used.	that there would be a possibility that they can experience increased workload levels if they need to investigate/analyse a source of rejection for more FPLs using the current HMI. It is part of the recommendations to improve the current HMI.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Impact of EFPL on IFPS operators staff	CRT-07.06.02-VALP-713A.1032	The IFPS operators are able to maintain a good Situation Awareness level using EFPL compared to current operating method where ICAO FPL is used.	IFPS operators considered that the introduction of the EFPL did not impact their Situation Awareness compared to the current ICAO Flight Plan Validation process.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Impact of EFPL on IFPS operators staff	CRT-07.06.02-VALP-713A.1033	The error propensity of IFPS operators is not increased compared to current operating method where ICAO FPL is used.	IFPS operators mentioned there is a strong potential to the reduction in the overall error rate in EFPL operations, mainly once the FPL acceptance rate is improved.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Impact of EFPL on IFPS operators staff	CRT-07.06.02-VALP-713A.1034	The FPL negotiation process (communication) for IFPS is acceptable compared to current operating method where ICAO FPL is used.	Not addressed.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Impact of EFPL on IFPS operators staff	CRT-07.06.02-VALP-713A.1035	The new operating methods support IFPS operators in performing their tasks in an efficient way.	IFPS operators considered that their operating methods did not significantly change while processing EFPL and they were able to perform their tasks in an efficient way.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Impact of EFPL on IFPS operators staff	CRT-07.06.02-VALP-713A.1036	The HMI supports efficiently the IFPS operators in handling the EFPL.	The current HMI supported the IFPS operators in handling the EFPL. However, having a summary of the EFPL in the beginning of the Flight plan editor would improve their performance.	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.1060**	**Feasibility of EFPL Updates**	CRT-07.06.02-VALP-713A.1061	Operational feasibility of FPL modification (Delay, Change and Cancel) is confirmed with the introduction of the EFPL: all the modification (Delay, Change and Cancel) are taken into account with the introduction of the EFPL, which means that to each ICAO modification reply corresponds an EFPL modification reply).	During the shadow exercise, EFPL update, FPL delay and cancel messages that correspond to ICAO messages were received and processed successfully on the EFPLs that were in the NM system. The exercise showed that the EFPL can be modified, cancelled and delayed as ICAO FPL is today.	**OK**
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1060	Feasibility of EFPL Updates	CRT-07.06.02-VALP-713A.1062	The system solution for managing EFPL modification is accepted by all affected actors.	The system solution to managing the EFPL modification was accepted by all affected actors. However, as mentioned previously, the EFPL change for AUs side can still be improved with more adequate interface implementations that better support them identifying the FPL changes they have to do in order to get the FPL approved.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1060	Feasibility of EFPL Updates	CRT-07.06.02-VALP-713A.1063	The information provided by EFPL (modifications introduced with respect to ICAO FPL) is relevant for the tasks to be performed by all actors.	The information provided by the EFPL is relevant for the tasks performed by all actors.	
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.1070**	**Feasibility of the mixed mode of operation**	CRT-07.06.02-VALP-713A.1071	The HMI supports efficiently the IFPS operators in mixed mode operations.	The current HMI did not fully support IFPS operators during mixed mode operations even though no negative impact was detected during their performance.	**OK**

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Feasibility of the mixed mode of operation	CRT-07.06.02-VALP-713A.1072	The workload of IFPS operators is not increased due to mixed mode of operations.	The evidence collected showed that mixed mode operations did not increase IFPS operators' workload.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Feasibility of the mixed mode of operation	CRT-07.06.02-VALP-713A.1073	IFPS operators are able to maintain a good situation awareness level in mixed mode of operations.	IFPS Operators were able to maintain a good situation awareness level even in mixed mode operations.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Feasibility of the mixed mode of operation	CRT-07.06.02-VALP-713A.1074	The error propensity of IFPS operators is not increased due to mixed mode of operations.	Mixed mode operations did not increase operators' error propensity.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Feasibility of the mixed mode of operation	CRT-07.06.02-VALP-713A.1075	ICAO Update messages (Change, Delay and Cancel) are applied correctly in NM Systems when they follow an EFPL message for the same flight.	This objective is partially reached. The EFPLs were successfully cancelled and delayed with ICAO cancel and delay messages. There was no ICAO update messages received due to the shadow platform set-up.	
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.1090**	**Confidentiality**	CRT-07.06.02-VALP-713A.1091	Flight Performance data and ToW are not accessible to other AUs via the CHMI and the NOP Portal.	This objective is partially reached. The FSPD and the ToW were not visible in the summary queries on the CHMI and NOP Portal. However, it is present in the OPLOG information that can be accessed via the CHMI and the NOP Portal.	**NOK**
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.1100**	**Impact on Flight Plan distribution to ATC**	CRT-07.06.02-VALP-713A.1101	No difference or differences explained and accepted by ANSPs are identified between the ATC distribution list based on ICAO FPLs and the ATC distribution list based on EFPLs.	As the number of differences between the ATC distribution list based on ICAO FPLs and the one based on EFPLs is very limited and in particular for under-addressing, the objective is considered as reached in V3	**OK**

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.2010**	**4D calculated Trajectories respective accuracies**	CRT-07.06.02-VALP-713A.2011	The use of EFPL data in DCB traffic predictions has no negative impact in general on the following factors: 1) traffic planned to cross TVs, 2) entry times in TVs; 3) occupancy times in TVs and has a positive impact on at least one of them.	One of the previous exercises VP311 addressed the benefit of using flight specific performance data from the EFPL. Therefore, VP-713 focused on the benefit of using the full EFPL dataset (combining the use of the AO 4D trajectory (filed trajectory) and flight specific performance data). The use of EFPL allows in average a slight improvement of traffic predictions more particularly in climbing phase. In general, the improvement is limited in magnitude apart from the prediction of flight occupancy time in sector where the improvement is more significant. There is no risk of global degradation of traffic predictability due to the use of EFPLs. The EFPL can have a significant impact on the traffic prediction of sectors/TVs handling flights close to their TOC or TOD. Depending on traffic volumes and airlines providing the EFPLs, the difference in traffic predictability is either positive or negative. The negative differences have been analysed and reviewed by operational experts concluding that they do not impact negatively DCB operations: ▪ These differences may need to be checked with respect to RAD ▪ The impact of these differences in terms of TV capacity needs to be checked. In order to this, the results need to be presented to the FMPs concerned.	**OK**

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2010	4D calculated Trajectories respective accuracies	CRT-07.06.02-VALP-713A.2012	Assess the proportion of the traffic for which the AO 4D trajectory (filed trajectory) can be used without modifications with regards ETFMS calculated 4D trajectory.	Not addressed. Not needed to achieve V3 e-OCVM maturity level.	
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.2030**	**Impact of EFPL Late updates on predictability**	CRT-07.06.02-VALP-713A.2031	The 4D trajectories, calculated by DCB, taking into account last update information are closer to the flown trajectories.	Not addressed. Not needed to achieve V3 e-OCVM maturity level.	NOK
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.2040**	**AO 4D(filed trajectory) and NM 4D Trajectories predictability without PTRs**	CRT-07.06.02-VALP-713A.2041	With the implementation of EFPL, DCB Prediction is improved both in areas where PTRs are applied and in areas where PTRs are not applied.	Not addressed. Not needed to achieve V3 e-OCVM maturity level.	NOK
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.2050**	**Consequences of the global mixed mode environment on demand and capacity balancing**	CRT-07.06.02-VALP-713A.2051	Validation results provide significant information making it possible to assess whether operating with 4D trajectories based on different sources introduces any bias.	Not addressed. Not needed to achieve V3 e-OCVM maturity level.	NOK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2050	Consequences of the global mixed mode environment on demand and capacity balancing	CRT-07.06.02-VALP-713A.2052	On a selection of TVs, validation results allow to compare the same traffic taking into account ICAO FPL only on the one hand and a mixed of ICAO FPL and EFPL on the other hand. This comparison will be done in terms of Flight Lists, Traffic Counts and Occupancy counts.	Not addressed. Not needed to achieve V3 e-OCVM maturity level.	
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.2060**	**Impact on ATFCM : regulated flights**	CRT-07.06.02-VALP-713A.2061	The impact of EFPL (compared to ICAO FPL) on the number of flights impacted by regulations is acceptable.	Not addressed. Not needed to achieve V3 e-OCVM maturity level.	**NOK**
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2060	Impact on ATFCM : regulated flights	CRT-07.06.02-VALP-713A.2062	The impact of EFPL (compared to ICAO FPL) on delays is acceptable.	Not addressed. Not needed to achieve V3 e-OCVM maturity level.	
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713A.2070**	**Impact on the reliability of the 4D Trajectory recalculation**	CRT-07.06.02-VALP-713A.2071	Validation results provide significant qualitative information on a difference of reliability between these two calculated 4D Trajectories.	This objective has been integrated in OBJ-07.06.02-VALP-713A.2010.	**NOK**
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713B.1010**	**Operational feasibility of soft ATC constraint integration**	CRT-07.06.02-VALP-713B.1011	The process/scenario is applicable (manually) on a number of flights/city-pairs covering as much as possible the diversity of the “types” of LOAs”.	Not addressed. Out of scope. For more information see Section 6.2.2.3.2.	**NOK**

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1010	Operational feasibility of soft ATC constraint integration	CRT-07.06.02-VALP-713B.1012	The decision criteria to apply PTRs are clarified for the studied cases.	Not addressed. Out of scope. For more information see Section 6.2.2.3.2.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1010	Operational feasibility of soft ATC constraint integration	CRT-07.06.02-VALP-713B.1013	The CFSP experts are confident that such a scenario can be at least partly automated in the future to avoid increase of operator workload.	Not addressed. Out of scope. For more information see Section 6.2.2.3.2.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1010	Operational feasibility of soft ATC constraint integration	CRT-07.06.02-VALP-713B.1014	The AUs/CFSPs experts agree with the process or at least consider that the information provided as feedback by IFPS (PTRs, accepted trajectory) is useful - in some cases - in their decision processes.	Not addressed. Out of scope. For more information see Section 6.2.2.3.2.	
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713B.1020**	FIXM implementation feasibility	CRT-07.06.02-VALP-713B.1021	The use of FIXM EFPL extension operates successfully.	The EFPLs were exchanged and processed successfully. The tests concluded that the EFPL requests that were issued and processed via the NM EFPL model can also be issued and processed via the FIXM EFPL model.	**OK**
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1020	FIXM implementation feasibility	CRT-07.06.02-VALP-713B.1022	The different types of trajectory exchanged and defined in the FIXM extension are agreed between NM and CFSPs.	The EFPL extension is reviewed and agreed between NM (EUROCONTROL) and the CFSP (Lufthansa Systems). All related services (and required clients) have been developed by NM (EUROCONTROL) and the CFSP (Lufthansa Systems) prior to implementation of the prototypes and successfully used for the FIXM analytical modelling exercise.	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.02-VP-713	**OBJ-07.06.02-VALP-713B.2010**	PTRs Impact on Predictability	CRT-07.06.02-VALP-713B.2011	The validation provides a quantitative measure of the benefit to apply some selected PTRs to better predict flight EETs, vertical profile and fuel consumption.	Not addressed. Out of scope. For more information see Section 6.2.2.3.2	**NOK**
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.2010	PTRs Impact on Predictability	CRT-07.06.02-VALP-713B.2013	The validation shows that the cases identified represent potentially a significant proportion of the ECAC traffic (e.g more than 3% of the traffic).	Not addressed. Out of scope. For more information see Section 6.2.2.3.2	

Table 21: Summary of Validation Exercises Results

4.1.1 Results on concept clarification

These three exercises allowed to validate most of operational requirements included in the P07.06.02 OSED (see section 4 of document [11]) related to information to include in the Extended flight plan, use of the information in NM operations and systems and required B2B services in support to implementing the solution.

They clarified the need to include both the 4D trajectory and flight performance data in the EFPL to achieve improvements on the following aspects:

- Flight plan acceptance process improvement by reducing both the rates of wrongly accepted and wrongly rejected flight plans;
- Reduction of trajectory misalignment between the AU and NM actors;
- Traffic predictability improvement.

VP-713 and VP311 exercises showed that in the first implementation step, full alignment cannot be achieved without a risk of reducing predictability. In particular, NM needs to adapt the AU trajectory received in the EFPL to better reflect ATC procedures (e.g. LOAs that will impact the trajectory in execution).

These exercises also clarified the impact of the EFPL on operators:

- At AU side, the EFPL will provide much more situation awareness to operators of NM operations impacting the flight due to increased alignment of trajectory views at both sides. This will provide AU operators with much more fine-tune means to minimise the impact of network constraints (flight restrictions, ATFCM regulations) on the trajectory.
- AT NM side, the role of IFPS operators will progressively evolve from the current role of manually correcting flight plans towards a role of advising AU operators on how to change themselves the trajectory when a flight plan is rejected.

VP-713 exercise validated the SWIM compliance of the EFPL services as defined in the ExtendedFlightPlanSubmission and FlightPlanDataDistribution Service Design Documents (please see [18] and [19]). The Step 1 Technical Specifications for EFPL V3 (please see [17]) elaborated on the SWIM requirements further and the Service Technical Design Documents for the two services were elaborated for the prototype development (please see [20] and [21]). The Service Technical Design Documents, AIRM/ISRM mappings were used to produce SWIM compliance report (please see [22]).

The SWIM compliance assessment team concluded that the services in the scope of the VP-713 exercise are: Information Service Compliant (ISRM), Information Ready (AIRM) and TI Binding Yellow Profile Compliant (TI Level).

These exercises also contributed to identify significant HMI improvements both at NM and AU sides to better integrate the new information exchanged. Moreover, due to the move towards more fine-tuned resolution of errors, it also highlighted the needs to exchange much more detailed information related to flight plan rejection causes in order to fully exploit the benefit of using EFPLs.

One major unclarified point is related to flight information returned back by NM to the AU in case of flight plan acceptance (the accepted trajectory and PTRs) and how this information could be used by AU to improve trajectory alignment and predictability while not increasing operator workload. Associated requirements in the OSED will remain in progress and need to be addressed in further validations.

4.1.2 Results per KPA

4.1.2.1.1.1 Capacity & network traffic predictability

These exercises did not directly measure the capacity KPIs. Nevertheless, they address the KPA capacity through the metrics related to traffic predictability.

To illustrate this link, the following table is extracted from the VP723 exercise report delivered by P13.02.03 (refer to [24]). It provides an evaluation of the impact of entry time predictability on the declared capacity buffer based on a model developed and calibrated on number of regulated traffic volumes.

Entry time accuracy (standard deviation) improvement (Delta)	1.1. minutes	2.1 minutes
Declared capacity increase	2.7 %	5.3 %

Table 22: impact of entry time predictability on the declared capacity buffer

More generally, the study quantified the link between the accuracy of prediction of occupancy counts and capacity buffers considered when activating ATFCM regulations.

Regarding the VP-713 exercise, the following results have been obtained related to the impact of the EFPL on sectors traffic predictions:

- No clear trend regarding the impact of EFPLs on entry times prediction accuracy;
- A significant improvement of the predictions of the sector occupancy times mainly in climbing phase.

The two factors are strongly influencing the quality of occupancy count predictions. However, since the model developed in the VP-723 exercise did not consider the sectors occupancy time accuracy factor, it is not possible to use the model to derive even a rough estimation of declared capacity gains from VP-713 results since the improvement is mainly on this factor.

In any case considering the balanced results both in terms of entry time prediction and identification of flights crossing a sector, the impact of the EFPL on the declared sectors capacities should be limited in general apart from for a limited number of sectors managing climbing traffic

4.1.2.1.1.2 Cost-effectiveness

VP-713 exercise addresses cost-effectiveness related to NM operator workload. Two factors were considered:

- The impact of EFPL on the rate of FPL rejection (shadow mode sessions)
- The time consumed by NM operators per rejection.

Regarding the first factor, quantitative measures were performed showing that, under certain conditions, the EFPL pass rate could become very close to 98% and the number of rejections could decrease significantly (between 30% and 50%) The conditions refer to a consistent application of all published constraints by airspace users during calculation of the planned trajectory that is then transmitted in the EFPL.

For the second factor, the gaming exercise highlighted that in the future the role of NM operators will evolve. Most of the rejections will be probably treated in automatic rejection mode and in that case the NM operator will be involved only if the AU dispatcher contacts the NM operator to request support. Therefore, it can be expected that the average time consumed by an NM operator per rejection will strongly go down due to the decrease of the rate of manual corrections.

4.1.2.1.1.3 Safety

All safety objectives included in the SPR document [13]– at least those directly linked to the solution #37 and PCP deployments – have been addressed and can be considered as V3 validated ensuring that safety will not be impacted negatively by the use EFPLs in Network operations. This is stated in the final SESAR SPR document [13].

Concerning quantified benefits, the exercises address the KPA however though the identification of cases where the ICAO FPL is accepted while the corresponding EFPL is rejected. This corresponds to cases where the AO 4D trajectories calculated by the FOC – and transmitted to the flight crew – is infringing some ATM constraints while accepted as ICAO flight plan. Deriving any quantitative results about the positive impact of EFPL on safety will be complex, since it needs to take into consideration a number of safety layers put in place in current operations to cope with the "low granularity" of the ICAO flight plan.

4.1.2.1.1.4 Predictability

Referring to the benefit mechanism, predictability improvement is expected to be achieved through the increased integration of ATC constraints/procedures (e.g. PTRs) in the trajectory as planned by the AU and included in the EFPL. This improvement is in the scope of the OI-0223 and has not been addressed in the exercises performed (See deviation with respect to the validation plan in section 3.2.2). Therefore no quantified results are available for this KPA.

4.1.2.1.1.5 AU cost effectiveness

The AU cost effectiveness as being assessed during these validation exercises mainly relates to workload of the flight planning process. The planning process in general is not influenced by the flight plan format. The workload as assessed in this validation exercises is rather referring to the workload caused by rejected flight plans. In particular, the number of Wrongly rejected ICAO flight plans is a criterion that increases the workload on flight dispatch side unnecessarily and should be reduced to an absolute minimum. Apart from that, AU cost effectiveness could also be related to the ability to file the most optimum trajectory for a flight.

Both criteria have been evaluated in a more qualitative approach. During the EXE-07.06.02-VP-713-A "Gaming Session" the participating flight dispatchers were asked for feedback in regard to the handling of the EFPL filing and the way they would omit wrongful rejects in case of ICAO FPL filing.

The predominant conclusion of the participating AUs was that use of the EFPL would decrease the workload of the flight dispatchers as the number of Wrongly rejected ICAO flight plans can be reduced to a minimum. But in this context, it was also be discussed that the ICAO flight plan is leading to a number of Wrongly accepted ICAO flight plans. In those cases, the airspace user calculates unintentionally a 4D trajectory that is not in accordance with all regulations or restrictions and the NM system (IFPS) is accepting such trajectory when filed as ICAO FPL. This is due to the fact that NM has to interpolate a 4D trajectory – out of the provided ICAO flight plan data to be able to check with respect to all constraints, and to be able to do the distribution– which is in accordance with all regulations and restrictions. The result is a Wrongly accepted ICAO flight plan. With the EFPL, those cases would be disclosed as those 4D trajectories would be rejected. This would increase the workload on flight dispatcher's side at least in the EFPL introduction phase if predefined routes are used for the 4D trajectory generation. But, this was assumed as being bearable. In concrete, the result of the VP-713-A shadow mode trials showed that the acceptance rate of the EFPL was reduced by about 2% points compared to the ICAO FPL acceptance rate. This reduction of the acceptance rate for the EFPL is mainly caused by Wrongly accepted ICAO flight plans of the ICAO FPL on the NM OPS system and hence consequences of the validation exercise setup. Anyhow, with the EFPL filing in the VP-713-A shadow mode an average acceptance of about 97% has been achieved. Acceptance rate values above 95% are assumed to be bearable in flight operations. For the cases were the ICAO flight plan was rejected during the EXE-07.06.02-VP-713-A "Shadow Mode", it was shown that a significant number of the related trajectories would be accepted when filed as EFPL.

That would reduce the workload for these flights and might increase the efficiency of the flights if the optimal trajectory can be filed and flown.

Contrary to this, the concern was expressed that differences between the trajectory planned by the airspace user and that one replied by the NM in case of the EFPL acceptance could cause a lot of workload if the airspace user is required to assess the extent of the deviations and has to estimate the effect on fuel and flight costs. It was concluded that the trajectory as planned by the airspace user shall be adopted by NM and in case of changes detailed information (restrictions/ constraints) shall be provided to the airspace user to allow him to adapt the trajectory accordingly if required. But in this context it must also be mentioned that the differences between the two trajectories (AU/ NM) when filing an EFPL should be less compared to the differences resulting when filing an ICAO flight plan. That means that even if the EFPL is currently not reducing trajectory differences to zero, it is already reducing the differences significantly compared to ICAO flight plan. Main drivers for the remaining differences were the application of PTRs that was done by NM and differences in the implementation of aeronautical data. For both, technical solutions can be found to reduce differences between the AU and NM system with the final goal to eliminate them.

4.1.2.1.1.6 Fuel Efficiency

No quantitative results are available for the KPA. However most of the operational experts involved in the exercise are confident that at term some benefits should be achieved for this KPA due to the fact that the EFPL provides to Airspace users with fine-tuned means to plan trajectories avoiding flight planning constraints or ATFCM regulations leading to more optimised filed 2D routes and/or vertical profiles.

4.1.2.1.1.7 Type of assessment per KPA

The following table summarises the type of assessment performed for each KPA introduced in the previous sections.

KPA	TYPE OF ASSESSMENT
Capacity	Some quantitative assessment related to traffic prediction factors. Qualitative assessment regarding the impact of EFPL on traffic counts and capacity.
Cost-Effectiveness	Quantitative measures.
Safety	Quantitative measures regarding some metrics related to Safety (occurrences of wrongly accepted FPLs).
Predictability	No quantitative measure available.
Fuel efficiency	Qualitative assessment.

Table 23: Type of assessment per KPA

4.1.3 Results impacting regulation and standardisation initiatives

The development of the Extended Flight Plan in Europe is conducted in close coordination with the definition of ICAO FF-ICE increment 1 provision and FIXM V4.0 standards. Therefore, any validation on EFPL impacts potentially these regulation and standardisation initiatives

The results of VP-713 exercise - in particular the technical exercise addressing the validation of the FIXM based B2B services in support to Extended FPL submission - combined with the results of VP311 exercise provide a solid material for promoting the Extended Flight plan in ICAO groups

(ATMRPP) and FIXM community. All the new information elements of the Extended Flight Plan addressed in the different SESAR exercises (e.g. 4D trajectory, flight performance data, Take-off mass) have already included in FIXM 4.0 and are part of FF-ICE provisions.

Moreover, the FIXM extension developed in the context of VP-713 exercise is providing strong input to the FIXM community not only in terms of data elements but also in terms of service and message definition.

4.2 Analysis of Exercises Results

Analysis of exercises results are described in the dedicated section specific to each exercise (refer to Section 6).

4.2.1 Unexpected Behaviours/Results

Unexpected behaviours that occurred during the exercises are described in the dedicated section specific to each exercise (refer to Section 6).

4.3 Confidence in Results of Validation Exercises

4.3.1 Quality of Validation Exercises Results

Quality of Validation exercises results is described in the dedicated section specific to each exercise (refer to Section 6).

4.3.2 Significance of Validation Exercises Results

Significance of Validation exercises results is described in the dedicated section specific to each exercise (refer to Section 6).

5 Conclusions and recommendations

5.1 Conclusions

The following general conclusions can be derived from the results of the exercises.

Operational and technical feasibility of the use of the extended flight plan has been proven both at the level of flight planning and flow management.

- Main critical safety requirements have been validated. In particular the exercise has demonstrated that the EFPL does not create risks in some safety critical processes like flight plan distribution to ANSPs and identification of potential overloads in DCB. Some specific issues in some geographical areas need further analysis and resolution but these can be addressed during implementation on a case by case basis.
- Some immediate benefits have been demonstrated both at the level of flight planning and flow management in terms of increased transparency and trajectory alignment, less FPL rejections or increased traffic predictability in some specific areas.
- In term of Key Performances Areas, quantified benefits are only available for the KPA cost-effectiveness linked to the reduction of occurrences of flight plan rejections and manual corrections by IFPS operators. For the other KPAs, the benefits quantitatively measured are limited at this stage. However, it is highlighted by all stakeholders that the exercise has not addressed some promising use-cases inducing potentially significant benefits such as the optimisation of todays accepted ICAO flight plans or the fine-tuning of trajectories to avoid constraints. Those use cases may be addressed progressively during implementation by airspace users themselves using NM services like the IFPUV.
- The technical feasibility of EFPL dedicated services has been proven. Dedicated services using the current NM B2B interface were prototyped and successfully used in the context of shadow mode sessions by on AUs on-site legacy flight planning systems.
- Standardisation needs have been covered and the migration to FIXM - the format for the future ICAO FPL - has been tested successfully.

A number of points have remained open and will require further validations:

- The exercises have shown that in a first implementation step, a full alignment of AU and NM trajectories is not possible. In order, to avoid the risk to decrease traffic predictability, NM needs to adapt the AU trajectory in particular to better integrate ATC procedures like LOAs.
- Related to the previous point, in the context of the EFPL information exchanges, NM is providing back to the AU more information about the PTRs (LOAs) impacting the flight and the resulting trajectory calculated by NM. How this information could be used by the AU, as well as the associated benefits have not been clarified yet.

The open points are not showstoppers and do not need to be addressed in the first step of implementation of the solution #37. Therefore, considering the results of the exercise VP-713, all stakeholders involved in the exercise (including NM, the CFSPs and AUs) agree that solution #37 can be considered as having achieved the E-OCVM V3 maturity status (some requirements remain in progress but these ones are either out of the scope of solution #37 or can be validated in the industrial phase; refer to Appendix E for detailed information).

5.2 Recommendations

From the results of the validation exercises, several recommendations can be extracted. Even if the concept is already at a very high maturity level a number of items are recommended to be further addressed in future activities. Two types of recommendation can be derived from the outcomes of the exercises:

- Recommendations concerning the first implementation step planned at short term;
- Recommendations regarding longer-term steps of implementation.

Regarding the first implementation step, the following recommendations are:

- To perform pre- operational live trials (V4) with candidate airlines in order to:
  - Minimise the risk of new flight plan rejections during the initial learning phase;
  - Further validate some aspects of the EFPL benefit mechanisms, and in particular the possibility for AUs to optimise todays filed 2D routes and 3D profiles and improve flight efficiency;
  - Identify the best options in terms of EFPL data (Take-off-weight, Performance data and 4D trajectory) to be used by the NM systems in order to optimise traffic predictability improvements and in particular study the non-mandatory provision of the performance data and their influence to the predictability in climb and descent phases.
  - Assess in coordination with concerned ASNPs the impact of EFPLs on flight plan distribution and traffic predictability in some specific areas.
- To further specify and implement NM HMI improvements in order to support IFPS operators in the management of Extended Flight Plans.

Regarding further steps of the EFPL implementation the recommendation is to plan additional SESAR validations in SESAR 2020 in order to:

- Assess the feasibility and benefits for AUs to better integrate ATC constraints (PTRs) in the AU planned trajectory included in the EFPL;
- Clarify the requirements in terms of more detailed error messages provided by NM to the AUs in the reply for an invalid EFPL;
- Validate EFPL distribution services and the use of EFPL data in ATC systems and processes;
- Investigate the use of the Extended Flight Plan for the management of TTOs/TTAs.

6 Validation Exercises reports

6.1 Validation EXE-07.06.02-VP-311 & EXE-07.06.02-VP-616-Report

EXE-07.06.02-VP-311 and EXE-07.06.02-VP-616 validation reports were delivered in 2014. Refer to "Step 1 Business Trajectory Validation Report for 2013 2014" document [16].

6.2 Validation EXE-07.06.02-VP-713 Report

6.2.1 Exercise Scope

Several aspects were focussed on in this exercise: to assess the impact of the EFPL format on the NM flight plan acceptance process and on the NM DCB traffic prediction, to assess the impact of the EFPL on the AU dispatchers and IFPS operators workload, to investigate technical differences between the flight planning and NM systems, and to assess the feasibility to use the FIXM EFPL format for the exchange of EFPL data. For this purpose several trials have been performed in the context of this exercise.

On the one hand, the proof of the maturity level V3 of the EFPL concept was in scope. This included the participation of airspace users into two different types of trial. The first, a gaming session was used to make some qualitative assessments of the maturity of the EFPL concept by inviting in a gaming session airline flight dispatchers to file flights using EFPL messages and IFPS operators to follow EFPLs submission at NM site. In a second trial, a quantitative approach has been chosen where the flight planning systems of a number of airlines were enabled to file flight plans using EFPL messages in parallel to the ICAO flight plan which was still filed operationally. This trial was setup as a shadow mode exercise. The two V3 validation sub-exercises are called:

- EXE-07.06.02-VP-713-A "Gaming Sessions"; and
- EXE-07.06.02-VP-713-A "Shadow Mode".

On the other hand, the proof of the maturity level V2 for the EFPL in the FIXM format was in scope. During this part of the validation exercise, it was investigated whether the current EFPL implementation in FIXM 3.0 (as so-called FIXM extension) delivers the same validation results as the NM EFPL format. This part of the validation exercise is called:

- EXE-07.06.02-VP-713-B "FIXM Analytical modelling".

6.2.1.1 Part-A – Gaming Sessions

The gaming sessions were performed on test traffic where Flight Planning Systems were used at the CFSP's premises (see Figure 5). Flight dispatchers were filing flights using the EFPL. The target was to assess how the EFPL would impact the flight planning process. This exercise involved 11 airlines representing different type of airspace user business models (mainline airlines, charter airlines, cargo airlines, regional airlines, and low cost airlines): Air France, Austrian Airlines, Condor, EasyJet, El Al, Germanwings, HOP, Lufthansa, Novair, TAP and Turkish Airline.

Figure 5: EXE-07.06.02-VP-713 Part-A Gaming Session

6.2.1.2 Part-A – Shadow Mode

The shadow mode sessions were performed at AU's premises for quantitative analysis and human performance assessment (IFPS operators only) on real traffic (see Figure 6) with the main objective to evaluate the impact of the EFPL implementation on current processes in operational conditions. This exercise involved 8 airlines, representing different business models (mainline airlines, charter airlines, cargo airlines, regional airlines, and low cost airlines): Air Dolomiti, Condor, Lufthansa, Lufthansa CityLine, Lufthansa Cargo, EasyJet, TAP and Thomas Cook For this exercise, the Lido/Flight flight planning system developed by Lufthansa Systems used operationally by the participating airlines was enabled to provide the EFPL to the Network Manager Validation Platform (NMVP) in addition to the ICAO flight plan that is filed to the NM OPS system. During this trial about 15.000 [7]EFPL submission messages were provided to the NMVP that were based on operational flights.

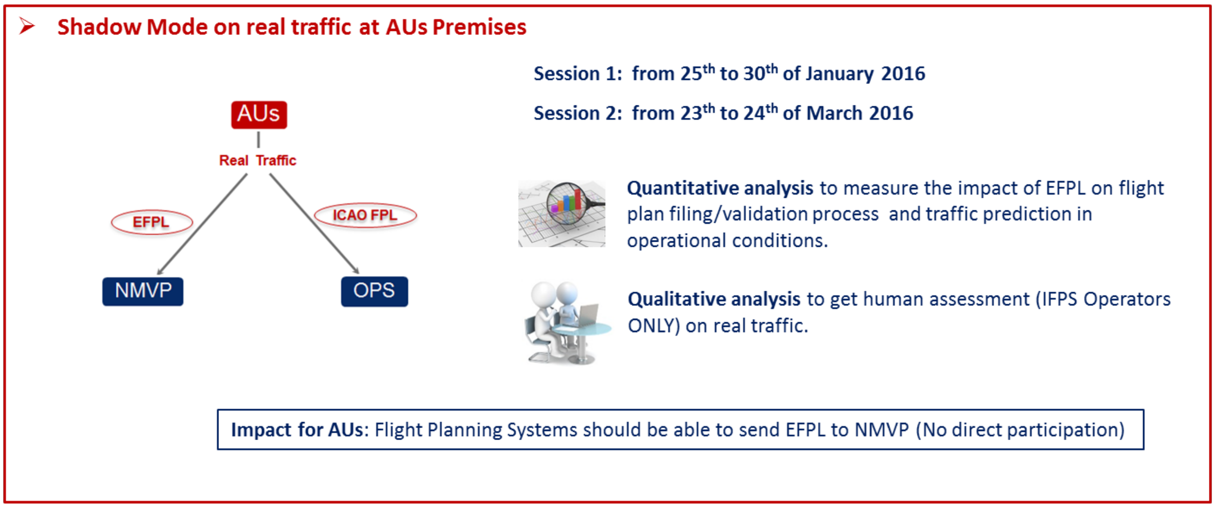


Figure 6: EXE-07.06.02-VP-713 Part-A Shadow Mode Session

This shadow mode session was followed by several replay sessions which took shadow recorded data as a basis to build different solution scenarios and produce needed statistics and metrics.

[7] This figure includes Creation, Delay, Update and Cancel messages

6.2.1.3 Part-B – FIXM Analytical Modelling

This part of the exercise was initially planned to cover E-OCVM V2 activities which would allow to further develop and refine operational concepts (such as investigate the operational feasibility and the benefits of integrating PTRs in AU calculated trajectory) and to assess the feasibility to use FIXM to support EFPL implementation. The scope of this part was significantly reduced and covered the second point only (see Section 6.2.2.3.2), so it was rather verification than validation with the objective to confirm that the EFPL related information as integrated into the FIXM V3.0 EFPL extension is adequate to cover the technical aspects of the EFPL data exchange. This exercise was solely performed by Lufthansa Systems and EUROCONTROL.

6.2.1.4 Summary of Expected Exercise/s outcomes

Expected outcomes related to validation exercises are described in Section 2.2.1.

6.2.1.5 Benefit mechanisms investigated

Benefit Mechanisms linked to the proposed operational changes that are under the scope of this validation exercise are described in Section 2.2.2.

6.2.1.6 Summary of Validation Objectives and success criteria

The Validation Objectives, detailed in the corresponding Validation Plan (refer to [15]), that were planned to be addressed by this specific exercise are listed in Section 2.2.3 with OBJ-07.06.02-VALP-713x.xxxx reference.

6.2.1.7 Choice of metrics and indicators

This section addresses the methods used in shadow mode and gaming session to collect data that were used in the post operations analysis to calculate the metrics and indicators defined for this validation exercise.

The EXE-07.06.02-VP-713 validation exercise provided two different types of results: quantitative and qualitative results. Generally, “quantitative” information is understood as objective measurements while “qualitative” information is related to subjective measurements. During the different sessions:

- **Quantitative data** were obtained from system data recorded during each run.
- **Qualitative data** were collected from the actors taking part in each run by different methods:
  - **Observations**: during the sessions, the activities of actors were observed in order to collect insights about their performance, strategies they use to perform the task and difficulties experienced. In order to better understand the reasoning and the way that provided information is used, operators were asked to “think-aloud” while performing their tasks.
  - **Debriefing sessions**: after each run, the difficulties on the exercise were discussed among all the participants (operational, validation and technical staffs).
  - **Questionnaires**: specific questionnaires were developed to obtain a feedback from the actors involved in the study on the concept, their performance, the scenarios and exercises performed.

The following sections list the metrics/indicators related to:

- "Flight Planning" (see Section 6.2.1.7.1);
- "DCB Traffic Prediction" (see Section 6.2.1.7.2);
- "FIXM Implementation" (see Section 6.2.1.7.3);
- "NOP" (see Section 6.2.1.7.4).

6.2.1.7.1 Metrics linked to "Flight Planning"

The Flight Planning Validation process was quantitatively measured according to two main axes:

- **The analysis of two specific situations:**
  - "New valids" Situation where flight plans were invalid in the reference scenario and valid in the solution scenario
  - "New Invalids" Situation where flight plans were valid in the reference scenario and invalid in the solution scenario

  The analysis consisted in comparing the following metrics for the reference scenario with the ones calculated for the solution scenario:
  - Pass rate and number of valid flight plans
  - Rejection rate and number of invalid flight plans
  - List of invalid flight plans (flight plan key fields)
  - Associated errors for each invalid flight plan (name and text)
  - Number of errors per error name
  - Number of errors per error kind

- **The comparison of 4D trajectories**

  The comparison was done between AO 4D trajectory (filed trajectory) and IFPS 4D trajectory (accepted trajectory) in terms of time and vertical profiles, as defined in Table 24.

Sol. Trajectory	Ref. Trajectory	Delta with Ref	Elements to be compared
T_{ICAO}IFPS	T_{EFPL}AO4D	Delta IFPS Ref	Time and Vertical profiles only
T_{EFPL}IFPS	T_{EFPL}AO4D	Delta IFPS	Time and Vertical profiles only

Table 24: 4D Trajectory comparisons in Flight Planning

Traj. Name	Traj. Type	Description
T_{ICAO}IFPS	Reference	Trajectory calculated by the Flight Plan Processing System (IFPS) taking into account ICAO information only
T_{EFPL}AO4D	Solution	Trajectory calculated by the FOC System sent to NMVP
T_{EFPL}IFPS	Solution	Trajectory calculated by the Flight Plan Processing System (IFPS) taking into account each element of the EFPL (= Accepted IFPS Trajectory)

Table 25: Trajectory descriptions in Flight Planning

The detailed measurements related to the assessment of the Flight Planning success criteria are listed in the following table

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
OBJ-07.06.02-VALP-713A.1010	Impact of EFPL on FPL Validation Process	CRT-07.06.02-VALP-713A.1011	The number of wrongly rejected current ICAO Flight Plans due to a misinterpretation of flight intents is reduced.	FPL Acceptance/Rejection Rates	Compare rates between Reference Scenario (ICAO in OPS) and Solution Scenario (EFPL in NMVP)
				#FPL messages where EFPL has been accepted and ICAO FPL rejected	Compare counts between Reference Scenario (ICAO in OPS) and Solution Scenario (EFPL in NMVP)
				Accepted EFPLs while ICAO has been rejected are judged as valid by IFPS Operators experts.	Expert judgment based on Error cause Distribution and Error List
		CRT-07.06.02-VALP-713A.1012	The number of wrongly accepted current ICAO Flight Plans due to a misinterpretation of flight intents is reduced..	#FPL messages where EFPL has been rejected and ICAO FPL accepted	Compare counts between Reference Scenario (ICAO in OPS) and Solution Scenario (EFPL in NMVP)
				Rejected EFPLs while ICAO have been accepted are judged as valid by IFPS Operators experts	Expert judgment based on Error cause Distribution and Error List
		CRT-07.06.02-VALP-713A.1013	The difference between AO 4D trajectory (filed trajectory) and IFPS 4D trajectory (accepted trajectory) is reduced in terms of Time and vertical profiles.	•Delta_IFPS_Ref = Difference in Time(*) between TICAOIFPS (IFPS Accepted trajectory in Ops) and TEFPLAO4D (AO4D Trajectory) •Delta_IFPS = Difference in Time(*) between TEFPLIFPS (IFPS Accepted trajectory from NMVP) and TEFPLAO4D (AO4D Trajectory) (*)"Delta flight duration" and "Average absolute delta altitude" on each common navigation point	Compare these Deltas and draw conclusion if the difference between IFPS accepted trajectory and AO4D trajectory is reduced
OBJ-07.06.02-VALP-713A.1020	Impact of EFPL on FOC staff	CRT-07.06.02-VALP-713A.1021	The workload of FOC Staff is not increased compared to current operating method where ICAO FPL is used.	On-line feedback from AO related to workload	Qualitative Assessment
				Off-line feedback from AO related to workload	Qualitative Assessment

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
		CRT-07.06.02-VALP-713A.1022	The FOC Staff is able to maintain a good Situation Awareness level using EFPL compared to current operating method where ICAO FPL is used.	Same as CRT-07.06.02-VALP-713A.1021	
		CRT-07.06.02-VALP-713A.1023	The error propensity of FOC Staff is not increased compared to current operating method where ICAO FPL is used.	Same as CRT-07.06.02-VALP-713A.1021	
		CRT-07.06.02-VALP-713A.1024	The Flight Planning negotiation process (communication) for FOC Staff is acceptable compared to current operating method where ICAO FPL is used.	Same as CRT-07.06.02-VALP-713A.1021	
		CRT-07.06.02-VALP-713A.1025	The new operating methods support FOC Staff in performing their tasks in an efficient way.	Same as CRT-07.06.02-VALP-713A.1021	
		CRT-07.06.02-VALP-713A.1026	The HMI supports efficiently the FOC Staff in preparing the EFPL.	Same as CRT-07.06.02-VALP-713A.1021	
OBJ-07.06.02-VALP-713A.1030	Impact of EFPL on IFPS operators	CRT-07.06.02-VALP-713A.1031	The workload of IFPS operators is not increased compared to current operating method where ICAO FPL is used.	On-line feedback from IFPS Operators related to workload	Qualitative Assessment
				Off-line feedback from IFPS Operators related to workload	Qualitative Assessment
				#EFPL messages handled by IFPS Operators	Compare counts between Reference Scenario (ICAO in OPS) and Solution Scenario (EFPL in NMVP)
		CRT-07.06.02-VALP-713A.1032	The IFPS operators are able to maintain a good Situation Awareness level using EFPL compared to current operating method where ICAO FPL is used.	On-line feedback from IFPS Operators related to workload	Qualitative Assessment
				Off-line feedback from IFPS Operators related to workload	Qualitative Assessment

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
		CRT-07.06.02-VALP-713A.1033	The error propensity of IFPS operators is not increased compared to current operating method where ICAO FPL is used.	Same as CRT-07.06.02-VALP-713A.1032	
		CRT-07.06.02-VALP-713A.1034	The FPL negotiation process (communication) for IFPS is acceptable compared to current operating method where ICAO FPL is used.	Same as CRT-07.06.02-VALP-713A.1032	
		CRT-07.06.02-VALP-713A.1035	The new operating methods support IFPS operators in performing their tasks in an efficient way.	Same as CRT-07.06.02-VALP-713A.1032	
		CRT-07.06.02-VALP-713A.1036	The HMI supports efficiently the IFPS operators in handling the EFPL.	Same as CRT-07.06.02-VALP-713A.1032	
OBJ-07.06.02-VALP-713A.1060	Feasibility of EFPL Updates	CRT-07.06.02-VALP-713A.1061	Operational feasibility of FPL modification (Delay, Change and Cancel) is confirmed with the introduction of the EFPL: all the modification (Delay, Change and Cancel) are taken into account with the introduction of the EFPL, which means that to each ICAO modification reply corresponds an EFPL modification reply).	#EFPL messages (for Delay, Change and Cancel)	Compare counts between Reference Scenario (ICAO in OPS) and Solution Scenario (EFPL in NMVP)
		CRT-07.06.02-VALP-713A.1062	The system solution for managing EFPL modification is accepted by all affected actors.	On-line feedback related to EFPL modification management	Qualitative Assessment
				Off-line feedback related to EFPL modification management	Qualitative Assessment

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
		CRT-07.06.02-VALP-713A.1063	The information provided by EFPL (modifications introduced with respect to ICAO FPL) is relevant for the tasks to be performed by all actors.	On-line feedback from all operators related to EFPL Information relevance	Qualitative Assessment
				Off-line feedback from all operators related to EFPL Information relevance	Qualitative Assessment
OBJ-07.06.02-VALP-713A.1070	Feasibility of the mixed mode of operation	CRT-07.06.02-VALP-713A.1071	The HMI supports efficiently the IFPS operators in mixed mode operations.	On-line feedback from IFPS Operators related to mixed mode	Qualitative Assessment
				Off-line feedback from IFPS Operators related to mixed mode	Qualitative Assessment
		CRT-07.06.02-VALP-713A.1072	The workload of IFPS operators is not increased due to mixed mode of operations.	Same as CRT-07.06.02-VALP-713A.1071	
		CRT-07.06.02-VALP-713A.1073	IFPS operators are able to maintain a good situation awareness level in mixed mode of operations.	Same as CRT-07.06.02-VALP-713A.1071	
		CRT-07.06.02-VALP-713A.1074	The error propensity of IFPS operators is not increased due to mixed mode of operations.	Same as CRT-07.06.02-VALP-713A.1071	
		CRT-07.06.02-VALP-713A.1075	ICAO Update messages (Change, Delay and Cancel) are applied correctly in NM Systems when they follow an EFPL message for the same flight.	Application of ICAO update messages on a set of EFPL flights	Verify that all the ICAO update messages are taken into account for the considered EFPL traffic sample
OBJ-07.06.02-VALP-713A.1090	Confidentiality	CRT-07.06.02-VALP-713A.1091	Flight Performance data and ToW are not accessible to other AUs via the CHMI and the NOP Portal.	Confidentiality is considered	Confidentiality check with the Aircraft operators for all NM HMIs (CHMI and Portal)

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
OBJ-07.06.02-VALP-713A.1100	Impact on Flight Plan distribution to ATC	CRT-07.06.02-VALP-713A.1101	No difference or differences explained and accepted by ANSPs are identified between the ATC distribution list based on ICAO FPLs and the ATC distribution list based on EFPLs.	ATC Distribution List	Compare ATC Distribution List between Reference Scenario (ICAO in OPS) and Solution Scenario (EFPL in NMVP)

1092 *Table 26: Metrics for Success criteria assessment method - Flight Planning*

6.2.1.7.2 Metrics linked to "DCB Traffic prediction"

DCB Traffic Prediction was mainly quantitatively measured through the comparison of various 4D trajectories provided by the different systems (FOC systems and NM Systems) in order to assess the benefits (regarding DCB predictions) of EFPL with regards to ICAO flight Plans. The different comparisons are listed in Table 27.

SOL. TRAJECTORY	REF. TRAJECTORY	DELTA WITH REF	ELEMENTS TO BE COMPARED
T_{EFPL}AO4D	Tflown	Delta AO4D	All (see Table 29)
T_{ICAO}DCB	Tflown	Delta DCB Ref	All (see Table 29)
T_{EFPL}DCB_full	Tflown	Delta DCB_full	All (see Table 29)
T_{EFPL}DCB$_{wo}$CDP	Tflown	Delta DCB$_{wo}$CDP	All (see Table 29)
T_{EFPL}DCB$_{wo}$PTR	Tflown	Delta DCB$_{wo}$PTR	All (see Table 29)

Table 27: 4D Trajectory comparisons in Flight Planning

TRAJ. NAME	TRAJ. TYPE	DESCRIPTION
T_{ICAO}DCB	Reference	Trajectory calculated by Enhanced Tactical Flow Management System (ETFMS) taking into account ICAO information only
Tflown	Reference	Trajectory flown
T_{EFPL}AO4D	Solution	Trajectory calculated by the FOC System sent to NMVP
T_{EFPL}DCB_full	Solution	Trajectory calculated by the DCB System (ETFMS) taking into account each element of the EFPL (Default calculation by the ETFMS)
T_{EFPL}DCB$_{wo}$CDP	Solution	Trajectory calculated by the DCB System (ETFMS) without taking into account Climb/Descent Performance data present in the EFPL
T_{EFPL}DCB$_{wo}$PTR	Solution	Trajectory calculated by the DCB System (ETFMS) without taking into account Profile Tuning Restrictions (PTR)

Table 28: Trajectory descriptions in DCB Traffic Prediction

The metrics related to DCB traffic prediction were defined with respect to DCB needs. Two types of analysis were performed (the corresponding metrics are described in Table 29):

- ETFMS Individual Trajectory prediction analysis to study the impact of EFPL on the accuracy of trajectory prediction in ETFMS. Two groups of metrics were used: points profile comparison and sector crossed comparison.

  The analysis was based on the comparison of trajectories calculated by ETFMS for different scenarios. The assessment of the benefits of one trajectory *vs.* another one was done according to the following process:

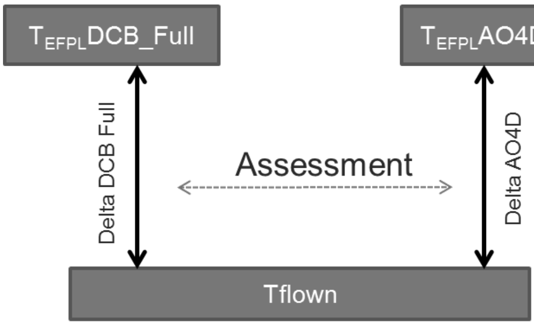


Figure 7: Comparison & assessment method of two 4D trajectories

In the example above, two 4D trajectories are compared: the T_{EFPL}DCB_full (the one calculated by DCB system from an EFPL) with the T_{EFPL}AO4D (the one provided by the AO). Both trajectories are compared individually to the flown trajectory. The gap (or delta) of each one with the flown trajectory is determined and then both gaps are compared and evaluated to determine which one is “closer” to the flown trajectory.

- Traffic/occupancy counts analysis to study the impact of EFPL on traffic and occupancy counts calculated by ETFMS.

Comparison Type		Metrics
Individual Trajectory Prediction Analysis	**Points profile Comparison**	Overall flight Time / Distance
		Flight elapsed Time / Distance per flight phase (Taxing, SID, en-route, STAR)
		Flight elapsed Time / Distance from Take-off to TOC
		Flight elapsed Time / Distance from TOD to arrival
		Entry Time / Level in a sector crossed
		Flight elapsed Time in a sector.
		TOC (Position/ Altitude / Elapsed Time)
		TOD (Position/ Altitude / Elapsed Time)
		Climbing gradient (rate of climb) in the climbing phase
		Descending gradient (rate of descent) in the descending phase
		SID (Name, Exit point)
		STAR (Name, Entry point)
		When common points are identified, compare Levels and Elapsed Times at these points
	Sectors crossed Comparison	Elementary sectors crossed by trajectories
		Entry condition in sectors: ▪ Entry level in a sector crossed ▪ Entry time in a sector crossed
		Number of flight levels crossed in a sector
		Flight elapsed time in a sector
Counts Analysis	**Counts Comparison** (For a few limited fixed horizon time (tbd) and for a very small set of TV (tbd))	Entry counts
		Occupancy counts
		Flights Lists

Table 29: Metrics used for 4D trajectory comparisons

The measurements related to the assessment of the DCB prediction success criteria are listed in the following table.

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
OBJ-07.06.02-VALP-713A.2010	4D calculated Trajectories respective accuracies	CRT-07.06.02-VALP-713A.2011	The use of EFPL data in DCB traffic predictions has no negative impact in general on the following factors: 1) traffic planned to cross TVs, 2) entry times in TVs; 3) occupancy times in TVs and has a positive impact on at least one of them.	·Delta_DCB_Ref= Difference between T_{ICAO}DCB and Tflown ·Delta_DCB_full = Difference between TEFPLDCB_full (obtained from full shadow mode) and Tflown ·Delta_DCBwoCDP = Difference between TEFPLDCBwoCDP (without the climb/descent profile) and Tflown	Compare these Deltas and draw conclusion of the contribution of 4D trajectory and Climb/descent profile elements
		CRT-07.06.02-VALP-713A.2012	Assess the proportion of the traffic for which the AO 4D trajectory (filed trajectory) can be used without modifications with regards ETFMS calculated 4D trajectory.	·Delta_AO4D = Difference between TEFPLAO4D and Tflown ·Delta_DCB_full = Difference between TEFPLDCB_full and Tflown	Compare these Deltas and draw conclusion of the proportion of the traffic for which the AO 4D trajectory (filed trajectory) can be used without modifications
OBJ-07.06.02-VALP-713A.2030	Impact of EFPL late updates on predictability	CRT-07.06.02-VALP-713A.2031	The 4D trajectories, calculated by DCB, taking into account last update information are closer to the flown trajectories.	·Delta_DCB_full = Difference between TEFPLDCB_full and Tflown for a selection of flights, the ones having been updated close to the TOT	Compare this Delta for the overall selection of flights (the ones having been updated close to the TOT) with the same Delta for the overall flights
OBJ-07.06.02-VALP-713A.2040	AO 4D and NM 4D Trajectories accuracies without PTRs	CRT-07.06.02-VALP-713A.2041	With the implementation of EFPL, DCB Prediction is improved both in areas where PTRs are applied and in areas where PTRs are not applied.	·Delta_AO4D = Difference between TEFPLAO4D and Tflown ·Delta_DCBwoPTR = Difference between TEFPLDCBwoPTR (without PTR) and Tflown	Compare these Deltas and draw conclusion on the contribution of PTR vs. the direct use of the AO4D
OBJ-07.06.02-VALP-713A.2050	Consequence s of the global mixed mode on DCB	CRT-07.06.02-VALP-713A.2051	Validation results provide significant information making it possible to assess whether operating with 4D trajectories based on different sources introduces any bias.	·No metric defined, this criterion has not been assessed.	

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
		CRT-07.06.02-VALP-713A.2052	On a selection of TVs, validation results allow to compare the same traffic taking into account ICAO FPL only on the one hand and a mixed of ICAO FPL and EFPL on the other hand. This comparison will be done in terms of Flight Lists, Traffic Counts and Occupancy counts.	·Flight Lists ·Entry Counts ·Occupancy counts	Compare Lists and Counts between Reference Scenario (ICAO in OPS) and Solution Scenario (Mixed mode in NMVP)
OBJ-07.06.02-VALP-713A.2060	Impact on ATFCM / regulated flights	CRT-07.06.02-VALP-713A.2061	The impact of EFPL (compared to ICAO FPL) on the number of flights impacted by regulations is acceptable.	·#flights per regulation	Compare Counts between Reference Scenario (ICAO in OPS) and Solution Scenario (EFPL in NMVP)
		CRT-07.06.02-VALP-713A.2062	The impact of EFPL (compared to ICAO FPL) on delays is acceptable.	·Delays	Compare Delays between Reference Scenario (ICAO in OPS) and Solution Scenario (EFPL in NMVP)
OBJ-07.06.02-VALP-713A.2070	Impact on the reliability of the 4D Trajectory recalculation	CRT-07.06.02-VALP-713A.2071	Validation results provide significant qualitative information on a difference of reliability between these two calculated 4D Trajectories.	·No specific metric as this objective was integrated in OBJ-07.06.02-VALP-713A.2010	

Table 30: Metrics for Success criteria assessment method - DCB Traffic prediction

6.2.1.7.3 Metrics linked to "FIXM Implementation"

Due to the reduced scope of EXE-07.06.02-VP-713 Part-B (see detailed explanation in Section 6.2.2.3), the measurement related to Part-B success criteria was reduced as listed in the following table.

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
OBJ-07.06.02-VALP-713B.1020	FIXM Implementation feasibility	CRT-07.06.02-VALP-713B.1021	The use of FIXM EFPL extension operates successfully.	The FIXM EFPL services give the same result as EFPL services	Compare B2B replies of EFPL and FIXM EFPL service interfaces
		CRT-07.06.02-VALP-713B.1022	The different types of trajectory exchanged and defined in the FIXM extension are agreed between NM and CFSPs.	The trajectory types are defined in the FIXM extension and implemented in the FOC and NM prototypes	Review and definition of the FIXM EFPL extension is finished and the exercise is run.

Table 31: Metrics for Success criteria assessment method - Constraint Integration

6.2.1.7.4 Metrics linked to "NOP"

The measurement related to the assessment of "NOP" success criteria are listed in the following table (refer to "07.06.01 – D47 - Step 1 Validation Plan 2015" document (see [25]) for detailed description).

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
OBJ-07.06.01-VALP-GEN1.0100	Assess that any change in stakeholders operational	CRT-07.06.01-VALP-GEN1.0103	The Network Manager is able to capture EFPL 4D trajectory information originated by AU and update the NOP accordingly.	MGef1/1061: Number of EFPL messages and updates	Refer to Doc [25])

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
	plans can be transmitted to the NOP and the Network Plan can be updated accordingly.	CRT-07.06.01-VALP-GEN1.0104	The NOP has been successfully updated when operating in global mix mode; i.e.; EFPLs and ICAO update messages	MGef2/1071: On-line feedback from IFPS operators related to mixed mode: EFPL+ ICAO FPL MGef3/1072: Application of ICAO update messages on a set of EFPL messages	Refer to Doc [25])
OBJ-07.06.01-VALP-GEN1.0200	Assess that all partners involved in operations can have easy access to any NOP update with potential impact on their operations.	CRT-07.06.01-VALP-GEN1.0203	NOP publishes the necessary data and updates for the AU to build their 4D trajectory (for example publication of PTRs and RAD)	MGef4:Positive feedback from operational users on the published data to build their 4D trajectories	Refer to Doc [25])
		CRT-07.06.01-VALP-GEN1.0204	The NOP supports the Mixed mode of operations by publishing (via SWIM-B2B and or in the situation display) AO 4D trajectories (filed trajectories), ICAO flight plans and derived NM calculated trajectories.	MGef5: Positive feedback from the NM on the support of the NOP to Mixed mode of operations	Refer to Doc [25])
		CRT-07.06.01-VALP-GEN1.0205	NOP provides confidentiality of commercially sensitive data (Flight Performance data and ToW).	MGef6/1091: Positive feedback from Aircraft operators for updated information on NM HMIs (CHMI Portal)	Refer to Doc [25])
OBJ-07.06.01-VALP-EFPL.0100	Assess that EFPL 4D trajectory information	CRT-07.06.01-VALP-EFPL.0101	Assess the level of contribution to traffic predictability of each element of the EFPL.	Mef2/2011: Compare TEFPLDCBwoTOW with Tflown Mef3/2011: Compare TEFPLDCBwoCDP with Tflown	Refer to Doc [25])

Validation Objective ID	Validation Objective	Success Criterion ID	Success Criterion	Metrics / Indicators	Assessment Method
	contributes to the elaboration of the Network Operation Plan with improved network predictability.	CRT-07.06.01-VALP-EFPL.0102	The 4D trajectories, calculated by DCB, taking into account last update information are closer to the flown trajectories.	Mef1/2031 Compare T_{EFPL}DCB_full with Tflown	Refer to Doc [25])
OBJ-07.06.01-VALP-EFPL.0200	Assess that EFPL 4D trajectory information contributes to the elaboration of the Network Operation Plan with improved DCB assessment/predictions	CRT-07.06.01-VALP-EFPL.0201	The NOP has received 4D trajectory information from an EFPL, which has been used to better assess traffic demand (with entry traffic counts, Occupancy counts and Flight Lists) supporting the Network Manager in the enhancement of DCB assessment.	Mef4/2052: Entry/Occupancy counts in ICAO FPL= Entry/Occupancy counts in Mixed mode	Refer to Doc [25])
		CRT-07.06.01-VALP-EFPL.0202	The impact of EFPL (compared to ICAO FPL) on delays is acceptable or delays are reduced.	Mef5/2062: Number of flights that EFPL Delays and ICAO FPL Delays are different	Refer to Doc [25])
		CRT-07.06.01-VALP-EFPL.0203	The impact of EFPL (compared to ICAO FPL) on the number of flights impacted by regulations is acceptable.	Mef6/2061:Number of EFPL Flights versus number of FPL flights impacted by regulations	Refer to Doc [25])

Table 32: Metrics for Success criteria assessment method - NOP

6.2.1.8 Summary of Validation Scenarios

VP-713 Validation scenarios are listed in Section 2.2.4 (Table 15). Further explanations are given here after.

6.2.1.8.1 Part-A – Gaming Sessions

The validation scenarios assessed in the gaming session were identical for Lufthansa Systems and Sabre. The following scenarios have been used for the assessment.

Reference scenario

In the reference scenario, all flight plans were only filed in the ICAO FPL format to the NMVP. The participating dispatchers had to initiate actions for rejects that were returned by the NMVP. The purpose of this reference scenario was the assessment of the workload and work complexity related to ICAO FPL rejections. For this scenario all aeronautical information related to AIRAC 10 2015 was relevant. As the focus was on the handling of flight plan rejects, the trajectories filed have been created in a way that they intentionally offend against certain restrictions.

Solution scenario

In the solution scenario, the same trajectories as in the reference scenario have been filed. This time the flight plan filing was done using the EFPL format. Those EFPL messages were sent to the NMVP. The purpose was to show differences in the replies (compared to the reference scenario) as well as the assessment of workload and work complexity related to the EFPL rejections. The trajectories that were used for filing have been created in the same way as for the reference scenario as well as under consideration of AIRAC 10 2015.

6.2.1.8.2 Part-A – Shadow Mode

The validation scenarios assessed in the shadow mode session were identical for Lufthansa Systems and Sabre. The following scenarios have been used for the assessment.

Baseline scenario

In the baseline scenario (SCN-07.06.02-VALP-713A.0000), all flight plans were only filed in the ICAO FPL format to the NM OPS platform. The flight dispatchers of the respective airlines only worked on this type of flight plan, with the target to get an IFPS acceptance.

Reference scenario

As some differences were observed between the operational environment and the NMVP in terms of environment data mainly, ICAO 2012 FPLs were processed on the NMVP Platform in order to build a reference scenario (SCN-07.06.02-VALP-713A.0002) in the same environment as the solutions scenarios and make things comparable.

Solution scenarios

Four different solution scenarios were built.

In the first solution scenario (SCN-07.06.02-VALP-713A.0010), the flight planning system has sent EFPL messages to the NMVP whenever an ICAO FPL was send by the airlines' flight dispatcher to the NM OPS platform. The solution scenario was only a background scenario that was not directly influenced by the flight dispatchers. That means all EFPL filings and EFPL updates were driven by ICAO FPL filings and updates as done by the flight dispatchers.

In addition to this full EFPL solution scenario, three additional scenarios were required:

- One to specifically assess the specific contribution of the climb and descent performance data provided in the EFPL with the AO4D (SCN-07.06.02-VALP-713A.0020);
- One to assess the specific contribution of NM when taking into account of the PTR with regard to a solution when the PTR are not taken into account (SCN-07.06.02-VALP-713A.0040);
- One to assess a mixed mode of operation where both the ICAO 2012 FPL and the EFPL are provided to the NM (SCN-07.06.02-VALP-713A.0050).

6.2.1.8.3 Part-B FIXM Analytical Modelling

Lufthansa Systems only participated to this Part-B session at CFSP side. The following scenarios have been used for the assessment.

Reference scenario

In the reference scenario, the flight planning system provided the EFPL information in the NM EFPL XML format. These messages correspond to the EFPL messages used in the other trial runs of EXE-07.06.02-VP-713.

Solution scenario

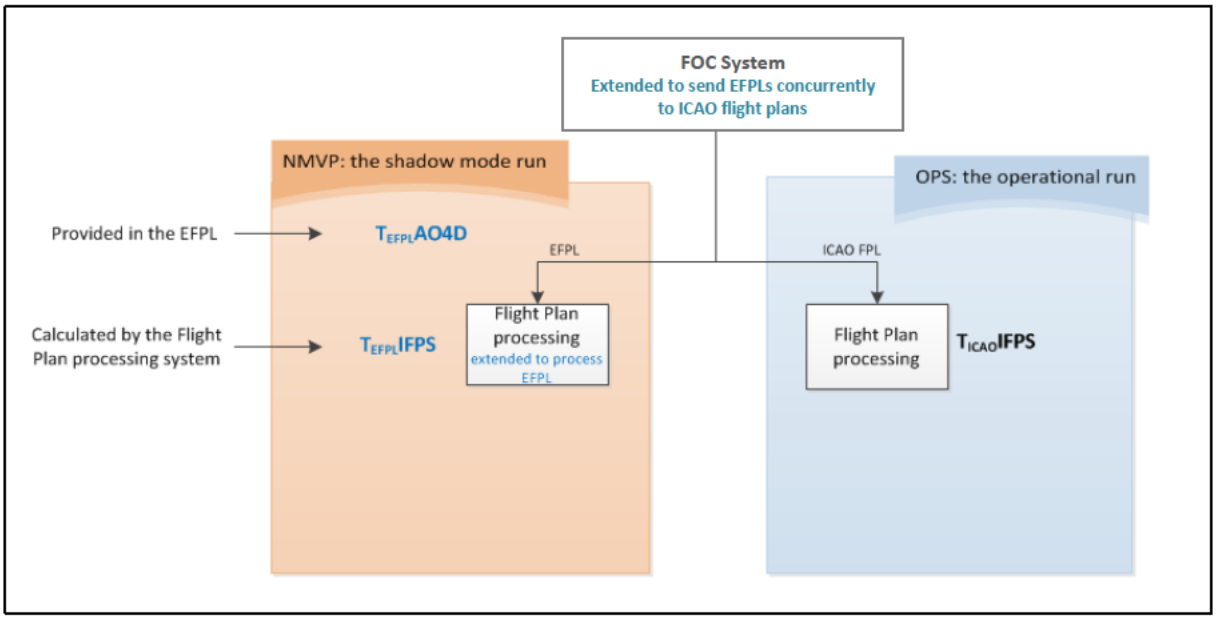
In the solution scenario, the flight planning system provided EFPL information in the FIXM EFPL format. These messages were send in parallel to the NM EFPL XML format messages to allow a direct comparison of both types of flight plan messages and the associated replies from NMVP.

6.2.1.9 Summary of Assumptions

The Assumptions for this exercise are not detailed here. Please, refer to Table 17 presented in section 2.2.5.

6.2.1.10 Choice of methods and techniques

6.2.1.10.1 Methods and Techniques for “Flight Planning” Metrics



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1217 *Table 33: Data collection technique Schema for "Flight Planning" metrics*
1218

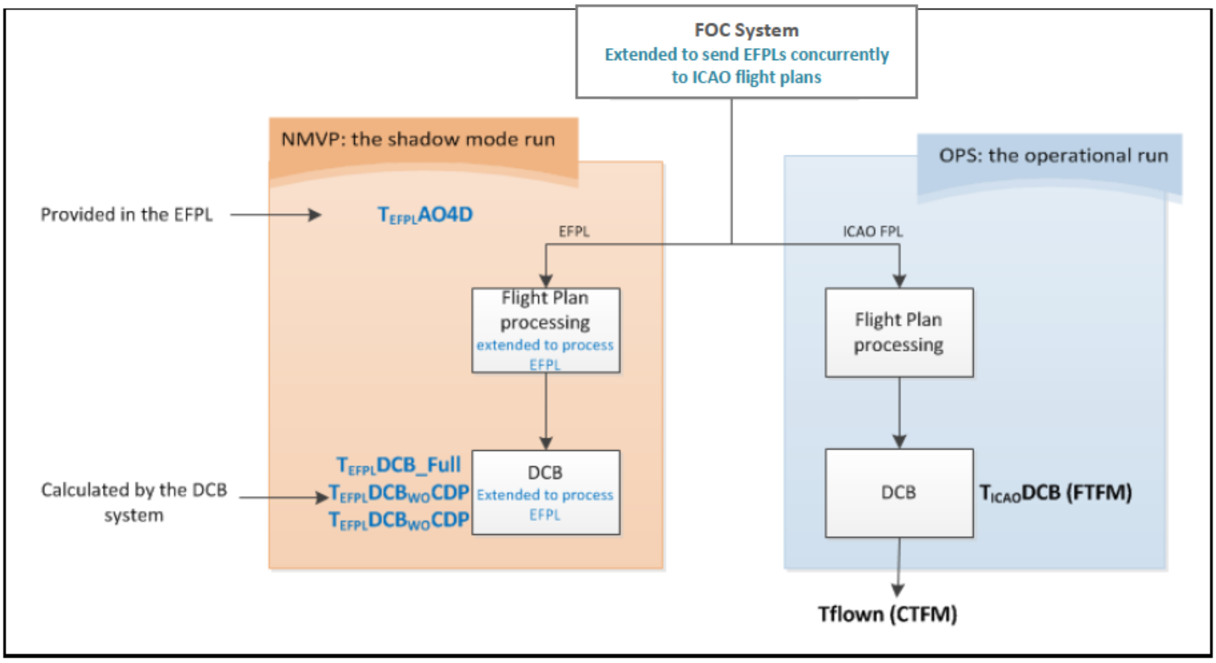
SUCCESS CRITERION ID	METRICS / INDICATORS	PLATFORM / TOOL	DATA COLLECTION METHOD
CRT-07.06.02-VALP-713A.1011	FPL Acceptance/Rejection Rates	NMVP / FOC System	Counts from Shadow Mode
	#FPL messages where EFPL has been accepted and ICAO FPL rejected	NMVP / FOC System	Counts from Shadow Mode
	Accepted EFPLs while ICAO has been rejected are judged as valid by IFPS Operators experts.	NMVP / FOC System	Expert Judgment from Shadow Mode Logs
CRT-07.06.02-VALP-713A.1012	• #FPL messages where EFPL has been rejected and ICAO FPL accepted	NMVP / FOC System	Counts from Shadow Mode Logs
	• Rejected EFPLs while ICAO have been accepted are judged as valid by IFPS Operators experts	NMVP / FOC System	Expert Judgment from Shadow Mode Logs
CRT-07.06.02-VALP-713A.1013	• Delta_IFPS_Ref = Difference between TICAOIFPS (IFPS Accepted trajectory in Ops) and TEFPLAO4D (AO4D Trajectory) • Delta_IFPS = Difference between TEFPLIFPS (IFPS Accepted trajectory from NMVP) and TEFPLAO4D (AO4D Trajectory)	NMVP / FOC System	Counts from Shadow Mode Logs
CRT-07.06.02-VALP-	• On-line feedback from AO related to workload	NMVP / FOC System	Expert Judgment from Gaming

Success Criterion ID	Metrics / Indicators	Platform / Tool	Data Collection Method
713A.1021	• Off-line feedback from AO related to workload	NMVP / FOC System	Expert Judgment and Questionnaire from Gaming
CRT-07.06.02-VALP-713A.1022	Same as CRT-07.06.02-VALP-713A.1021		
CRT-07.06.02-VALP-713A.1023	Same as CRT-07.06.02-VALP-713A.1021		
CRT-07.06.02-VALP-713A.1024	Same as CRT-07.06.02-VALP-713A.1021		
CRT-07.06.02-VALP-713A.1025	Same as CRT-07.06.02-VALP-713A.1021		
CRT-07.06.02-VALP-713A.1026	Same as CRT-07.06.02-VALP-713A.1021		
CRT-07.06.02-VALP-713A.1031	• On-line feedback from IFPS Operators related to workload	NMVP / FOC System	Expert Judgment from Gaming and Shadow Mode
	• Off-line feedback from IFPS Operators related to workload	NMVP / FOC System	Expert Judgment and Questionnaire from Gaming and Shadow Mode
	• #EFPL messages handled by IFPS Operators	NMVP / FOC System	Counts from Shadow Mode Logs
CRT-07.06.02-VALP-713A.1032	• On-line feedback from IFPS Operators related to workload	NMVP / FOC System	Expert Judgment from Gaming and Shadow Mode
	• Off-line feedback from IFPS Operators related to workload	NMVP / FOC System	Expert Judgment and Questionnaire from Gaming and Shadow Mode
CRT-07.06.02-VALP-713A.1033	Same as CRT-07.06.02-VALP-713A.1032		
CRT-07.06.02-VALP-713A.1034	Same as CRT-07.06.02-VALP-713A.1032		
CRT-07.06.02-VALP-713A.1035	Same as CRT-07.06.02-VALP-713A.1032		
CRT-07.06.02-VALP-713A.1036	Same as CRT-07.06.02-VALP-713A.1032		
CRT-07.06.02-VALP-713A.1061	• #EFPL messages (for Delay, Change and Cancel)	NMVP / FOC System	Counts from Shadow Mode Logs
CRT-07.06.02-VALP-	• On-line feedback related to EFPL modification management	NMVP / FOC System	Expert Judgment from Gaming and Shadow Mode

Success Criterion ID	Metrics / Indicators	Platform / Tool	Data Collection Method
713A.1062	▪ Off-line feedback related to EFPL modification management	NMVP / FOC System	Expert Judgment and Questionnaire from Gaming and Shadow Mode
CRT-07.06.02-VALP-713A.1063	▪ On-line feedback from all operators related to EFPL Information relevance	NMVP / FOC System	Expert Judgment from Gaming and Shadow Mode
	▪ Off-line feedback from all operators related to EFPL Information relevance	NMVP / FOC System	Expert Judgment and Questionnaire from Gaming and Shadow Mode
CRT-07.06.02-VALP-713A.1071	▪ On-line feedback from IFPS Operators related to mixed mode	NMVP / FOC System	Expert Judgment from Gaming
	▪ Off-line feedback from IFPS Operators related to mixed mode	NMVP / FOC System	Expert Judgment and Questionnaire from Gaming and Shadow Mode
CRT-07.06.02-VALP-713A.1072	Same as CRT-07.06.02-VALP-713A.1071		
CRT-07.06.02-VALP-713A.1073	Same as CRT-07.06.02-VALP-713A.1071		
CRT-07.06.02-VALP-713A.1074	Same as CRT-07.06.02-VALP-713A.1071		
CRT-07.06.02-VALP-713A.1075	▪ Application of ICAO update messages on a set of EFPL flights	NMVP / FOC System	Verification from Shadow Mode
CRT-07.06.02-VALP-713A.1091	▪ Confidentiality is considered	NMVP / FOC System	Verification from gaming and Shadow Mode
CRT-07.06.02-VALP-713A.1101	▪ ATC Distribution List	NMVP / FOC System	Lists from Shadow Mode Logs

Table 34: Data collection method for "Flight Planning" metrics

1222 ### 6.2.1.10.2 Methods and Techniques for "DCB Traffic Prediction" Metrics



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1224 *Table 35: Data collection technique Schema for "DCB Traffic prediction" metrics*

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Success Criterion ID	Metrics / Indicators	Platform / Tool	Data Collection Method
CRT-07.06.02-VALP-713A.2011	• Delta_DCB_full = Difference between TEFPLDCB_full (obtained from full shadow mode) and Tflown • Delta_DCBwoCDP = Difference between TEFPLDCBwoCDP (without the climb/descent profile) and Tflown	NMVP / FOC System	Counts from Shadow Mode Logs & Replay Logs
CRT-07.06.02-VALP-713A.2012	• Delta_AO4D = Difference between TEFPLAO4D and Tflown • Delta_DCB_full = Difference between TEFPLDCB_full and Tflown	NMVP / FOC System	Counts from Shadow Mode Logs & Replay Logs
CRT-07.06.02-VALP-713A.2031	• Delta_DCB_full = Difference between TEFPLDCB_full and Tflown for a selection of flights, the ones having been updated close to the TOT	NMVP / FOC System	Counts from Shadow Mode Logs
CRT-07.06.02-VALP-713A.2041	• Delta_AO4D = Difference between TEFPLAO4D and Tflown • Delta_DCBwoPTR = Difference between TEFPLDCBwoCDP (without the climb/descent profile) and Tflown	NMVP / FOC System	Counts from Shadow Mode Logs & Replay Logs

Success Criterion ID	Metrics / Indicators	Platform / Tool	Data Collection Method
CRT-07.06.02-VALP-713A.2051	• No metric defined, this criterion has not been assessed.		
CRT-07.06.02-VALP-713A.2052	• Flight Lists • Entry Counts • Occupancy counts	NMVP / FOC System + RNEST	Lists and Counts in RNEST from Shadow Mode Logs & Replay Logs
CRT-07.06.02-VALP-713A.2061	• #flights per regulation	NMVP / FOC System + RNEST	Counts in RNEST from Shadow Mode Logs & Replay Logs
CRT-07.06.02-VALP-713A.2062	• Delays	NMVP / FOC System + RNEST	Counts in RNEST from Shadow Mode Logs & Replay Logs
CRT-07.06.02-VALP-713A.2071	• No specific metric as this objective was integrated in OBJ-07.06.02-VALP-713A.2010		

Table 36: Data collection method for "DCB Traffic prediction" metrics

6.2.1.10.3 Methods and Techniques for "FIXM Integration" Metrics

Success Criterion ID	Metrics / Indicators	Platform / Tool	Data Collection Method
CRT-07.06.02-VALP-713B.1021	The FIXM EFPL services give the same result as EFPL services	NMVP	Logs captured for each request are saved, processing results between non-FIXM and FIXM requests are compared.
CRT-07.06.02-VALP-713B.1022	The trajectory types are defined in the FIXM extension and implemented in the FOC and NM prototypes	NMVP, FOC prototype	The 4D trajectory from AU and NM are compared between FIXM and non-FIXM requests and replies.

Table 37: Data collection method for "FIXM Implementation" metrics

6.2.1.10.4 Methods and Techniques for “NOP” Metrics

The methods and Techniques used to collect “NOP” metrics are described the “07.06.01 – D47 - Step 1 Validation Plan 2015” document (Refer to Doc [25]).

Success Criterion ID	Metrics / Indicators	Platform / Tool	Data Collection Method
CRT-07.06.01-VALP-GEN1.0103	MGef1/1061: Number of EFPL messages and updates	Refer to Doc [25]	
CRT-07.06.01-VALP-GEN1.0104	MGef2/1071: On-line feedback from IFPS operators related to mixed mode: EFPL+ ICAO FPL MGef3/1072: Application of ICAO update messages on a set of EFPL messages	Refer to Doc [25]	
CRT-07.06.01-VALP-GEN1.0203	MGef4:Positive feedback from operational users on the published data to build their 4D trajectories	Refer to Doc [25]	
CRT-07.06.01-VALP-GEN1.0204	MGef5: Positive feedback from the NM on the support of the NOP to Mixed mode of operations	Refer to Doc [25]	
CRT-07.06.01-VALP-GEN1.0205	MGef6/1091: Positive feedback from Aircraft operators for updated information on NM HMIs (CHMI Portal)	Refer to Doc [25]	
CRT-07.06.01-VALP-EFPL.0101	Mef2/2011: Compare TEFPLDCBwoTOW with Tflown Mef3/2011: Compare TEFPLDCBwoCDP with Tflown	Refer to Doc [25]	
CRT-07.06.01-VALP-EFPL.0102	Mef1/2031 Compare T_{EFPL}DCB_full with Tflown	Refer to Doc [25]	
CRT-07.06.01-VALP-EFPL.0201	Mef4/2052: Entry/Occupancy counts in ICAO FPL= Entry/Occupancy counts in Mixed mode	Refer to Doc [25]	
CRT-07.06.01-VALP-EFPL.0202	Mef5/2062: Number of flights that EFPL Delays and ICAO FPL Delays are different	Refer to Doc [25]	
CRT-07.06.01-VALP-EFPL.0203	Mef6/2061:Number of EFPL Flights versus number of FPL flights impacted by regulations	Refer to Doc [25]	

Table 38: Data collection method for "NOP" metrics

6.2.2 Conduct of Validation Exercise

The table below (Table 39) summarizes the different sessions performed in the context of EXE-07.06.02-VP-713 validation exercise.

EXERCISE ID	EXERCISE TITLE	ACTUAL EXERCISE EXECUTION START DATE	ACTUAL EXERCISE EXECUTION END DATE
EXE-07.06.02-VP-713-Part-A – Gaming	Extended flight plan exchange in operations – gaming session.	21/09/2015	25/09/2015
EXE-07.06.02-VP-713- Part-A – Shadow 1	Extended flight plan exchange in operations – shadow mode session (1^{st} trial).	26/01/2016	30/01/2016
EXE-07.06.02-VP-713- Part-A – Shadow 2	Extended flight plan exchange in operations – shadow mode session (2^{nd} trial).	23/03/2016	24/03/2016
EXE-07.06.02-VP-713- Part-B	Extended flight plan exchange in the FIXM EFPL.	11/01/2016	19/01/2016

Table 39: Summary of validation exercise conduction dates

6.2.2.1 Exercise Preparation

As EXE-07.06.02-VP-713 was organized in different types of session with different approaches and technics, different preparation activities were performed as described in the following paragraphs.

6.2.2.1.1 Part-A - Gaming Sessions

For the gaming session, the CFSP systems prototypes (installed and operated by the CFSPs themselves) were connected to the NMVP, through B2B services as shown in the figure below. Test flights, in ICAO and in EFPL format, were submitted from the CFSP systems to the NMVP.

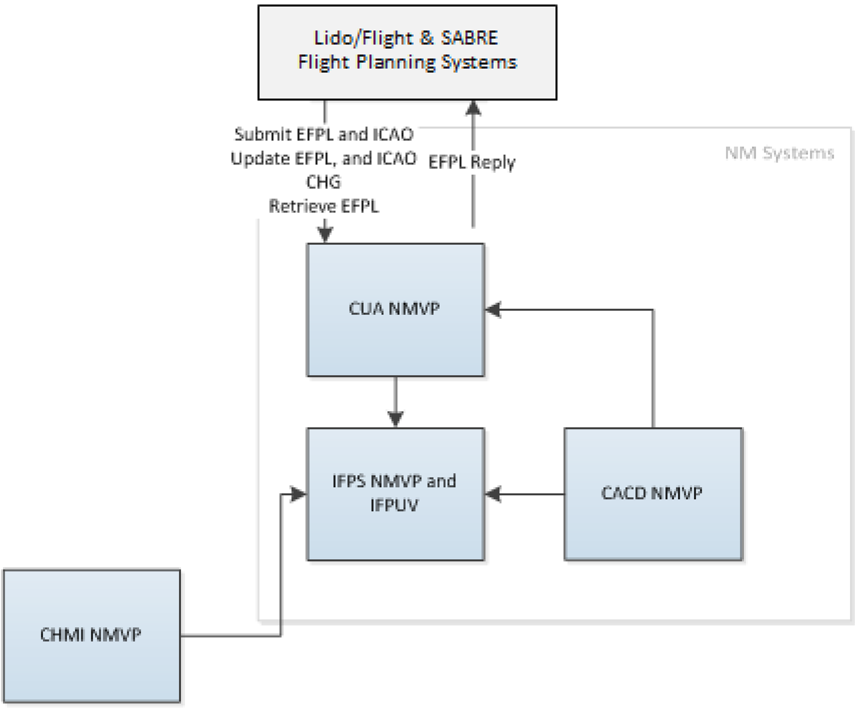


Figure 8: the gaming session: NMVP sub-systems

The following activities were completed prior to the commencement of the exercise (between June 2015 to September 2015):

- Platform Installation, configuration and acceptance;
- Scenario preparation;
- Dry runs;
- Data log saving and metric production tools development;
- Questionnaires and observer logs preparation;
- Installation of trial positions at each site:
  - Preparation of a room dedicated to the exercise to host AU flight dispatchers (in Frankfurt for Lufthansa Systems and in Vienna for Sabre) equipped with flight planning trial positions;
  - Preparation of trial positions equipped with CHMI tool for IFPS operators In Brussels EUROCONTROL.

6.2.2.1.2 Part-A - Shadow Mode

The shadow mode session used the Network Manager Validation Platform configured in a way that the Environment data are the same in OPS and in the shadow mode systems. The environment data was continuously fed from the OPS to the NMVP. In a shadow mode, no feedback loop from the NMVP to the OPS was implemented to avoid interference with real flight planning operations.

All submission of EFPL to the NMVP was done through B2B services. The CUA component (CFMU User Access) dealt with the B2B requests management and all authorization/authentication process. The Update & change messages on an EFPL was also done through the corresponding B2B services.

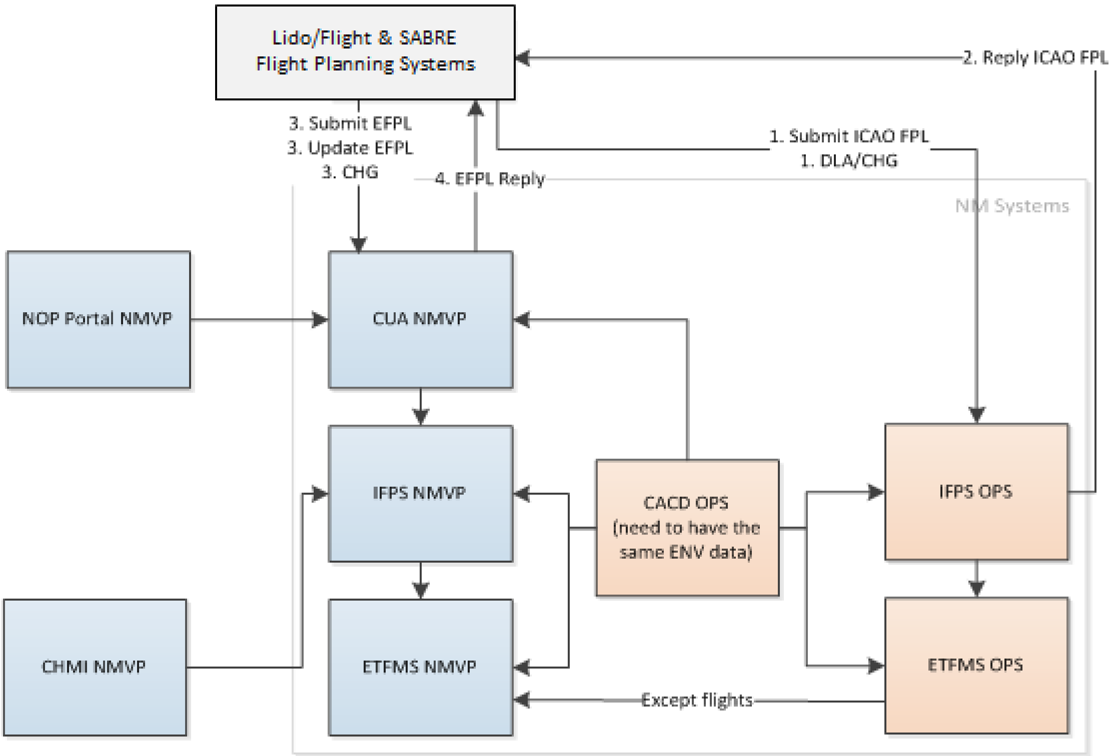


Figure 9: the shadow mode session: NMVP sub-systems and OPS sub-systems

The following activities were completed prior to the commencement of the exercise (from October 2015 to January 2016):

- Platform Installation, configuration and acceptance:
  - Installation and setup of the FOC flight planning system to enable the EFPL filing for each participating airspace user;
  - Installation and setup of the NMVP;
- Dry runs
  - Dry run with some airspace user;
- Data log saving and metric production tools development.
- Preparation of replay sessions as described below.

The replay modes

The replay modes used the capability of the NMVP and the OPS NM system to log information, especially the EFPL and the ICAO FPL as soon as they are submitted through B2B services. The CUA sub-system, among all its features, acts as the entry point for the B2B services and ensures the Log of this early information set.

From this information set, EFPL and ICAO FPL were pre-processed in order to build a new set of data to be injected into the NMVP replay tool.

In the NMVP replay mode, there is a feature to emulate the FPL filing, the input of which is the results of any processing we may have performed earlier. The figure below illustrates this process for a specific post-processing that is the mixed mode of operation.

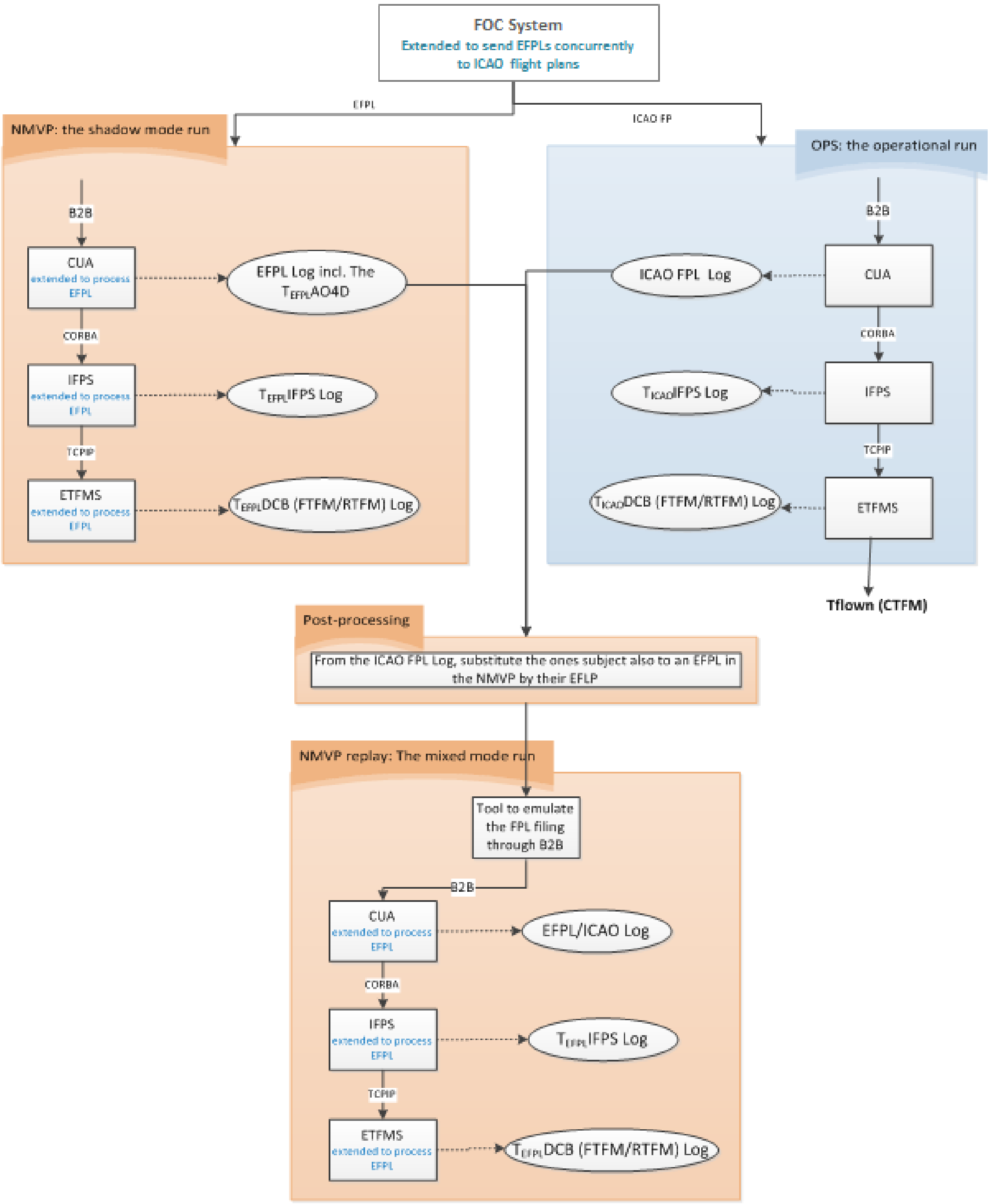


Figure 10: the replay mode: NMVP sub-systems

6.2.2.1.3 Part-B - FIXM Analytical Modelling

The main preparatory activities were:

- Development
  - Data model and format definition
  - Definition of FIXM EFPL Validation, Creation and Retrieve service interfaces.
  - Development of NM prototype implementing the defined service interfaces.
  - Development of Lido/Flight system using the defined service interfaces.
- Platform Installation
  - Set-up of the FIXM EFPL prototype on NMVP
  - Set-up of the FIXM EFPL client prototype on the Lido/Flight prototype platform.
- Scenario preparation
  - Definition of a flight list to be calculated by Lido/Flight during the trial.
  - Development of the agreed Verification Plan
- Dry runs
  - Common dry run between EUROCONTROL (NMVP) and Lufthansa Systems (Lido/Flight).

6.2.2.2 Exercise execution

6.2.2.2.1 Part-A - Gaming Sessions

6.2.2.2.1.1 Trial runs

This part of the validation exercise was performed between the 21st and the 25th of September 2015. During this week, several validation trial sessions were performed involving different airspace users (airlines) in every trial session. The trials were performed at three locations. The first location was the EUROCONTROL Headquarter in Brussels where IFPS staff members were working with the NMVP. The other two locations were the premises of Lufthansa Systems (in Frankfurt) on the one hand and of Sabre (In Vienna) on the other hand. These two locations were hosting the gaming sessions for the particular airspace users. To better support the participating airspace users the number of participants was reduced to maximum three airlines a day per site, while every airspace user was allowed to send up to two flight dispatchers to join the respective trial run. This approach allowed to better utilize the time window that was agreed for this part of the validation exercise. The airspace users that joined the validation exercise were:

- At Lufthansa Systems premises:
  - Seven customers: Air France, Condor/TC, EasyJet, El Al, Germanwings, Lufthansa, TAP.
  - Two further airlines (Hop and Novair) joined this gaming session although they are not Lufthansa Systems customers and hence not familiar with the Lido/Flight flight planning system.
- At SABRE premises
  - Two customers: Austrian Airlines and Turkish Airlines.

The validation exercise was supported by SESAR colleagues working for the innovate consortium, who were responsible for the human performance assessment during the trial. They were present at each site to assess human factors for both AU dispatchers and IFPS operators. Observers from P07.06.02 or WP11.01 were also joining the gaming session to get in contact with the "end user of the EFPL concept". Table 40 gives an overview about the scheduled trial days and the participating partners.

Location	Monday 21/09	Tuesday 22/09	Wednesday 23/09	Thursday 24/09	Friday 25/09
Lufthansa System Premises (Frankfurt)	Lufthansa Easyjet EL AL Innovate		Condor/TC Germanwings Novair[5] Innovate P07.06.02	TAP Air France P07.06.02	HOP[8]
Sabre Premises (Vienna)		Turkish Airline			Austrian Airline Innovate
NM Premises (Brussels)	IFPS Op. Innovate P07.06.02	IFPS Op. Innovate P07.06.02	IFPS Op. P07.06.02 WP11.01	IFPS Op. P07.06.02	IFPS Op. P07.06.02

AU Dispatchers
IFSP Operators from NM
Human Performance Experts
Observers

Table 40: Schedule of EXE-07.06.02-VP-713 Part-A - Gaming Sessions

6.2.2.2.1.2 Systems under test

For this part of the validation exercise, Lido/Flight system and Sabre system were used at CFSP sight and connected to the NMVP via the internet using the dedicated B2B web services provided by EUROCONTROL.

6.2.2.2.1.3 Flight Samples

At Lufthansa Systems side

Before the validation exercise was started, all participating airlines (at LSY side) as well as EUROCONTROL IFPS operators were invited to provide cases from daily work which often lead to problems during the filing process. After reception of these cases they were analysed on Lufthansa Systems side to ensure that they lead to meaningful results in the validation exercise. The criteria to filter those scenarios were:

- It is possible to reproduce the reported issue on a daily basis,
- The provided issue relates to flight plan inconsistencies as addressed by the exercise,
- The provided issue helps to raise the awareness of the limitations related to both concepts, the ICAO FPL filing on the one hand; and the EFPL filing on the other hand.

After the review of the reported issues, a sample was created that allowed to show the impact of the two flight plan formats in regard to:

- Rejects related to ETOs; and
- Rejects related to vertical profiles.

[8] Airline which is neither Lufthansa Systems customer nor SABRE customer

As a morning session and an afternoon session was planned two flight lists had to be prepared. The differences between the two flight lists were:

- The call signs used, to avoid rejects caused by duplicates; and
- The estimated off block times, to avoid – where required – rejects related to a too late filing of the flights plans.

In all cases the trajectories have been predefined and stored to the Lido/Flight system used for this exercise to avoid that the results differ from one trial day to another.

At SABRE side

Before commencing the gaming session, the EFPL concept and implementation has been explained in detail. After that every participant was asked to come up with a list of flights he/she wanted to work on. This list was separated into two groups of flights.

The first group of flights should cover a quantitative aspect of the exercise, meaning the participants were asked to prepare a number of routine flights. The flight preparation included the manual creation of the flight, the adjustment of flight parameters (ZFW, Aircraft…) an optimization of the trajectory and finally a filing to the NMVP. The immediate response from the NMVP was shown to the participant and the result was discussed.

The second group of flights aimed to cover problematic flights. Problematic in the sense of dispatchers frequently facing problems getting a correct trajectory accepted in the flight plan. The idea behind planning such flights was to validate whether the concept reduces workload and increases the situational awareness.

6.2.2.2.2 Part-A - Shadow Mode

6.2.2.2.2.1 Trial runs

This part of the validation exercise had the purpose to validate the EFPL concept as close as possible to real flight operations. Therefore, the flight planning systems of participating airlines had to be enabled to file the EFPL in the background and in parallel to the ICAO FPL. The parallel EFPL flight plan provision to NMVP was completely done in background, meaning that the flight dispatchers still worked on the basis of ICAO flight plan validity replies. This required that all participating airlines had to use the latest version of the respective flight planning system. To achieve that as much as possible airlines could join the validation exercise two time windows were defined for this part of the validation exercise:

- The first trial run was performed in the time between the 25th and 30th of January 2016;
- And, the second trial was performed in the time between the 23rd and 24th of March 2016.

This allowed a quite big number of airlines to participate in this validation exercise. All participating airlines are using Lufthansa Systems' Lido/Flight flight planning system. Table 41 provides an overview about the trial runs that have been conducted as EFPL shadow mode exercises and the airlines that have participated in these validation exercise trial runs.

CFSPs	Session 1 (25th to 30th of January 2016)	Session 2 (23rd and 24th of March 2016)
Lufthansa Systems	**Thomas Cook group** Condor / TC (CFG) Thomas Cook Airlines Belgium (TCW) Thomas Cook Airlines UK (TCX) Thomas Cook Airlines Scandinavia (WKG)	**TAP Portugal (TAP)**
	Lufthansa group Air Dolomiti (DLA) Lufthansa (DLH) Lufthansa Cargo (GEC) Lufthansa CityLine (CLH)	
	EasyJet group EasyJet Switzerland (EZS) EasyJet (EZY)	

Table 41: Airlines involved in EXE-07.06.02-VP-713 Part-A Shadow mode

6.2.2.2.2.2 Systems under test

The shadow mode trial runs have been conducted from the FOC environments that are operationally used by the participating airlines. These environments have been upgraded and configured prior to the validation exercise to be able to use the "Extended Flight Plan Creation" request of the FlightFiling service as it was available on the NMVP that was operated with NM release 19.5 during the two trial runs.

All FOC systems used in these trial runs were completely operational systems. The EFPL message transition functionalities have been fully integrated into the respective operational Flight planning system versions as background functionalities

The ICAO flight plans as well as the EFPLs were generated on the basis of the same 4D trajectory that is calculated by the FOC System. These messages did not only include initial flight plan filings for a given flight but actually included update and cancellation messages. As the flight dispatcher only worked on the ICAO flight plan, only a reject of the ICAO flight plan led to any action of the dispatcher to resolve the issue.

The ICAO flight plans were sent to EUROCONTROL's NM OPS platform via AFTN, while the EFPLs were sent to EUROCONTROL's NMVP via the internet using web services developed and published with the NM release version NM19.5.

Further information on Lido/Flight EFPL Systems can be found in document [27].

6.2.2.2.2.3 Flight Samples

The shadow mode trials were planned to be as close as possible to daily flight operations. Therefore, the operational flight planning systems of the airlines listed in Table 41 have been upgraded and configured to send out an EFPL message to the NMVP whenever an ICAO flight plan is provided to the NM OPS platform. As a consequence the flight sample considered during the shadow mode trial runs are the flights that were planned[9] by the participating airlines during the two trial runs.

All participating airlines planned the trajectories for every flight to get an acceptance of the ICAO FPL. None of the flight dispatchers had direct access to the EFPL validation results returned by NMVP. Figure 11 shows the number of EFPL submission (updates and cancels are in further sections) messages received for each of the days. As the setup of the respective airspace user environments was done in a step-wise approach the number of flight was very low on the 25th and 26th of January. Therefore, only recorded data from the 27th to the 30th of January for the first session and the 23rd to 24th of March for the second session have been analysed.

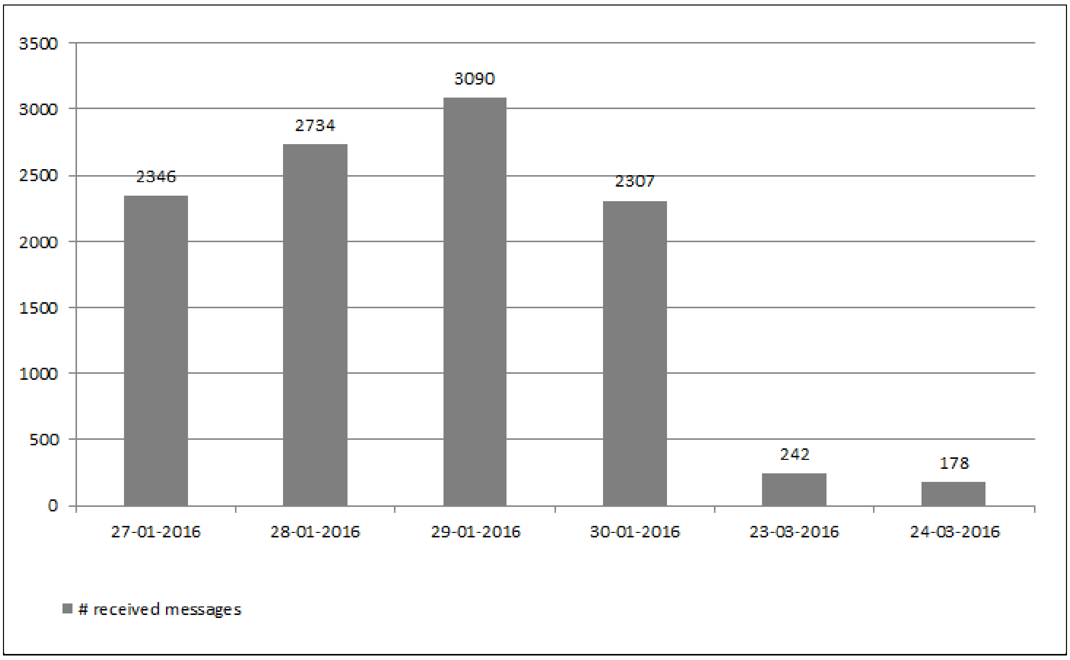


Figure 11: Number of received EFPL creation messages during EXE-07.06.02-VP-713-A "Shadow Mode" trials

During these days, about 11.000 EFPL creation messages have been provided by the contributing airspace users Figure 12 gives an overview about the share of EFPL submission messages from the respective airspace user in reference to the number of recorded messages for the 29th of January 2016.

[9] The term "planned" is used intentionally as not all scheduled flights were really operated. That means that the flight sample also included flights that have been cancel by the airline on the day of operations.

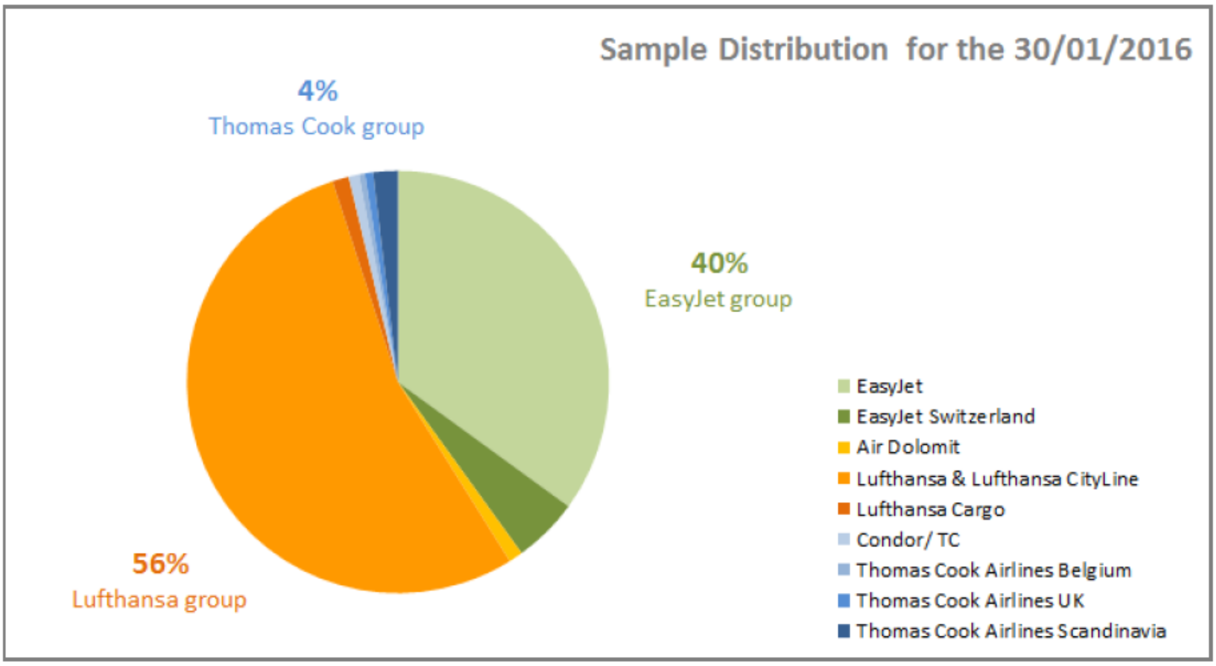


Figure 12: Recorded EFPL submission messages per airspace user on the 30/01/2016

To get meaningful results some of the flights had to be sorted out.

- First of all, submission messages received the 25th and the 26th of January were removed from the sample. This was done to avoid that the validation result is falsified by effects that purely relate to the setup procedure. For instance, a flight plan update requires that a flight plan has been filed before. But in some cases (during the setup time window), the EFPL setup was done after the flight plan filing. In such cases an EFPL was not available on the NMVP. In case the airspace user was updating the flight plan after the EFPL setup, the NMVP responded with an error as no EFPL was filed before.

- On the other hand, some messages have been removed from the sample due to the fact that not all the EFPL submission messages were usable to assess the validation objective which was related to the alignment of views onto the trajectory of each flight between the airspace user and NM. That means that messages have been removed from the sample where technical issues were reported referring to a software issue either related to Lido/Flight or related to the NM software used on NMVP.

In sum, approximately 76% of the received EFPL submission messages were included in the sample that was used to analyse the effect of the use of the 4D trajectory in the NM system. Anyhow an analysis of the EFPL submission messages that have been removed from the "validation sample" has been done nevertheless to address necessary technical improvements identified during the validation exercise. Figure 13 shows for every trial day the number of recorded messages for this day as well as the number of messages that have been considered in the flight sample. In result, about 8.000 messages have been considered in the validation sample.

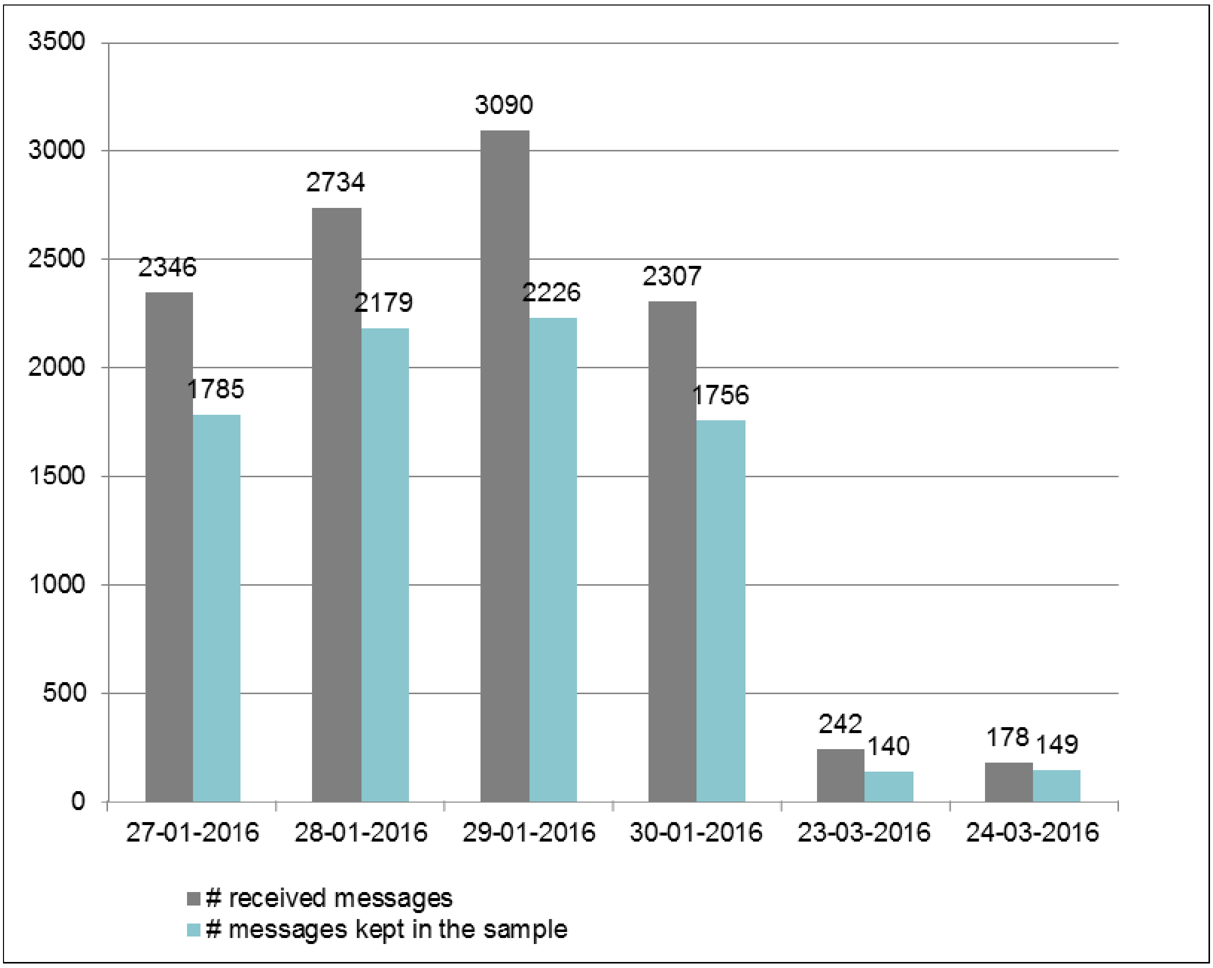


Figure 13: Comparison of the number of recorded EFPL submission messages and number of messages in the validation sample of EXE-07.06.02-VP-713-A "Shadow Mode" trials

These technical issues, referring to verification of the prototypes, were grouped in 5 categories as listed below:

- Incorrectly formatted B2B request was sent to the NMVP;
- Invalid Attribute Value (value that does not respect the expected format) was coded in the EFPL message; therefore the EFPL was rejected;
- Equipment Errors (e.g. FILED PBN REQUIRES CEQPT G)
- Object Exists errors (e.g. when the corresponding ICAO FPL were rejected and filled again while the first EFPL were accepted, or an ICAO FPL message as update was translated to EFPL create message instead of EFPL update message);
- SID/STAR replacement errors due to the fact that the SID/STAR from the A04D insertion into the F15 was sometimes erroneous (e.g. ROUTE 165 LIDCT)

Figure 14 shows the repartition by categories of the messages excluded from the sample on the 30th of January 2016.

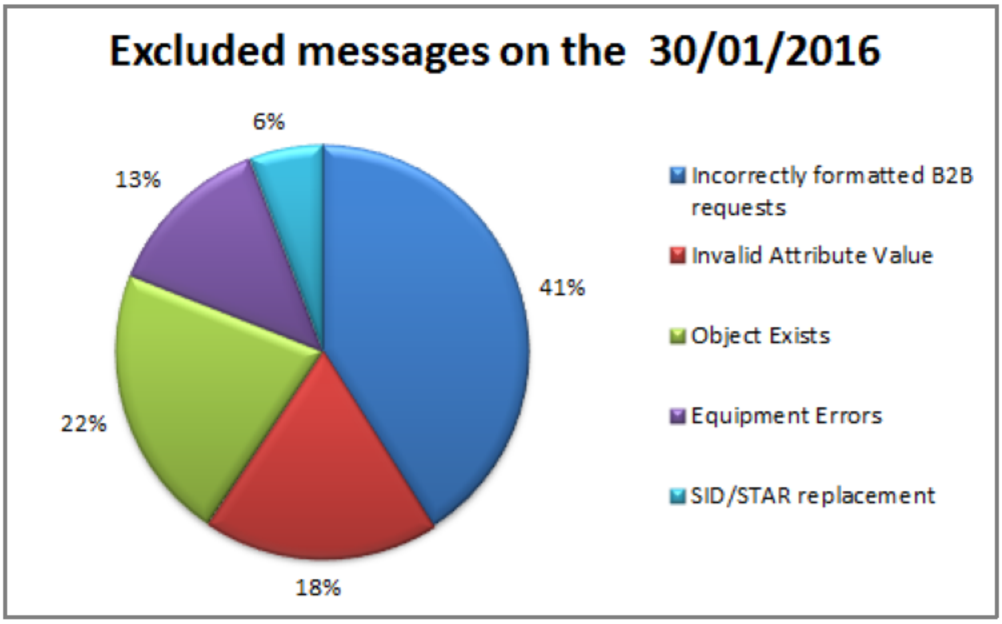


Figure 14: EFPL Submission Messages excluded from the sample on the 30/01/2016

6.2.2.2.3 Part-B - FIXM Analytical Modelling

The Part-B of EXE-07.06.02-VP-713 is a trial that supports standardization by demonstrating that NM EFPL submission web service can migrate to FIXM without impacting flight plan validation and processing negatively.

Therefore, the exercise focused only on exchanging the same information via different service interfaces: NM EFPL and FIXM EFPL. The objective was to demonstrate that the systems enable requesting the same flight information with both interfaces and receiving the same results with both interfaces.

6.2.2.2.3.1 Trial Run

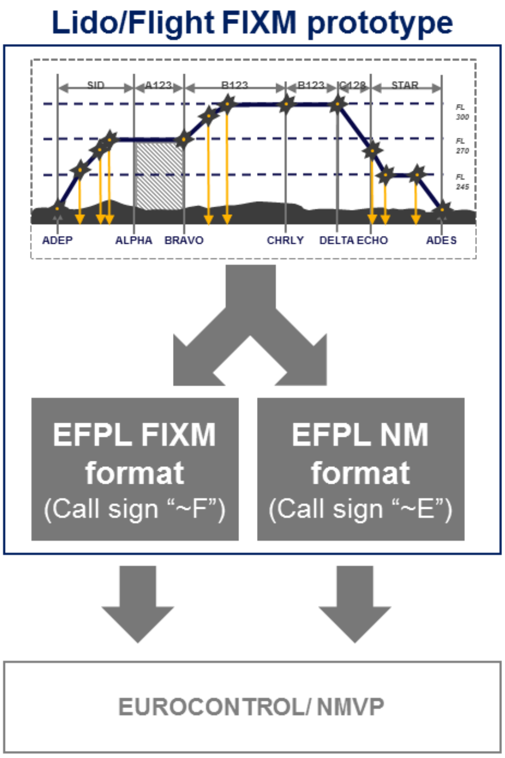
For this part of the validation, a single trial run was scheduled by EUROCONTROL and Lufthansa Systems. The trial run was scheduled to be conducted between the 11th and 15th of January 2016, while the concrete trials have been done on the 14th and 15th of January 2016. This trial involved Lufthansa Systems with their flight planning system Lido/Flight and EUROCONTROL with NM system prototypes.

6.2.2.2.3.2 System under test

For this part of the validation exercise, the flight planning system provided by Lufthansa Systems (Lido/Flight Version V5.8.3.) and EUROCONTROL NMVP systems were used. The Lido/Flight system was enhanced to allow the flight plan filing, flight plan status retrieval and flight plan validation of FIXM EFPL messages and NM EFPL messages in parallel. These messages were sent to the NMVP with the objective of comparing the reply of the FIXM EFPL service with the reply of the EFPL service (for Validate and Create) in terms of:

- Filing status
- Accepted Trajectory
- Returned errors

During the trial run, the both the Lido/Flight and NMVP systems were connected to all operational data feeds that are used during operations. Hence the operational data bases were close to any environment operated by any airline[10] and NM. Figure 15, extracted from "11.01.05-D31-Contribution to EXE-07.06.02-VP-713- EFPL Step 1 V3 Validation Report LSY" (refer to [6]) briefly describes the prototype used for the FIXM EFPL Analytical Modelling.



The Lido/Flight FIXM EFPL prototype was realised in a Lido/Flight system solely used by Lufthansa Systems for SESAR validation exercises. It is based on the operation Lido/Flight version V5.8.3. The NMVP was installed with an NM release which also exposes EFPL service interfaces in FIXM.

The Lido prototype was built in a way that the filing of a flight was always triggering the creation and transmission of

- One EFPL in the NM format; and
- One EFPL in the FIXM format.

The FIXM EFPL flight plan is based on the FIXM v3.0 + a EUROCONTROL EFPL extension.
To avoid rejects due to the provision of two flights plans for the same flight, the prototype also included a function that changed the call sign of a flight depending on the type of EFPL format. In both cases the last character of the call sign was added by the prototype before the transmission of it to the NMVP. The following characters were added to the respective call signs:

- "F" was used for the FIXM format flight plan; and
- "E" was used for the EFPL in the NM XML format.

In both cases the EFPLs were provided via the internet using web services as installed on the NMVP.

Figure 15: Description of the Lido/Flight FIXM EFPL and NMVP prototype for the EXE-07.06.02-VP-713-B "FIXM Analytical Modelling" exercise

[10] Differences only relate to information that is maintained by every airline individually.

6.2.2.2.3.3 Flight Samples

The flight sample used for this trial run had the only purpose to compare the EFPL information provided by the flight planning system and associated reply messages provided by NMVP on the one hand in the NM EFPL format and on the other hand in the FIXM EFPL format. Therefore, the focus was on having a number of flights for which different replies could be expected. For that reason the flights were calculated with three different flight planning settings:

- The first 50 flights of the sample were calculated under consideration of all constraints and restrictions as they are maintained in Lido/Flight;
- The second 50 flights of the sample were calculated under consideration of all constraints and restrictions as maintained in Lido/Flight except the restrictions from the Route Availability Document; and
- The last 50 flights were calculated without consideration of any restrictions and constraints.

In sum, 150 flights were calculated and provided to the NMVP. Due to the setup of the flight calculations, it becomes directly understandable that an assessment of the flight plan acceptance rate, as a performance indicator for the quality of the flight plans, was not in focus of this part of the validation exercise.

During this validation exercise, all reply messages that have been received from the NMVP have been recorded for the NM EFPL as well as for the FIXM EFPL. Based on this recorded data, the size of the sample was adapted again as some flight had to be sorted out. But there was only a single reason for filtering out flight from the sample. In some cases there was no reply message recorded for the NM EFPL creation. In such cases the EFPL message is incorrectly coded and cannot be accepted by the NM service. As this aspect of the NM web service has not been covered yet by the flight planning system prototype, those cases have been sorted out. In result the samples included:

- 144 flights on the 18th January 2016; and
- 146 flights on the 19th January 2016.

6.2.2.3 Deviation from the planned activities

6.2.2.3.1 Deviations with respect to the Validation Strategy

No deviation with respect to the Validation Strategy.

6.2.2.3.2 Deviations with respect to the Validation Plan

6.2.2.3.2.1 Deviation on exercise scope

1. Due to insufficient time and resources, some VP-713 Part-A success criteria have not been addressed as they have been considered as not mandatory to achieve e-OCVM V3 maturity level:
   - CRT-07.06.02-VALP-713A.2012: Assess the proportion of the traffic for which the AO 4D trajectory (filed trajectory) can be used without modifications with regards ETFMS calculated 4D trajectory.
   - CRT-07.06.02-VALP-713A.2031: The 4D trajectories, calculated by DCB, taking into account last update information are closer to the flown trajectories.
   - CRT-07.06.02-VALP-713A.2041: With the implementation of EFPL, DCB Prediction is improved both in areas where PTRs are applied and in areas where PTRs are not applied.
   - CRT-07.06.02-VALP-713A.2051: Validation results provide significant information making it possible to assess whether operating with 4D trajectories based on different sources introduces any bias.
   - CRT-07.06.02-VALP-713A.2052: On a selection of TVs, validation results allow to compare the same traffic taking into account ICAO FPL only on the one hand and a mixed of ICAO FPL and EFPL on the other hand.

- CRT-07.06.02-VALP-713A.2061: The impact of EFPL (compared to ICAO FPL) on the number of flights impacted by regulations is acceptable.
- CRT-07.06.02-VALP-713A.2062: The impact of EFPL (compared to ICAO FPL) on delays is acceptable.

2. Some validation objectives have been merged:
    - OBJ-07.06.02-VALP-713A.2070 has been integrated in OBJ-07.06.02-VALP-713A.2010.

3. The conditions of the experimentation for VP-713 Part-A gaming session didn't allow to assess the Flight Planning negotiation process (communication) between AU flight dispatchers and IFPS operators. Therefore, the success criteria listed below have not been addressed:
    - CRT-07.06.02-VALP-713A.1024: The Flight Planning negotiation process (communication) for FOC Staff is acceptable compared to current operating method where ICAO FPL is used.
    - CRT-07.06.02-VALP-713A.1034: The FPL negotiation process (communication) for IFPS is acceptable compared to current operating method where ICAO FPL is used.

4. Due to workload and technical difficulties, the scope of VP-713 Part-B was significantly reduced. This part focussed on verification activities mainly and addressed only the validation objective linked to FIXM implementation, there was no validation of the use of Profile Tuning Restrictions. This was due to the fact that the effort of prototype development was too big to ensure the availability of certain prototypes in time. In particular, that related to the following points:
    - The concept of PTR implementation is not sufficiently described yet. The early assumption that PTR can be considered during trajectory generation like any restriction from the RAD was not fulfilled. Indeed, both types of restrictions are coded in the same way, but PTRs are considered in a different way that allows the initiation of a climb/ descent at any location while restrictions from the RAD require an initiation at a waypoint that has been published in the AIP. The change of the top of descent/ bottom of climb philosophy would require significant changes in the trajectory generation process of the flight planning system.
    - As ICAO FPLs filed to the NM system have to indicate FL change at waypoints that have been published in the AIP, the trajectory considering the PTRs in the correct way would get a reject with the ICAO FPL, if a FL-change would have been initiated at any location on an ATS route between two published points. (NM systems do not allow the use of user defined waypoints located on ATS routes). A change from this specification would require significant changes in the NM system used for the flight plan processing.

    As a result, the validation objectives listed below have not been assessed:
    - OBJ-07.06.02-VALP-713B.1010: Operational feasibility of soft ATC constraint integration
    - OBJ-07.06.02-VALP-713B.2010: PTRs Impact on Predictability

6.2.2.3.2.2 Deviation on exercise participation

AU participation to the second shadow mode session in March was reduced:

- Austrian Airlines faced difficulties with the Sabre platform set-up and the NMVP certificate activation;
- Turkish airlines decided to postpone the Sabre Flight plan manager upgrade due to internal reasons.

6.2.3 Exercise Results

6.2.3.1 Summary of Exercise Results

VP-713 Exercise results are summarised in section 4.1 (Table 21 gives the validation objective achievement status overview).

6.2.3.1.1 Results on concept clarification

Results on concept clarification can be found in Section 4.1.1.

6.2.3.1.2 Results per KPA

Results per KPA are described in Section 4.1.2.

6.2.3.1.3 Results impacting regulation and standardisation initiatives

Results impacting regulation and standardisation initiatives are described in Section 4.1.3.

6.2.3.2 Analysis of Exercise Results

This section focusses on detailed analysis concept, human performance and operational / technical feasibility validation objectives. It is structured to report on each pre-defined success criterion. Each section starts with a brief text box summarising the conclusion for each success criterion. The colour coding corresponds to the achievement status as used in the Validation objective achievement status table in Section 4.1, as defined below:

	OK
	Either OK or NOK with issues explained
	NOK
	Not assessed

6.2.3.2.1 Results on validation objectives related to "Flight Planning"

6.2.3.2.1.1 General Results

The overall result on flight planning creation messages (For the entire sample as described in Figure 13) shows that the average acceptance rate of 97% for the ICAO reaches 95% for the EFPL (see the following Table 42).

ICAO Messages				EFPL Messages				New Valid messages	New Invalid Messages
Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
8235	8002	233	97%	8235	7835	400	95%	35	215

Table 42: Overall Results on Flight Planning

As part of the post-exercise analysis, a sample of 25 of the invalid flight plans filed on 30/01/2016 (see Table 47 for the overall results on 30/01/2016) have been recalculated using a modified system configuration of the Lido/Flight system with the aim to produce a valid EFPL trajectory while maintaining the 2D trajectory unchanged. For 17 flight plans in this sample the recalculation was successful and resulted in a valid EFPL that was filed to the NMVP.

For the remaining 8 flight plans it was not possible to calculate a valid 4D trajectory without changing the original 2D route. This is assumed to be due to one of the following reasons:

- The environment data (mainly restrictions from the RAD, NOTAMs etc.) has changed, making it not possible to fully reproduce the operational conditions and to plan a valid 4D trajectory;
- The original 2D route was already, on the 30th of January, unsuitable to create a valid 4D trajectory.

An in depth analysis of these reasons was not possible on the day of the exercise as environment data changes have not been tracked.

This simulation exercise has shown that, by using a relatively simple change of the FOC system configuration, 68% of a sample of invalid EFPLs would directly become valid without significantly increasing the effort on the airspace user side.

Applying the same percentage to the total number of invalid EFPLs on the 30/01/2016 (107) would result in an additional 72 valid EFPLs. That would increase the pass rate from 94%, during the exercise, to 98% which, at the same time, would represent an increase of 2% compared to the pass rate of ICAO format messages in operations (96%) for the same day. These results are summarised in the following table.

ICAO Messages	EFPL Messages Simulation			EFPL Messages Shadow				EFPL Messages Estimated	
Pass Rate	Nb of messages	Accepted	Pass Rate	Nb of Messages	Accepted	Rejected	Pass Rate	Accepted	Pass Rate
96%	25	17	68%	1756	1649	107	**94%**	1721	**98%**

Table 43: Simulation exercise results compared to operational and shadow results for 30/01/2016

Figure 16 gives the global results on Flight planning creation messages by AU group.

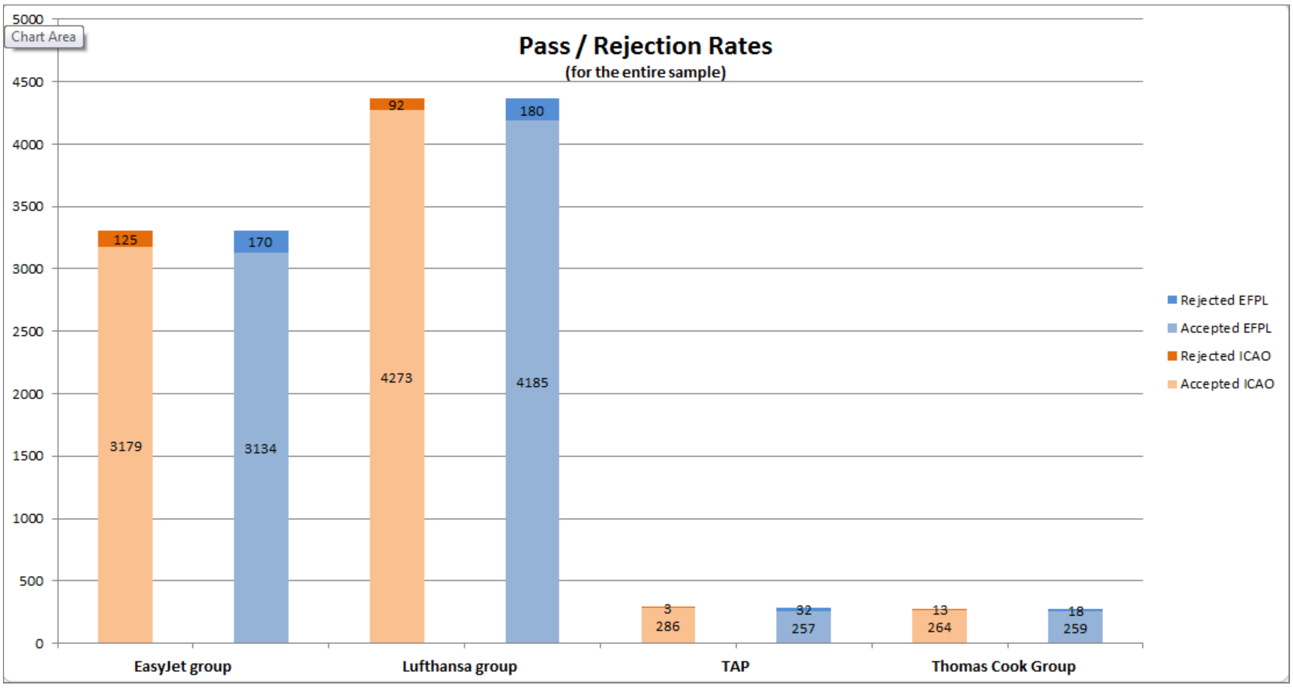


Figure 16: Results by AU group on Flight Planning

The following tables give the detailed results on flight planning creation messages for each day of the shadow mode session.

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG	Condor/ TC	20	20	0	100%	20	19	1	95%	0	1
DLA	Air Dolomiti	23	23	0	100%	23	20	3	87%	0	3
DLH	Lufthansa & Lufthansa CityLine	1057	1028	29	97%	1057	1006	51	95%	3	26
EZS	EasyJet Switzerland	57	56	1	98%	57	55	2	96%	0	1
EZY	EasyJet	558	540	18	97%	558	534	24	96%	3	12
GEC	Lufthansa Cargo	19	18	1	95%	19	18	1	95%	0	0
TCW	Thomas Cook Airlines Belgium	8	7	1	88%	8	6	2	75%	0	0
TCX	Thomas Cook Airlines UK	8	8	0	100%	8	8	0	100%	0	0
VKG	Thomas Cook Airlines Scandinavia	35	31	4	89%	35	32	3	91%	1	0
Total		**1785**	**1731**	**54**	**97%**	**1785**	**1698**	**87**	**95%**	**7**	**43**

Table 44: Results on Flight Planning creation messages for the 27/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG	Condor/ TC	17	17	0	100%	17	16	1	94%	0	1
DLA	Air Dolomiti	27	27	0	100%	27	27	0	100%	0	0
DLH	Lufthansa & Lufthansa CityLine	1151	1129	22	98%	1151	1108	43	96%	4	25
EZS	EasyJet Switzerland	89	89	0	100%	89	89	0	100%	0	0
EZY	EasyJet	833	804	29	97%	833	794	39	95%	7	22
GEC	Lufthansa Cargo	19	19	0	100%	19	18	1	95%	0	1
TCW	Thomas Cook Airlines Belgium	2	2	0	100%	2	2	0	100%	0	0
TCX	Thomas Cook Airlines UK	16	13	3	81%	16	13	3	81%	0	0
VKG	Thomas Cook Airlines Scandinavia	25	24	1	96%	25	25	0	100%	1	0
Total		**2179**	**2124**	**55**	**97%**	**2179**	**2092**	**87**	**96%**	**12**	**49**

Table 45: Results on Flight Planning creation messages for the 28/01/2016

Airspace User	ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
	Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG Condor/ TC	25	24	1	96%	25	23	2	92%	0	1
DLA Air Dolomiti	22	22	0	100%	22	22	0	100%	0	0
DLH Lufthansa & Lufthansa CityLine	1039	1024	15	99%	1039	1008	31	97%	0	16
EZS EasyJet Switzerland	129	126	3	98%	129	124	5	96%	1	3
EZY EasyJet	935	906	29	97%	935	889	46	95%	5	24
GEC Lufthansa Cargo	21	20	1	95%	21	20	1	95%	0	0
TCW Thomas Cook Airlines Belgium	6	6	0	100%	6	6	0	100%	0	0
TCX Thomas Cook Airlines UK	11	11	0	100%	11	11	0	100%	0	0
VKG Thomas Cook Airlines Scandinavia	38	37	1	97%	38	36	2	95%	0	1
Total	**2226**	**2176**	**50**	**98%**	**2226**	**2139**	**87**	**96%**	**6**	**45**

Table 46: Results on Flight Planning creation messages for the 29/01/2016

Airspace User	ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
	Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG Condor/ TC	14	14	0	100%	14	14	0	100%	0	0
DLA Air Dolomiti	19	19	0	100%	19	18	1	95%	0	1
DLH Lufthansa & Lufthansa CityLine	946	923	23	98%	946	900	46	95%	1	23
EZS EasyJet Switzerland	88	75	13	85%	88	76	12	86%	3	4
EZY EasyJet	615	583	32	95%	615	573	42	93%	5	17
GEC Lufthansa Cargo	22	21	1	95%	22	20	2	91%	0	1
TCW Thomas Cook Airlines Belgium	8	8	0	100%	8	8	0	100%	0	0
TCX Thomas Cook Airlines UK	11	10	1	91%	11	11	0	100%	1	0
VKG Thomas Cook Airlines Scandinavia	33	32	1	97%	33	29	4	88%	0	3
Total	**1756**	**1685**	**71**	**96%**	**1756**	**1649**	**107**	**94%**	**10**	**49**

Table 47: Results on Flight Planning creation messages for the 30/01/2016

Airspace User	ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
	Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
TAP Air Portugal	140	138	2	99%	140	123	17	88%	0	15

Table 48: Results on Flight Planning creation messages for the 23/03/2016

Airspace User	ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
	Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
TAP Air Portugal	149	148	1	99%	149	134	15	90%	0	14

Table 49: Results on Flight Planning creation messages for the 24/03/2016

6.2.3.2.1.2 OBJ-07.06.02-VALP-713A.1010: Impact of EFPL on FPL Validation Process

CRT-07.06.02-VALP-713A.1011 The number of "wrongly rejected" Flight Plans due to a different interpretation of the flight intent is reduced.

Date	Rejected FPL	Rejected FPL Accepted as EFPL	Percentage
28/01/2016	55	12	22%
29/01/2016	50	6	12%
30/01/2016	69	8	12%

Table 50: Wrongly rejected FPLs

Currently the IFPS would build its own version of a flight trajectory based on the route information included in an ICAO flight plan (FPL) and using generic BADA performance data corresponding to the aircraft type included in the flight plan. IFPS uses this trajectory to perform its flight plan validation function. Obviously currently an FPL does not include the trajectory calculated for the flight by the AU. This may sometimes lead to a flight plan being deemed as "Invalid" by IFPS while the originator AU may consider it as valid when looking at his own calculated trajectory. Such flight plans are then considered by AUs as being "wrongly rejected" by IFPS.

During the exercise, some of the flight plans that were sent in ICAO format to the IFPS operational system and deemed as "invalid" were valid on the NMVP platform to which they were sent as EFPLs. The different validation result was due mainly to different estimated levels over constrained points or route segments between the two calculated trajectories. The EFPL based levels on the NMVP were closer and often identical with the levels included in the AU EFPL. In few cases, the different validation results were due to different estimated times over constrained points or route segments.

Therefore, sending flight plans as EFPLs has reduced the number ICAO flight plan messages that were invalid due to a different interpretation of flight intents by IFPS by up to 22%. The minimum recorded during the session was a reduction of 12%. As on all days of the session a reduction has been recorded, this objectives is considered as achieved.

CRT-07.06.02-VALP-713A.1012 The number of "wrongly accepted" Flight Plans due to a different interpretation of the flight intent is reduced.

Date	Accepted FPL	Accepted FPL Rejected as EFPL	Percentage
28/01/2016	2124	49	2.3%
29/01/2016	2176	45	2.1%
30/01/2016	1685	49	2.9%

Table 51: Wrongly accepted FPLs

A similar approach as the one described in the previous paragraph may also lead the IFPS to accept an ICAO format flight plan that is based on an "invalid" trajectory calculated by the AU, based on the fact that the IFPS would deem its own calculated trajectory as "valid". Such flight plans are called in this report "wrongly accepted" flight plans.

Up to 2,9% of the accepted (valid) flight plans filed in ICAO format to the IFPS operational system in ICAO format , were deemed as invalid on the NMVP platform when filed as EFPLs. A maximum of 2.6% was recorded on the 30th of January, the last day of the exercise. The vast majority of the errors raised by the IFPS for them were due to a different level calculated by the IFPS over constrained points or a route segments with (EFPL) and without (FPL) using the AU trajectory information.

While the resultant additional invalid flight plans compared to the current operations have reduced the overall EFPL pass rate compared to the current FPL pass rate in operations, they may be regarded as representing a benefit from a safety point of view. They were indeed flight plans for flights that, although their calculated trajectory was planned to enter published constraints (RAD, closed CDR2 routes), were accepted as ICAO 2012 FPLs by IFPS, based on its own calculated trajectory, without knowledge of the actual planned trajectory of the flight. Such flight plans are expected to be filed as EFPLs with a valid trajectory and as a result do not contribute to a reduction of the overall EFPL pass rate. Otherwise they will be rejected by the IFPS and therefore the number of wrongly accepted flight plans due to a different interpretation of the flight intent will be reduced which demonstrates that the validation objective above is achieved.

It should also be noted that some of the invalid EFPLs would have been manually accepted by IFPS under current operational procedures as they were due to known limitations in the IFPS validation process.

CRT-07.06.02-VALP-713A.1013 The difference between AO 4D trajectory (filed trajectory) and IFPS 4D trajectory (accepted trajectory) is reduced in terms of Time and vertical profiles.

Alignment in Altitude

To address alignment in altitude, three notions are introduced:

- Trajectory point alignment: a named trajectory point included both in the AO 4D trajectory (filed trajectory) and the IFPS 4D trajectory is considered as aligned vertically if it has the same planned flight level in the two trajectories.
- Full trajectory alignment in altitude: all common points of the AO4D and the IFPS 4D trajectories are fully aligned (see previous definition).
- Trajectory alignment in average: the difference of altitude between the AO 4D trajectory and the IFPS trajectory is less than 500 feet in average considering all the named trajectory points.

As shown in the following three figures, EFPL introduction allows to significantly reduce the difference between AO 4D trajectory and IFPS 4D trajectory (accepted trajectory) in terms of vertical profile:

- Figure 17: In average 16% of points in the climb/descent profile are aligned in altitude between AO 4D trajectory and IFPS 4D trajectory based on ICAO FPL. This figure increases to 46% when the IFPS 4D trajectory is calculated based on EFPL.
- Figure 18: While the full alignment in Altitude is almost never observed between AO 4D trajectory and IFPS 4D trajectory based on ICAO FPL, it reaches 11% in average when AO 4D trajectory is compared to the IFPS 4D trajectory calculated from EFPL.

- Figure 19: In average, the alignment in Altitude in the climb/descent profile between AO 4D trajectory and IFPS 4D trajectory based on ICAO FPL is 2%. This figure jumps to 31% when the EFPL is used by NM systems to calculate the IFPS 4D trajectory.

However, the alignment remains incomplete. The main differences between the 4D trajectory generated by the AU and the 4D trajectory generated by the NM system based on the EFPL data in terms of vertical profile result from the PTRs that are not implemented in most AUs flight planning systems whereas NM systems adapts the vertical profiles of the 4D trajectories included in the EFPLs to cope with those restrictions. A good example is Thomas Cook who uses the PTRs published by NATS already. This could explain that Thomas Cook has a better alignment, even with the ICAO FPL, than the other two groups of Airspace Users (see the following figures).

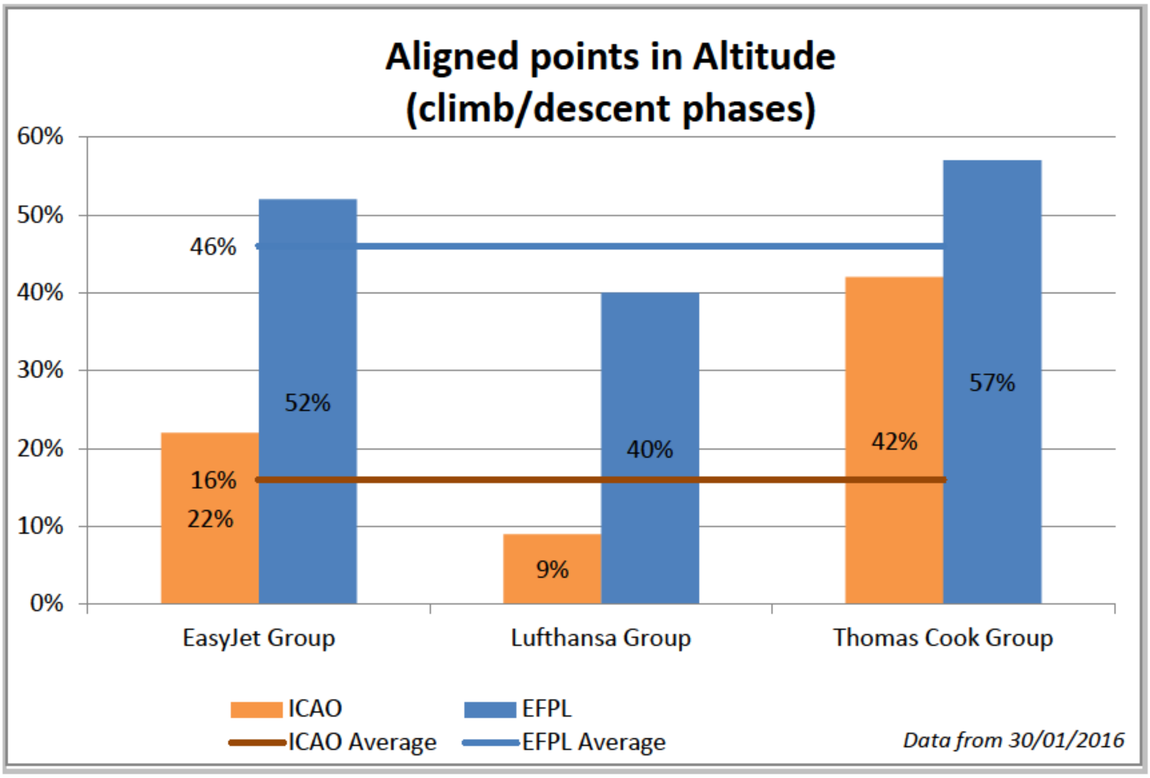


Figure 17: Aligned points in altitude (climb/descent phases)

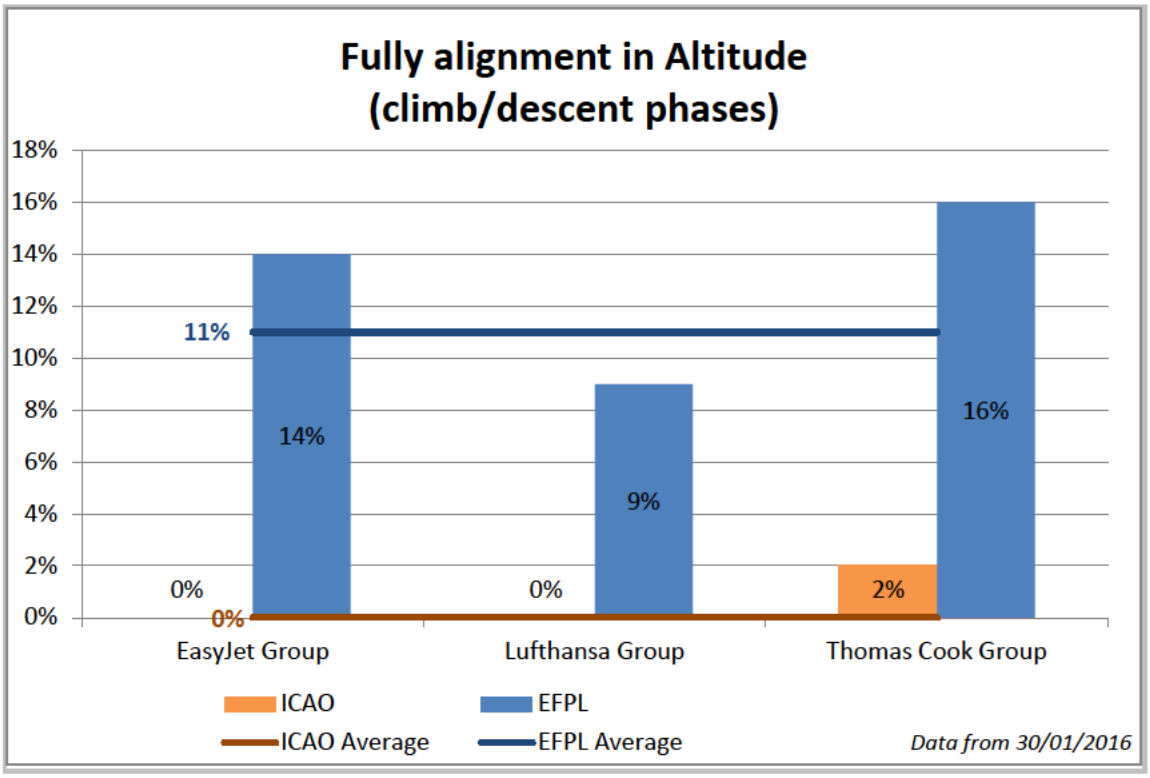


Figure 18: Fully alignment in altitude (climb/descent phases)

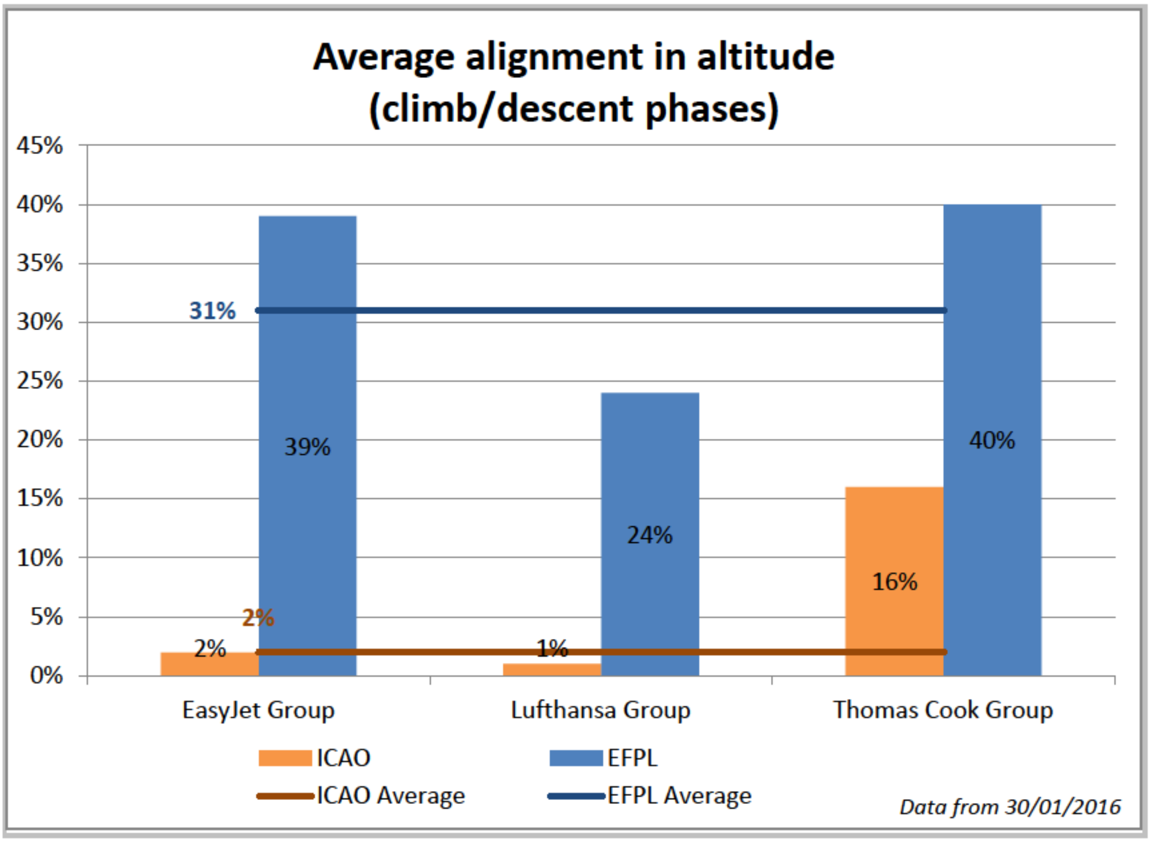


Figure 19: Average alignment in altitude (climb/descent phases)

Alignment in Time

Due to a bug in the NM prototype, it was not possible to produce global statistics to assess time alignment improvement. However, the analysis of a number of individual cases (about 100 flights) using the NM HMI showed that time alignment is fully achieved in most of the cases (around 90%)

6.2.3.2.1.3 OBJ-07.06.02-VALP-713A.1020: Impact of EFPL on FOC staff

CRT-07.06.02-VALP-713A.1021 The workload of FOC Staff is not increased compared to current operating method where ICAO FPL is used.

FOC staff did not perceive their workload as increased compared to current operations. 15 in a total of 17 dispatchers considered their workload would be the same or even reduced during EFPL operations. The positive replies were motivated by the fact that dispatchers expect that with the EFPL introduction, the number of wrongly rejected flight plans might decrease and in case of any reject, the reject reason provided by the flight dispatcher is always given, consequently reducing the time and effort of analysing the reject reason.

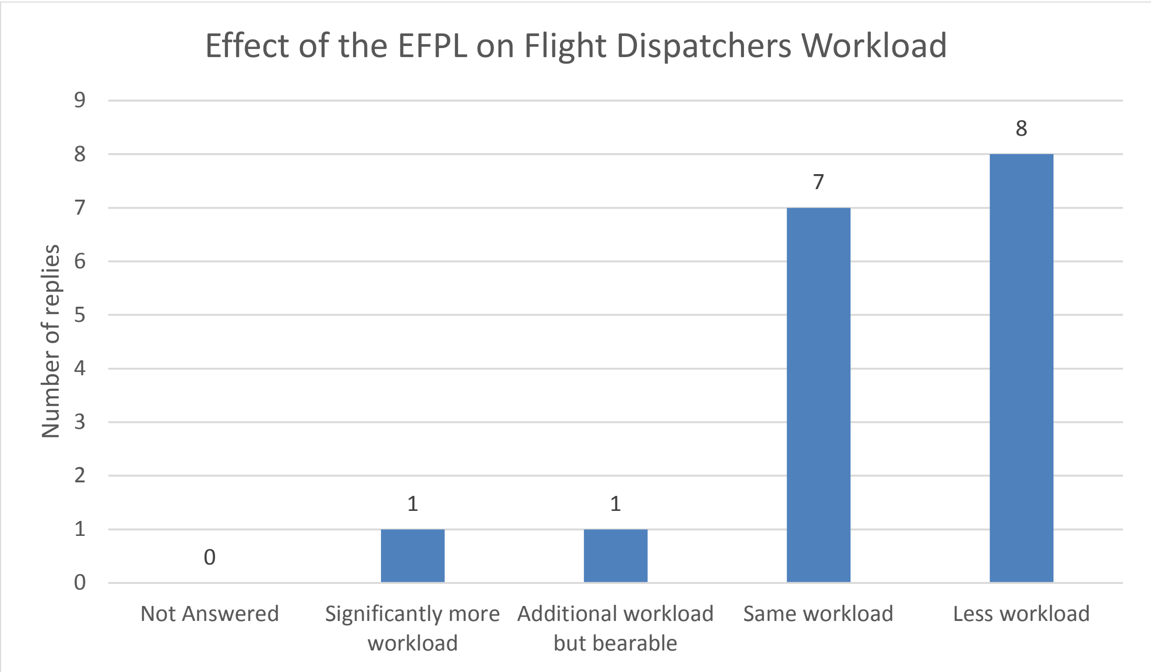


Figure 20: Effect of the EFPL on Flight Dispatchers Workload

CRT-07.06.02-VALP-713A.1022 The FOC Staff is able to maintain a good Situation Awareness level using EFPL compared to current operating method where ICAO FPL is used.

The majority of the dispatchers (13 in a total of 16 valid answers) expressed that they expect their Situation Awareness during EFPL operations would be the same or better. However, flight dispatchers who foresaw their situation awareness would be improved (5) were motivated by the fact that they expect that once the concept is already integrated in operations, they will have an improved interface that will support them in the visualization of flight plan changes from the NM.

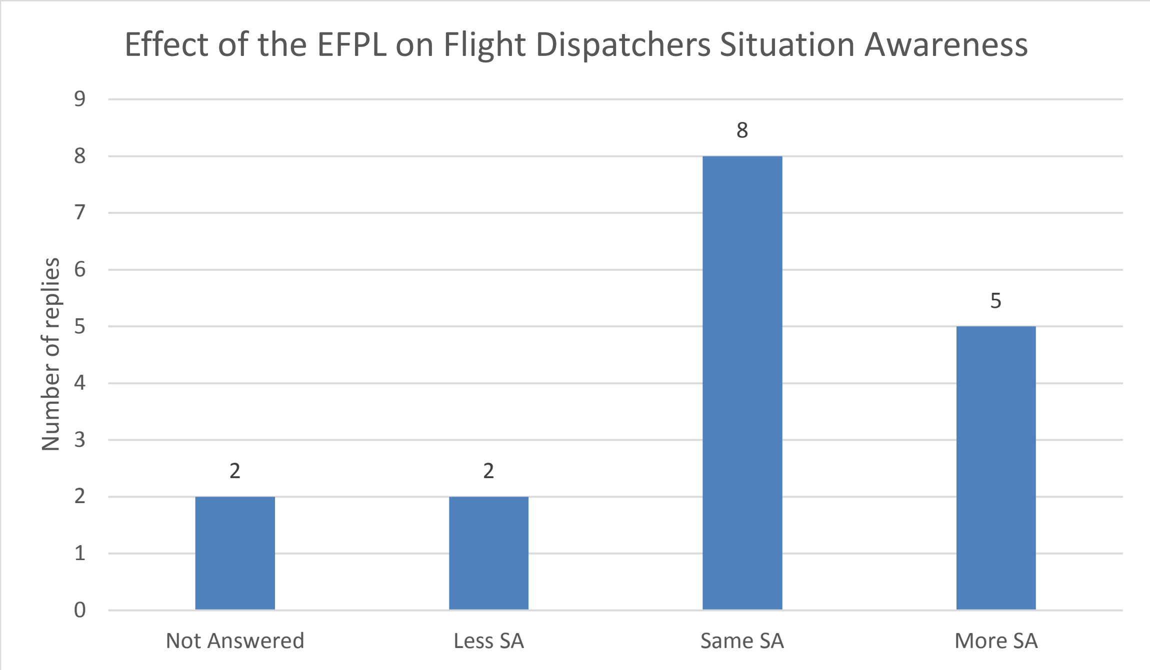


Figure 21: Effect of the EFPL on Flight Dispatchers Situation Awareness

CRT-07.06.02-VALP-713A.1023 The error propensity of FOC Staff is not increased compared to current operating method where ICAO FPL is used.

The majority of the dispatchers (12 in a total of 17) thought that error propensity in trajectory planning will not increase with EFPL introduction, which means that during the gaming exercise dispatchers did not perceive that the introduction of EFPL will negatively affect their probability to commit mistakes while processing FPLs. Only 4 flight dispatchers stated that the error propensity could increase but some of the justifications suggest that some flight dispatchers misinterpreted the question towards the handling and content of reject replies.

Most participants considered that the introduction of the EFPL has the potential to bring a better alignment between their operations and the NM, which potentially could reduce the number of errors and make easier for dispatchers to react effectively on any reject.

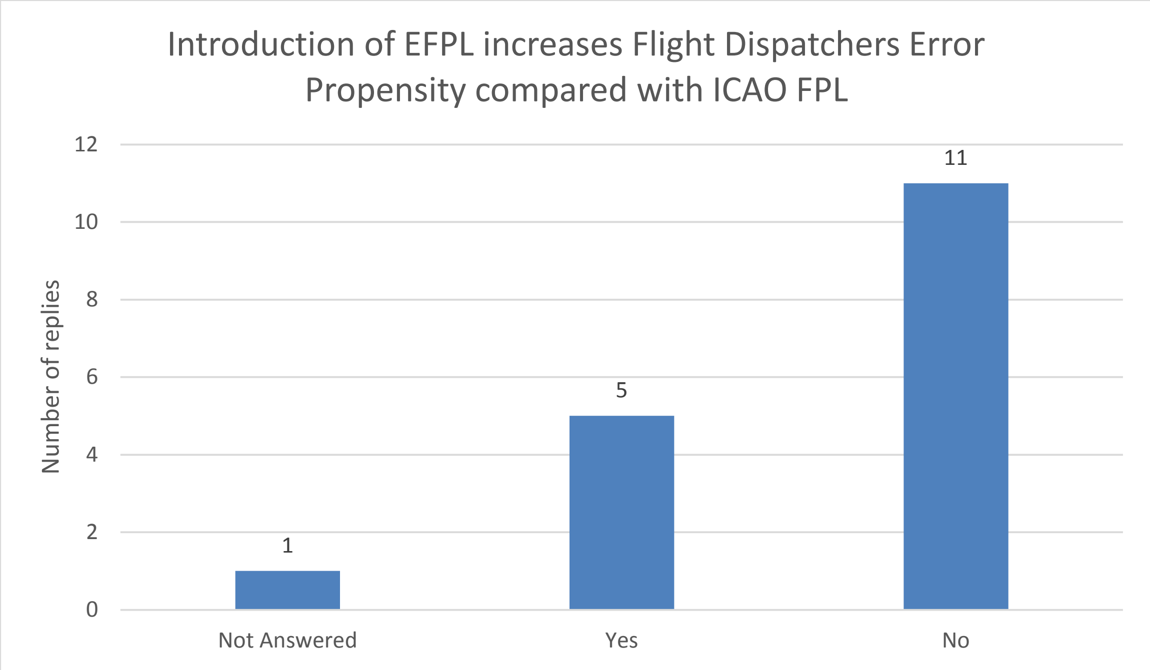


Figure 22: Introduction of EFPL increases Flight Dispatcher Error Propensity compared with ICAO FPL

CRT-07.06.02-VALP-713A.1024: The Flight Planning negotiation process (communication) for FOC Staff is acceptable compared to current operating method where ICAO FPL is used.

This objective was not addressed during the validation activities (see Section 6.2.2.3.2.1). Even if the majority of the participants joining the gaming session of EXE-07.06.02-VP-713-A confirmed that this negotiation (communication) process was acceptable, we have to conclude that a negotiation (communication) as intended to be implemented for the iterative SBT definition process, or currently used in operations to solve flight plan validity issues has not been assessed for this validation exercise. Hence this criterion cannot be evaluated yet.

CRT-07.06.02-VALP-713A.1025: The new operating methods support FOC Staff in performing their tasks in an efficient way.

The answers concerning this question were contradictory and not conclusive, 8 in a total of 17 flight dispatchers reported that the operating methods did not support them in performing their tasks in the most efficient way. They justified with their expectations towards an HMI improvement, but this question is not directly related to the EFPL transition because these same expectations are true for ICAO FPL. They expect that FPL filing/refiling could be done much faster and efficiently once the reply message has a more information and better visualization (once the new interface implemented). However, flight dispatchers were able to perform all their filing/refiling tasks, even if some of them believe their efficiency in operations can be improved.

CRT-07.06.02-VALP-713A.1026: The HMI supports efficiently the FOC Staff in preparing the EFPL.

The HMI supported most flight dispatchers in preparing the EFPL. However, most of them also suggested that they would like to see improvements to be implemented in order to improve their performance. Flight dispatchers considered that a more complete FPL response message and good visualization of the NM response would allow them to process FPL rejections more efficiently or even avoid getting a FPL rejection. It is important to highlight that the previously mentioned requirements are not related to EFPL transition but to the expectations that dispatchers have towards a more general operational improvement. Therefore, objectively, the HMI supports at the same extend the EFPL and ICAO FPL.

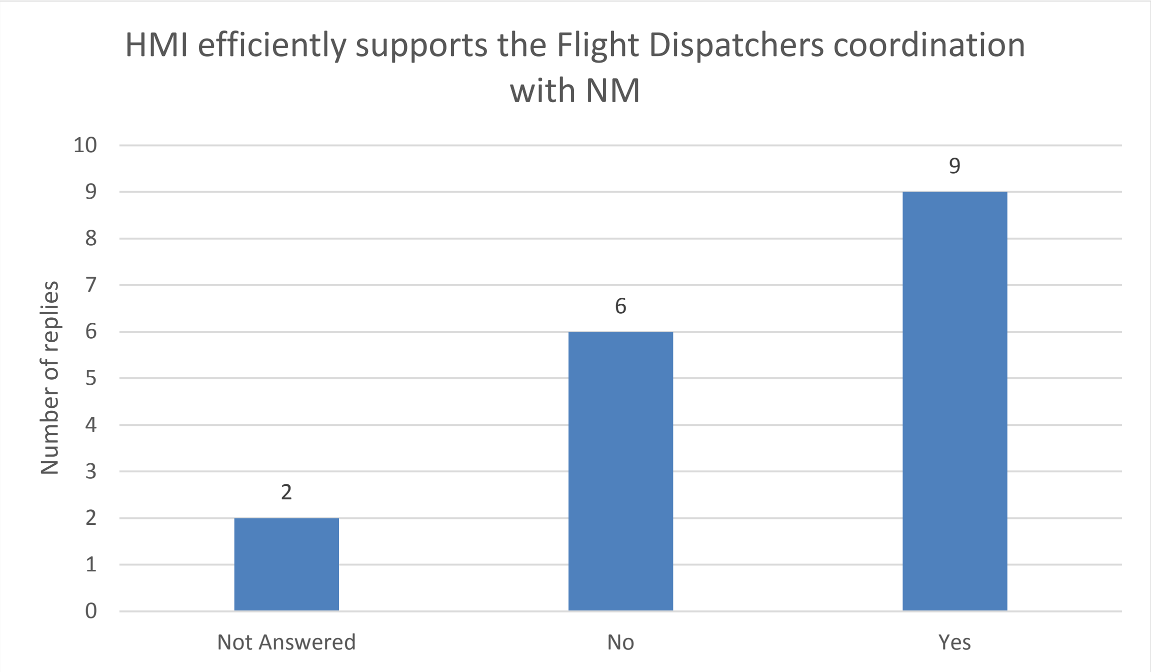


Figure 23: HMI efficiently supports the Flight Dispatcher coordination with NM

6.2.3.2.1.4 OBJ-07.06.02-VALP-713A.1030: Impact of EFPL on IFPS operators

CRT-07.06.02-VALP-713A.1031: The workload of IFPS operators is not increased compared to current operating method where ICAO FPL is used.

During the validation exercise IFPS Operators considered that the level of workload during EFPL operations didn't change significantly in respect to ICAO FPL. However, they mentioned that there would be a possibility that they can experience increased workload levels if they need to investigate/analyse a source of rejection for more FPLs using the current HMI. It is part of the recommendations to improve the current HMI.

CRT-07.06.02-VALP-713A.1032: The IFPS operators are able to maintain a good Situation Awareness level using EFPL compared to current operating method where ICAO FPL is used.

IFPS operators considered that the introduction of the EFPL did not impact their Situation Awareness compared to the current ICAO Flight Plan Validation process.

CRT-07.06.02-VALP-713A.1033: The error propensity of IFPS operators is not increased compared to current operating method where ICAO FPL is used.

IFPS operators mentioned there is a strong potential to the reduction in the overall error rate in EFPL operations, mainly once the FPL acceptance rate is improved.

CRT-07.06.02-VALP-713A.1034: The FPL negotiation process (communication) for IFPS is acceptable compared to current operating method where ICAO FPL is used.

This objective was not addressed during the validation activities (see Section 6.2.2.3.2.1). During the gaming exercise the coordination between IFPS operators and flight dispatchers was done via telephone with only with an exploratory intent, to look for possible gaps and inconsistencies between the two formats of FPL.

CRT-07.06.02-VALP-713A.1035: The new operating methods support IFPS operators in performing their tasks in an efficient way.

IFPS operators considered that their operating methods did not significantly change while processing EFPL and they were able to perform their tasks in an efficient way.

CRT-07.06.02-VALP-713A.1036: The HMI supports efficiently the IFPS operators in handling the EFPL.

The current HMI supported the IFPS operators in handling the EFPL. IFPS Operators mentioned they are used to making a quick assessment during the EFPL processing phase based mainly on the ICAO FPL message fields, therefore, having a summary of the EFPL in the beginning of the Flight plan editor would improve their performance. Concerning the FPL post-processing, the features that would be useful for IFPS operators would be a solution that allows them to easily compare the same point in the two different FPLs and a unit conversion tool to support with the different operational units.

Additionally, the IFPS operators also mentioned that the possibility to put markers in specific points (geopoints) between different windows (FPL editor, FPL vertical profile and map) in a synchronized way would support them greatly when they are analysing a specific FPL in more detail or even making a comparison between two FPLs

6.2.3.2.1.5 OBJ-07.06.02-VALP-713A.1060: Feasibility of EFPL Updates

CRT-07.06.02-VALP-713A.1061: Operational feasibility of FPL modification (Delay, Change and Cancel) is confirmed with the introduction of the EFPL.

The Delay,Change and Cancel messages were received on the NMVP via the FPL service interfaces and processed successfully.

However due to a bug in the FOC prototype, the ICAO FPL messages that are sent as update messages on OPS (ICAO FPL checkpoint Update) have been sent as EFPL Create messages to NMVP, which then were all rejected because the EFPL service interfaces are designed to receive distinct create or update messages. For that reason, the FOC systems need to adapt to send EFPL Update messages for the FPL messages that are intended to be updated by the Airspace Users.

Here after, results are detailed by message types.

Results on Delay Messages

Figure 24 shows for every trial day the number of recorded Delay messages for this day as well as the number of Delay messages that have been considered in the flight sample. In result, 160 Delay messages have been considered in the validation sample.

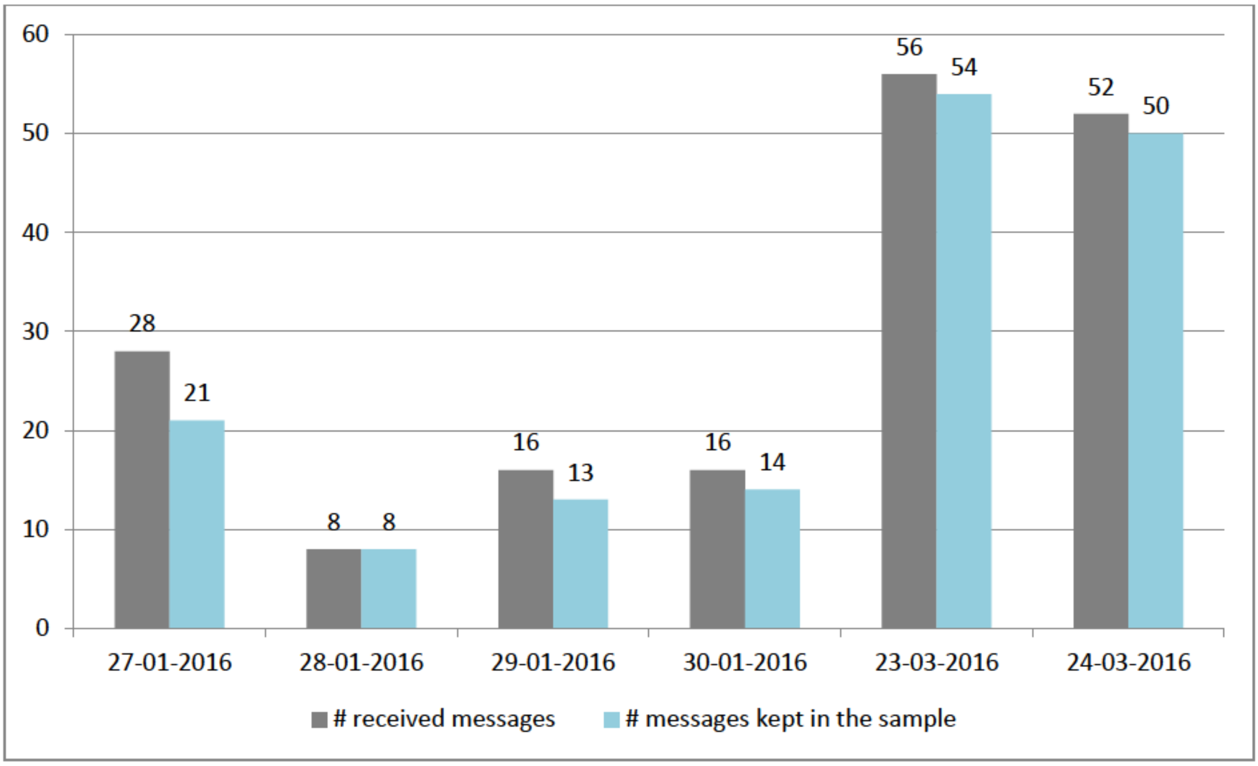


Figure 24 Comparison of the number of recorded messages and number of messages in the validation sample of EXE-07.06.02-VP-713-A "Shadow Mode" trials

As shown in the following tables which provide detailed pass rate information for the Delay messages, no differences for the January session and minor differences for the March session have been observed between ICAO FPLs delay messages and the ones based on EFPLs.

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
DLH	Lufthansa	6	6	0	100%	6	6	0	100%	0	0
EZY	EasyJet	3	3	0	100%	3	3	0	100%	0	0
GEC	Lufthansa Cargo	3	2	1	67%	3	3	0	100%	1	0
TCW	Thomas Cook Airlines Belgium	5	5	0	100%	5	5	0	100%	0	0
VKG	Thomas Cook Airlines Scandinavia	4	4	0	100%	4	4	0	100%	0	0
Total		**21**	**20**	**1**	**95%**	**21**	**21**	**0**	**100%**	**1**	**0**

Table 52: Results on Flight Planning delay messages for the 27/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
DLH	Lufthansa	4	4	0	100%	4	4	0	100%	0	0
EZS	EasyJet Switzerland	1	1	0	100%	1	1	0	100%	0	0
EZY	EasyJet	2	2	0	100%	2	2	0	100%	0	0
VKG	Thomas Cook Airlines Scandinavia	1	1	0	100%	1	1	0	100%	0	0
Total		**8**	**8**	**0**	**100%**	**8**	**8**	**0**	**100%**	**0**	**0**

Table 53: Results on Flight Planning delay messages for the 28/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG	Condor/ TC	2	2	0	100%	2	2	0	100%	0	0
DLH	Lufthansa	6	4	2	67%	6	4	2	67%	0	0
EZY	EasyJet	1	1	0	100%	1	1	0	100%	0	0
GEC	Lufthansa Cargo	1	1	0	100%	1	1	0	100%	0	0
TCX	Thomas Cook Airlines UK	1	0	1	0%	1	0	1	0%	0	0
VKG	Thomas Cook Airlines Scandinavia	2	2	0	100%	2	2	0	100%	0	0
Total		**13**	**10**	**3**	**77%**	**13**	**10**	**3**	**77%**	**0**	**0**

Table 54: Results on Flight Planning delay messages for the 29/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
DLH	Lufthansa	1	1	0	100%	1	1	0	100%	0	0
EZY	EasyJet	6	6	0	100%	6	6	0	100%	0	0
GEC	Lufthansa Cargo	3	3	0	100%	3	3	0	100%	0	0
VKG	Thomas Cook Airlines Scandinavia	4	4	0	100%	4	4	0	100%	0	0
Total		**14**	**14**	**0**	**100%**	**14**	**14**	**0**	**100%**	**0**	**0**

Table 55: Results on Flight Planning delay messages for the 30/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
TAP	Air Portugal	54	54	0	100%	54	51	3	94%	0	3
Total		**54**	**54**	**0**	**100%**	**54**	**51**	**3**	**94%**	**0**	**3**

Table 56: Results on Flight Planning delay messages for the 23/03/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
TAP	Air Portugal	50	50	0	100%	50	49	1	98%	0	1
Total		**50**	**50**	**0**	**100%**	**50**	**49**	**1**	**98%**	**0**	**1**

Table 57: Results on Flight Planning delay messages for the 24/03/2016

Results on Update Messages

Figure 25 shows for every trial day the number of recorded Update messages for this day as well as the number of Update messages that have been considered in the flight sample. In result, 3301 Update messages have been considered in the validation sample.

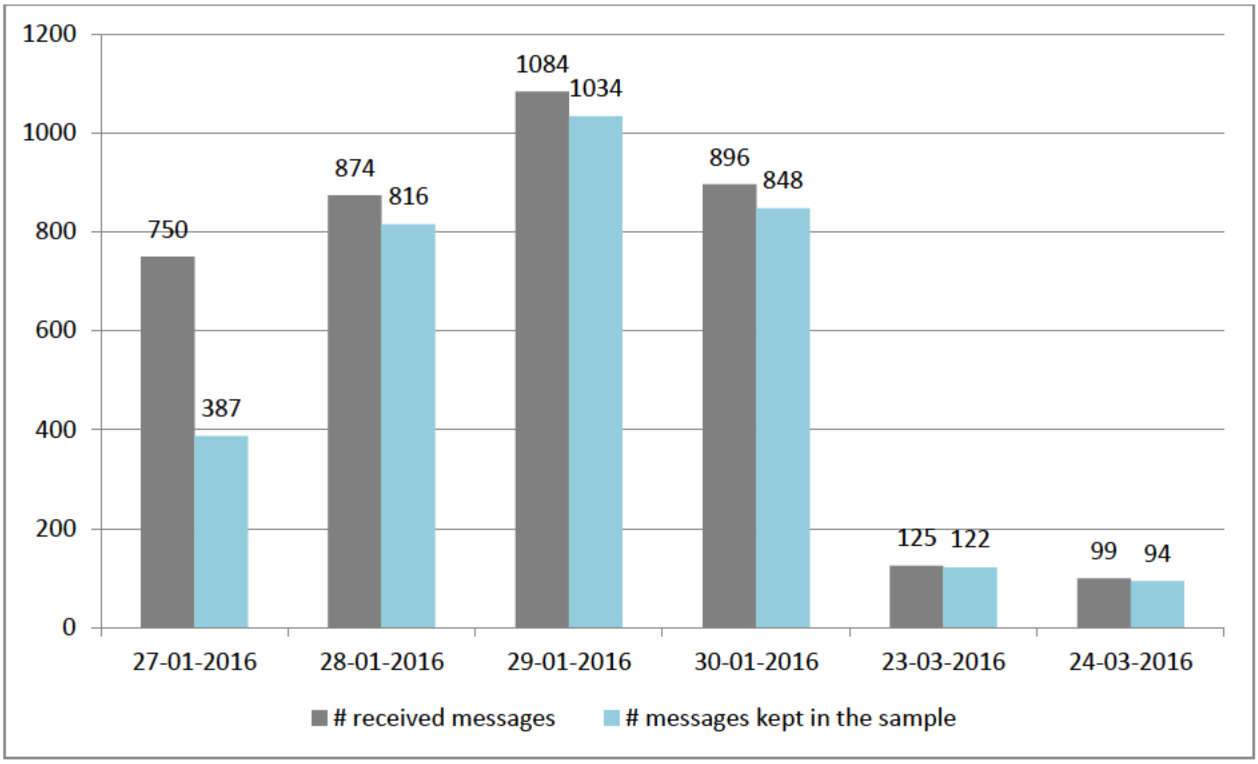


Figure 25 Comparison of the number of recorded messages and number of messages in the validation sample of EXE-07.06.02-VP-713-A "Shadow Mode" trials

As shown in the following tables which provide detailed pass rate information for the Update messages, minor differences only (1% for one day) have been observed between ICAO FPLs update messages and the ones based on EFPLs.

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
DLA	Air Dolomiti	15	15	0	100%	15	15	0	100%	0	0
DLH	Lufthansa	255	252	3	99%	255	250	5	98%	0	3
EZS	EasyJet Switzerland	4	4	0	100%	4	4	0	100%	0	0
EZY	EasyJet	111	108	3	97%	111	108	3	97%	1	1
GEC	Lufthansa Cargo	2	2	0	100%	2	2	0	100%	0	0
Total		**387**	**381**	**6**	**98%**	**387**	**379**	**8**	**98%**	**1**	**4**

Table 58: Results on Flight Planning update messages for the 27/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG	Condor/ TC	1	1	0	100%	1	1	0	100%	0	0
DLA	Air Dolomiti	22	22	0	100%	22	22	0	100%	0	0
DLH	Lufthansa	523	518	5	99%	523	514	9	98%	1	5
EZS	EasyJet Switzerland	16	16	0	100%	16	16	0	100%	0	0
EZY	EasyJet	251	247	4	98%	251	250	1	100%	4	1
GEC	Lufthansa Cargo	3	3	0	100%	3	3	0	100%	0	0
Total		**816**	**807**	**9**	**99%**	**816**	**806**	**10**	**99%**	**5**	**6**

Table 59: Results on Flight Planning update messages for the 28/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
DLA	Air Dolomiti	21	21	0	100%	21	21	0	100%	0	0
DLH	Lufthansa	514	510	4	99%	514	507	7	99%	0	3
EZS	EasyJet Switzerland	61	61	0	100%	61	61	0	100%	0	0
EZY	EasyJet	437	430	7	98%	437	432	5	99%	2	0
GEC	Lufthansa Cargo	1	1	0	100%	1	1	0	100%	0	0
Total		**1034**	**1023**	**11**	**99%**	**1034**	**1022**	**12**	**99%**	**2**	**3**

Table 60: Results on Flight Planning update messages for the 29/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG	Condor/ TC	1	1	0	100%	1	1	0	100%	0	0
DLA	Air Dolomiti	22	22	0	100%	22	22	0	100%	0	0
DLH	Lufthansa	537	533	4	99%	537	529	8	99%	0	4
EZS	EasyJet Switzerland	37	37	0	100%	37	36	1	97%	0	1
EZY	EasyJet	246	244	2	99%	246	241	5	98%	0	3
GEC	Lufthansa Cargo	4	4	0	100%	4	4	0	100%	0	0
VKG	Thomas Cook Airlines Scandinavia	1	1	0	100%	1	1	0	100%	0	0
Total		**848**	**842**	**6**	**99%**	**848**	**834**	**14**	**98%**	**0**	**8**

Table 61: Results on Flight Planning update messages for the 30/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
TAP	Air Portugal	122	122	0	100%	122	0	0	100%	0	0
Total		**122**	**122**	**0**	**100%**	**122**	**0**	**0**	**100%**	**0**	**0**

Table 62: Results on Flight Planning update messages for the 23/03/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
TAP	Air Portugal	94	93	1	99%	94	92	2	98%	0	1
Total		**94**	**93**	**1**	**99%**	**94**	**92**	**2**	**98%**	**0**	**1**

Table 63: Results on Flight Planning update messages for the 24/03/2016

Results on Cancel messages

Figure 26 shows for every trial day the number of recorded Cancel messages for this day as well as the number of Cancel messages that have been considered in the flight sample. In result, 75 Cancel messages have been considered in the validation sample.

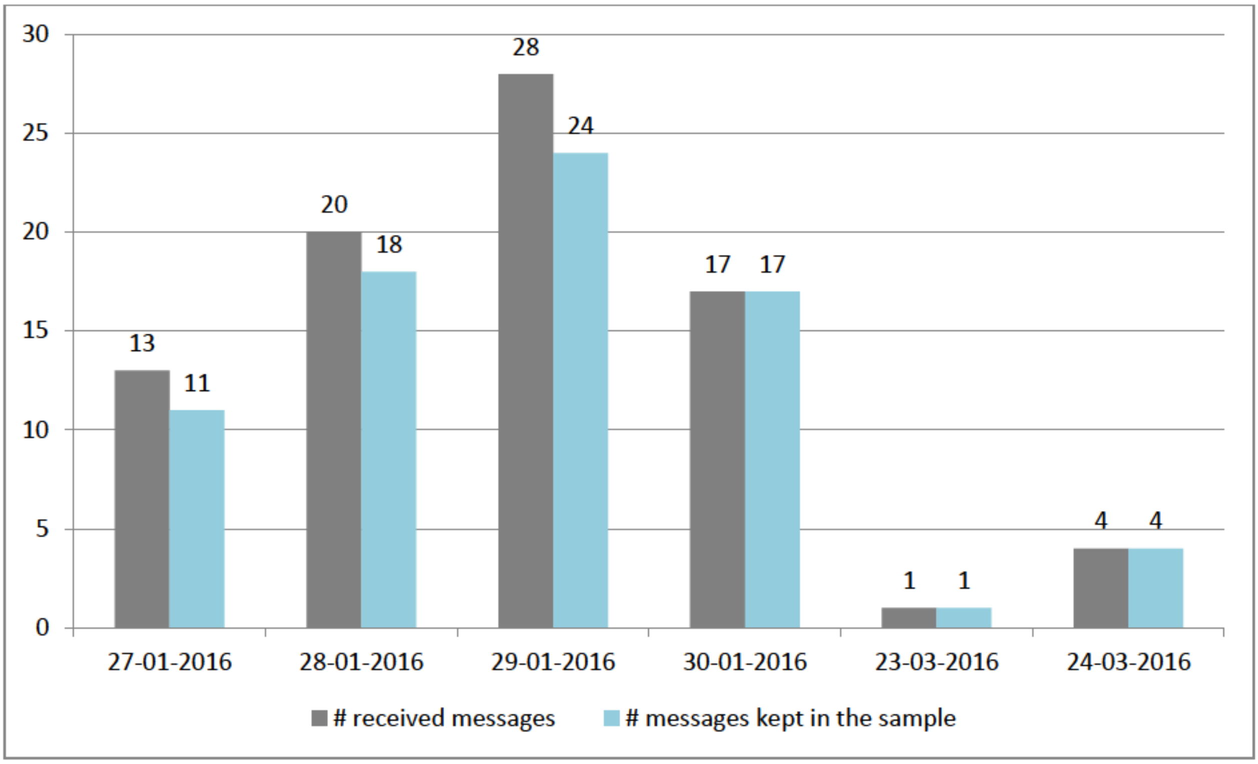


Figure 26 Comparison of the number of recorded messages and number of messages in the validation sample of EXE-07.06.02-VP-713-A "Shadow Mode" trials

As shown in the following tables which provide detailed pass rate information for the Cancel messages, no differences have been observed between ICAO FPLs cancel messages and the ones based on EFPLs.

AIRSPACE USER		ICAO MESSAGES				EFPL MESSAGES				NEW VALID MESSAGES	NEW INVALID MESSAGES
		NB OF MESSAGES	ACCEPTED	REJECTED	PASS RATE	NB OF MESSAGES	ACCEPTED	REJECTED	SHADOW MODE PASS RATE		
CFG	Condor/ TC	2	2	0	100%	2	2	0	100%	0	0
DLH	Lufthansa	2	2	0	100%	2	2	0	100%	0	0
EZY	EasyJet	1	1	0	100%	1	1	0	100%	0	0
GEC	Lufthansa Cargo	2	2	0	100%	2	2	0	100%	1	0
TCW	Thomas Cook Airlines Belgium	2	2	0	100%	2	2	0	100%	0	0
VKG	Thomas Cook Airlines Scandinavia	2	2	0	100%	2	2	0	100%	0	0
Total		**11**	**11**	**0**	**100%**	**11**	**11**	**0**	**100%**	**1**	**0**

Table 64: Results on Flight Planning cancel messages for the 27/01/2016

AIRSPACE USER		ICAO MESSAGES				EFPL MESSAGES				NEW VALID MESSAGES	NEW INVALID MESSAGES
		NB OF MESSAGES	ACCEPTED	REJECTED	PASS RATE	NB OF MESSAGES	ACCEPTED	REJECTED	SHADOW MODE PASS RATE		
CFG	Condor/ TC	2	2	0	100%	2	2	0	100%	0	0
DLA	Air Dolomiti	4	4	0	100%	4	4	0	100%	0	0
DLH	Lufthansa	5	5	0	100%	5	5	0	100%	0	0
EZY	EasyJet	5	5	0	100%	5	5	0	100%	0	0
TCX	Thomas Cook Airlines UK	2	2	0	100%	2	2	0	100%	0	0
Total		**18**	**18**	**0**	**100%**	**18**	**18**	**0**	**100%**	**0**	**0**

Table 65: Results on Flight Planning cancel messages for the 28/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG	Condor/ TC	4	4	0	100%	4	4	0	100%	0	0
DLH	Lufthansa	10	10	0	100%	10	10	0	100%	0	0
EZY	EasyJet	3	3	0	100%	3	3	0	100%	0	0
GEC	Lufthansa Cargo	2	2	0	100%	2	2	0	100%	0	0
TCW	Thomas Cook Airlines Belgium	2	2	0	100%	2	2	0	100%	0	0
TCX	Thomas Cook Airlines UK	3	3	0	100%	3	3	0	100%	0	0
Total		**24**	**24**	**0**	**100%**	**24**	**24**	**0**	**100%**	**0**	**0**

Table 66: Results on Flight Planning cancel messages for the 29/01/2016

Airspace User		ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
		Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
CFG	Condor/ TC	1	1	0	100%	1	1	0	100%	0	0
DLH	Lufthansa	10	10	0	100%	10	10	0	100%	0	0
EZY	EasyJet	2	2	0	100%	2	2	0	100%	0	0
GEC	Lufthansa Cargo	3	3	0	100%	3	3	0	100%	0	0
VKG	Thomas Cook Airlines Scandinavia	1	1	0	100%	1	1	0	100%	0	0
Total		**17**	**17**	**0**	**100%**	**17**	**17**	**0**	**100%**	**0**	**0**

Table 67: Results on Flight Planning cancel messages for the 30/01/2016

Airspace User	ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
	Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
TAP Air Portugal	1	1	0	100%	1	1	0	100%	0	0
Total	**1**	**1**	**0**	**100%**	**1**	**1**	**0**	**100%**	**0**	**0**

Table 68: Results on Flight Planning cancel messages for the 23/03/2016

Airspace User	ICAO Messages				EFPL Messages				New Valid Messages	New Invalid Messages
	Nb of Messages	Accepted	Rejected	Pass Rate	Nb of Messages	Accepted	Rejected	Shadow Mode Pass Rate		
TAP Air Portugal	4	4	0	100%	4	3	1	75%	0	1
Total	**4**	**4**	**0**	**100%**	**4**	**3**	**1**	**75%**	**0**	**1**

Table 69: Results on Flight Planning cancel messages for the 24/03/2016

CRT-07.06.02-VALP-713A.1062: The system solution for managing EFPL modification is accepted by all affected actors.

The system solution to managing the EFPL modification was accepted by all affected actors. However, as mentioned previously, the EFPL change for AUs side can still be improved with more adequate interface implementations that better support them identifying the FPL changes they have to do in order to get the FPL approved. Also, the lack of familiarity with the EFPL concept by dispatchers and lack of familiarity of the ones that are not Lido/Flight users (HOP! And Novair) has caused them some troubles in performing some modifications.

CRT-07.06.02-VALP-713A.1063: The information provided by EFPL (modifications introduced with respect to ICAO FPL) is relevant for the tasks to be performed by all actors.

The information provided by the EFPL is relevant for the tasks performed by all actors.

IFPS Operators mentioned that in the EFPL message there are some message blocks that they don't even take in consideration to understand why the flight went invalid (for instance aircraft performance data). In this case, EFPL provides them with more information than they require for most operations.

The flight dispatchers found the information provided by EFPL relevant. They added that having access to more detailed information on the reasons behind rejected FPLs and more meaningful data visualization would improve their efficiency in operations.

6.2.3.2.1.6 OBJ-07.06.02-VALP-713A.1070: Feasibility of the mixed mode of operation

CRT-07.06.02-VALP-713A.1071: The HMI supports efficiently the IFPS operators in mixed mode operations.

The current HMI did not fully support IFPS operators during mixed mode operations even though no negative impact was detected during their performance. This was due to the current interface that did not inform the operator if he is receiving an EFPL or ICAO FPL.

CRT-07.06.02-VALP-713A.1072: The workload of IFPS operators is not increased due to mixed mode of operations.

The evidence collected showed that mixed mode operations did not increase IFPS operators' workload.

CRT-07.06.02-VALP-713A.1073: IFPS operators are able to maintain a good situation awareness level in mixed mode of operations.

IFPS Operators were able to maintain a good situation awareness level even in mixed mode operations. The current interface did not have a solution integrated to inform the IFPS operator if he is receiving an EFPL or ICAO FPL, but during the validation but this had no significant negative impact on their performance. Operators were able to maintain a good level of situation awareness and distinguish between the EFPL and ICAO FPL once they opened the message due to its size, which is much bigger on the EFPL.

CRT-07.06.02-VALP-713A.1074: The error propensity of IFPS operators is not increased due to mixed mode of operations.

Mixed mode operations did not increase operators' error propensity. IFPS operators did not have a solution integrated in their current interface informing them if they have received an EFPL or ICAO FPL, but during the validation this had no significant negative impact on their performance.

CRT-07.06.02-VALP-713A.1075: ICAO Update messages (Change, Delay and Cancel) are applied correctly in NM Systems when they follow an EFPL message for the same flight.

This objective is partially reached. The Delay and Cancel messages were received on the NMVP via the FPL service interfaces and processed successfully. These messages are applicable for both ICAO FPL and EFPL.

Due to the exercise set-up the ICAO CHG messages for EFPL were not received on the NMVP platform shadow mode, therefore this part of the objective is not reached.

6.2.3.2.1.7 OBJ-07.06.02-VALP-713A.1090: Confidentiality

CRT-07.06.02-VALP-713A.1091: Flight Performance data and ToW are not accessible to other AUs via the CHMI and the NOP Portal

This objective is partially reached. The FSPD and the ToW were not visible in the summary queries on the CHMI and NOP Portal. However, it is present in the OPLOG information that can be accessed via the CHMI and the NOP Portal.

Therefore this objective has not been completely achieved.

6.2.3.2.1.8 OBJ-07.06.02-VALP-713A.1100: Impact on Flight Plan distribution to ATC

CRT-07.06.02-VALP-713A.1101: No difference or differences explained and accepted by ANSPs are identified between the ATC distribution list based on ICAO FPLs and the ATC distribution list based on EFPLs.

Very few differences have been observed between the ATC distribution list based on ICAO FPLs and the one based on EFPLs. As it is listed in Table 70 below, 2175 flight plans were distributed to ATC on 29/01/2016, over-addressing has been identified for 59 EFPLs (2,71%) and under-addressing for only 14 EFPLs (0,64%). As the number of impacted flights is very limited and in particular for under-addressing, the objective is considered as reached in V3. The specific cases of under-addressing will be studied with concerned ANSPs in V4/V5.

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ARCID	ADEP	ADES	EOBD	EOBT	EFPL OVER ADDRESSING	EFPL UNDER ADDRESSING
DLH2LA	LIRQ	EDDF	160130	0615	LIPEZAZX	
DLH309	LIRQ	EDDF	160130	0845	LIPEZAZX	
DLH3AE	EDLP	EDDM	160130	0540	EDDXYIYR EDYYZQZA EDYYZQZX	
DLH3FN	LIRQ	EDDF	160130	1330	LIPEZAZX	
DLH6LY	EDLP	EDDM	160130	0830	EDDXYIYR EDYYZQZA EDYYZQZX	
DLH8YE	EDDM	LBSF	160130	1430	LYNIZAZX LYNIZPZX	
DLH975	EGPD	EDDF	160130	0525	EDUUZQZA	
DLH9MC	EDDM	LBSF	160130	0755	LYNIZAZX LYNIZPZX	
EZY12DM	EGKK	LPPT	160130	0940	EGHIZTZX	
EZY17TB	EGPF	EDDB	160130	0730	EDUUZQZA	
EZY2085	EGGW	LLBG	160130	1140	EBBRCATX EBBUZQZX	
EZY21EG	LEBL	LFLL	160130	0750	GCGAYXYX LEGNYXYX LEPGYXYX LEXXXTES	
EZY28YH	EGCC	EDDB	160130	0715	EDUUZQZA	
EZY29GN	EGGW	LOWS	160130	1050	EBBRCATX EBBUZQZX	
EZY35BC	EGKK	GMMX	160130	0740	EGHIZTZX	
EZY35LG	EGKK	LPFR	160130	0630	EGHIZTZX	
EZY36YV	EGKK	LEMG	160130	0650	EGHIZTZX	
EZY37JT	EGKK	LFRS	160130	1100	EGHIZTZX	
EZY52VT	EGKK	LEMD	160130	0735	EGHIZTZX	
EZY54YE	EGGW	EDDB	160130	0715	EDUUZQZA	
EZY56HR	EGKK	LOWI	160130	0735	LSAZZQZG LSAZZQZX	LOZZFAVI
EZY57NJ	EGKK	EGJJ	160130	0705	EGHIZTZX	
EZY61AR	EDDB	LGTS	160130	0530		LGGGYKYX
EZY72LM	EGKK	LXGB	160130	0755	EGHIZTZX	
EZY81LF	EGKK	GCLP	160130	0730	EGHIZTZX	
EZY83PE	EGKK	LEZL	160130	0620	EGHIZTZX	
EZY89JX	EGGW	LSZH	160130	0635	EBBRCATX EBBUZQZX	
EZY96BX	EGKK	LOWI	160130	0700	LSAZZQZG LSAZZQZX	LOZZFAVI

ARCID	ADEP	ADES	EOBD	EOBT	EFPL OVER ADDRESSING	EFPL UNDER ADDRESSING
EZY98HL	EGKK	GCRR	160130	0740	EGHIZTZX	
CFG184	EDDF	MUHA	160129	1310		BGBWZTZX EDLLZQZX EGPXZQZZ EGZYADEX EGZYFPDS EGZYPXAD EGZYPXFO EGZYPXTE
CFG7KF	EDDS	GCRR	160129	0955	CFMUTACT EDDAYGCD EDDAYGLZ EDDSYQYX EDDXYIYT EDDZYNYS EDFFZQZX EDGGZQZA GCCCYFPX GCCCYXYX GCGAYXYX GCRRIRPL GCRRZPZX GMMMZQZX LEGNYXYX LEPGYXYX LESCYFPX LEXXXTES LFFBTEST LFFFSTIP LFPBYRYD LPAMYCYX LPAMYWYA LPPCZQZX LSAGZQZG LSAGZQZX LSAZZQZG LSAZZQZX	
DLH05U	EDDF	LEBL	160129	1205	GCGAYXYX LEGNYXYX LEPGYXYX LEXXXTES	
DLH1AC	LYBE	EDDF	160129	1230		LYBTZAZX LYBTZPZX
DLH23F	EDDF	LEBL	160129	0905	GCGAYXYX LEGNYXYX LEPGYXYX LEXXXTES	
DLH431	KORD	EDDF	160129	2215		EDLLZQZX
DLH491	KSEA	EDDF	160129	2225	EDUUZQZA	
DLH4NF	EDDM	EDDV	160129	1020	EDFFZQZX EDGGZQZA	
DLH5TX	EDDV	EDDM	160129	1915	EDUUZQZA	
DLH690	EDDF	LLBG	160129	1650		EDUUZQZA
DLH7TX	EDDM	EDDV	160129	1425	EDFFZQZX EDGGZQZA	
DLH848	EDDF	EFHK	160129	0850		EETNZPZX
DLH8LY	EGPD	EDDF	160129	1605	EDUUZQZA	
DLH9KX	EDDF	LSGG	160129	0705	CFMUTACT EDDAYGCD EDDAYGLZ EDDGZTZG EDDXYIYT EDDZYNYS EDFFYQYX EDFFZQZX EDGGZQZA EDUUZQZA LSAGZQZG LSAGZQZX LSAZZQZG LSAZZQZX LSGGZTZX	
EZS38FR	LSGG	LPPR	160129	1640	LFLLZPZX	
EZS59UB	LEBL	LFSB	160129	1545	GCGAYXYX LEGNYXYX LEPGYXYX LEXXXTES	
EZY12HU	LIMC	ELLX	160129	1420	EBURZQZX EDDXYIYR EDDXYIYT EDYYZQZA EDYYZQZX	LFSTZPZX
EZY12KH	EGGP	EDDB	160129	1220	EDUUZQZA	
EZY14YV	EGKK	LEMD	160129	1225	EGHIZTZX	
EZY16FX	EGKK	LEMG	160129	0935	EGHIZTZX	
EZY21ND	EBBR	LFBD	160129	1535	EDDXYIYR EDDXYIYT EDYYZQZA EDYYZQZX	
EZY239F	LFBO	LFPG	160129	0525	CFMUTACT EDDAYGCD LFBDZPZX LFBOZPZX LFFBTEST LFFFSTIP LFPBYRYD LFPGZDZD	

ARCID	ADEP	ADES	EOBD	EOBT	EFPL OVER ADDRESSING	EFPL UNDER ADDRESSING
EZY29DK	EGKK	EGJJ	160129	1520	EGHIZTZX	
EZY29NK	EGGW	LSZH	160129	1300	EBBRCATX EBBUZQZX	
EZY32PK	EGKK	LPPT	160129	1635	EGHIZTZX	
EZY36XL	EGKK	LEMG	160129	1645	EGHIZTZX	
EZY37JT	EGKK	LFRS	160129	1435	EGHIZTZX	
EZY38WC	EBBR	LFBO	160129	1550	EDDXYIYR EDDXYIYT EDYYZQZA EDYYZQZX	
EZY56KR	EGMC	EDDB	160129	1335	EDUUZQZA	
EZY57NJ	EGKK	EGJJ	160129	1225	EGHIZTZX	
EZY59TR	EDDB	EGGD	160129	2010		EDUUZQZA
EZY61MN	EGKK	LPMA	160129	1350	EGHIZTZX	
EZY69XD	LCLK	EGKK	160129	1815	LBSFATCI LBSFATCX LBSFSTAT LCRAYFYX LCRAZTZX LWSSZQAI	LOXBZQZB LOZZFAVI LWSSZQZX
EZY75VR	EGKK	EGJJ	160129	1850	EGHIZTZX	
EZY82AY	EPKK	EDDH	160129	1955		EDDXYIYR EDYYZQZA EDYYZQZX
EZY83PE	EGKK	LEZL	160129	0935	EGHIZTZX	
EZY86YP	EGGW	EDDB	160129	1330	EDUUZQZA	
EZY95BU	EGAA	EGGD	160129	2109		EGZYCCTE
GEC8175	EGCC	EDDF	160129	1415		EDLLZQZX
VKG1916	VTSP	ESSA	160129	1035	CFMUTACT EETTZQZX EFESZQZX EFHKYWYX ESOSADXP ESOSZQZN ESOSZQZX ESSAZPZI ESSAZTZN ESSAZTZX	

2134 *Table 70: Distribution to ATC - EFPL Over addressing & Under addressing*
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6.2.3.2.2 Results on validation objectives related to EFPL use in DCB processes

6.2.3.2.2.1 OBJ-07.06.02-VALP-713A.2010: 4D calculated Trajectories respective accuracies

CRT-07.06.02-VALP-713A.2011: The use of EFPL data in DCB traffic predictions has no negative impact in general on the following factors: 1) traffic planned to cross TVs, 2) entry times in TVs; 3) occupancy times in TVs and has a positive impact on at least one of them..

One of the previous exercises VP311 addressed the benefit of using flight specific performance data from the EFPL. Therefore, VP-713 focused on the benefit of using the full EFPL dataset (combining the use of the AO 4D trajectory (filed trajectory) and flight specific performance data).

Basically, results on the traffic predictability can be divided in 3 topics:

- Impact of EFPL on the identification of flights crossing a sector or traffic volume. Note that since the extended flight plan has limited impact on the 2D prediction of the trajectory, this topic is mainly related to the prediction of the vertical profile of the flights.
- Impact of EFPL on time predictions. Results addressed the following aspects:
    - The prediction accuracy of entry time in sectors as well as occupancy times in sectors: these are the two key factors influencing the accuracy of occupancy counts predictions used in DCB to identify hotpots;
    - The impact of using the EFPL taxi time on DCB traffic prediction.
- Impact of EFPL on the prediction of the vertical profile planned in sectors in particular entry levels. These factors are important in complexity management processes.

Note: the results presented in this section – and in Appendix C and Appendix D - focus on the climbing and descending phases since these are the areas where the impact of EFPL on DCB traffic predictions is the most significant. Some differences can be explained by the fact that terminal procedures/SIDs/STARs are managed differently in ICAO FPL and EFPLs the environment data is not harmonised between NM and AUs. It is recommended in future validations to further analyse these differences.

Impact of the EFPL on the identification of flights crossing a sector or traffic volume

The following table provide an overview of the results for the 29th and 30th of January.

AIRLINE	DATE	TV IMPACTED	TV WITH POSITIVE IMPACT	TV WITH NEGATIVE IMPACT
Lufthansa group [11]	29/01/2016	104	35	69
	30/01/2016	170	76	94
EasyJet group [12]	29/01/2016	100	70	30
	30/01/2016	59	43	16

Table 71: Results on TV impacted

Detailed analysis of positive and negative differences on the TVs is provided in Appendix C. Main conclusions from this table and the analysis of individual traffic volumes are:

- Generally speaking, the results are balanced and no general trend - either in terms of improvement or degradation - can be derived from the global results;
- Results are strongly varying depending on the airlines providing the EFPLs;
- Feedback from the operational side: The impact of these differences in terms of TV capacity needs to be checked. In order to do this the differences will be presented to the FMPs concerned in the near future.

Impact of the EFPL on time predictions

➔ The following table provides an overall view of the impact of the EFPL on elapse time predictions from take-off time up to the entry in the Airspaces/Traffic volumes.

	AVERAGE ELAPSE TIME PREDICTION ERROR (SECONDS) USING ICAO	AVERAGE ELAPSE PREDICTION ERROR (SECONDS) USING EFPL	% OF ELAPSE TIME "GOOD PREDICTIONS" USING ICAO	% OF ELAPSE TIME "GOOD PREDICTIONS" USING EFPL
Climbing Traffic volumes	100	97	84%	86%
All traffic volumes	129	130	76%	76%

Table 72: Impact of EFPL on elapse time predictions from take-off to entry in traffic volumes

Explanations:

- The elapse time corresponds to the duration between take-off and the entry time in a sector/traffic volume;
- The elapse time prediction error corresponds to the difference between the DCB system prediction of elapse time and the elapse time of the trajectory flown;
- A "good prediction" corresponds to the case when the elapse time prediction error is lower than 3 minutes.

[11] Lufthansa group includes the following Airlines: Air Dolomiti, Lufthansa, Lufthansa Cargo and Lufthansa CityLine.
[12] EasyJet group includes the following Airlines: EasyJet Switzerland and EasyJet.

Appendix D provides more detailed results per traffic volume and airport of departure.

Main conclusions that can be derived are:

- The use of EFPL (using both the 4D trajectory and flight specific performance data) has in general a balanced impact on traffic volume entry time traffic predictions;
- A slight improvement can be noticed in climbing sectors but no general conclusion can be drawn about the positive impact of EFPLs on the accuracy of elapse time.

➔ The following table provides an overall view of the impact of EFPL of the prediction of occupancy time in Sectors/TVs for flights in climbing phase. More detailed results are available in Appendix D.

AIRLINE	AVERAGE OF SECTOR OCCUPANCY TIME PREDICTION ERROR (SECONDS) ICAO	AVERAGE OF SECTOR OCCUPANCY PREDICTION ERROR (SECONDS) EFPL	% OF SECTOR OCCUPANCY TIME "GOOD PREDICTIONS" ICAO	% OF SECTOR OCCUPANCY TIME "GOOD PREDICTIONS" EFPL
DLH	95	94	54%	55%
EZS	108	104	49%	51%
EZY	107	96	49%	54%
Total	**102**	**96**	**51%**	**54%**

Table 73: Impact of EFPL on occupancy time predictions in sectors/traffic volumes

Explanations:

- The sector occupancy time corresponds to the duration between the entry in the sector/TV and the exit;
- The sector occupancy time predictor error corresponds to the difference between the DCB system prediction of sector occupancy time and the flown occupancy time;
- A “good prediction “corresponds to the case of the sector elapse time prediction error is lower than 1 minute.

Appendix D provides more detailed results regarding in particular the sectors/TVs significantly impacted by the EFPL.

Main conclusions that can be derived from Table 73 above are:

- The use of EFPL has in general a positive impact on the prediction of occupancy times in sectors/Traffic volumes in particular in flights climbing phase. This will have a positive impact on the accuracy of the occupancy counts of the concerned sectors/TVs.
- The trend is the same for all participating airlines. The improvement is particularly significant for Easy-Jet traffic.

➔ The following table provide an overview of the impact of using EFPL taxi-time on the accuracy of sectors entry time prediction accuracy.

AIRLINE	AVERAGE ENTRY TIME ERROR USING EFPL TAXI-TIME (SECONDS)	AVERAGE ENTRY TIME ERROR USING NM TAXI-TIME (SECONDS)
DLH	464	524
EZY	620	630

Table 74: Impact of EFPL taxi time on sectors/traffic volumes entry time predictions accuracy

The main conclusions that can be derived from Table 74 above are that the use of the EFPL taxi time seems to improve traffic predictability.

It must be noted in the table above that the NM taxi time column does not consider taxi times received in real time from CDM airports.

Appendix D provides more detailed results on EFPL taxi time impact per airport of origin.

Impact of EFPL on the prediction of the entry level in planned sectors

➔ The two following tables provide an overall view of the impact of EFPL on the prediction of entry level in sectors/TVs respectively for the climbing and descending phases.

CLIMBING PHASE				
AIRLINE	AVERAGE OF ENTRY LEVEL PREDICTION ERROR (FL) - ICAO	AVERAGE OF ENTRY LEVEL PREDICTION (FL) ERROR - EFPL	% OF ENTRY LEVEL GOOD PREDICTION ICAO	% ENTRY LEVEL GOOD PREDICTION - EFPL
DLH	17	17	48%	49%
EZS	17	15	51%	57%
EZY	18	17	47%	50%
Total	**18**	**17**	**47%**	**50%**

Table 75: Impact of EFPL on sectors/TVs entry level prediction in the climbing phase

DESCENDING PHASE				
AIRLINE	AVERAGE OF ENTRY LEVEL PREDICTION ERROR (FL) - ICAO	AVERAGE OF ENTRY LEVEL PREDICTION (FL) ERROR - EFPL	% OF ENTRY LEVEL GOOD PREDICTION ICAO	% ENTRY LEVEL GOOD PREDICTION - EFPL
DLH	10	10	68%	69%
EZS	13	12	64%	68%
EZY	12	11	65%	68%

Descending phase				
Airline	Average of Entry level prediction error (FL) - ICAO	Average of Entry level prediction (FL) error - EFPL	% of entry level good prediction ICAO	% entry level good prediction - EFPL
Grand Total	11	11	66%	68%

Table 76: Impact of EFPL on sectors/TVs entry level prediction in the descending phase

Explanations:

- The entry level prediction error corresponds to the difference between the DCB system prediction of sector entry level and the entry level in the sector of the trajectory flown;
- A "good prediction "corresponds to the case of the sector entry level prediction error is lower than 10 levels (1000 feet).

Conclusions:

- The use of EFPL has in general a slight positive impact on the prediction of entry level sectors/TVs in particular in flights climbing phase and for the Easy Jet company;
- This better prediction of entry level may be useful for ATC and complexity management tools.

General conclusions of the impact of EFPL of DCB traffic predictions.

The use of EFPL allows in average a slight improvement of traffic predictions more particularly in climbing phase. Improvement mainly concerns the prediction of flight occupancy time in sectors.

There is no risk of global degradation of traffic predictability due to the use of EFPLs.

The EFPL can have a significant impact on the traffic prediction of sectors/TVs handling flights close to their TOC or TOD. Depending on traffic volumes and airlines providing the EFPLs, the difference in traffic predictability is either positive or negative. The negative cases have been analysed and reviewed by NM operational experts concluding that they should not necessarily impact negatively DCB operations. Further investigations should be performed. In particular:

- These differences may need to be checked with respect to RAD;
- The impact of these differences in terms of TV capacity needs to be checked. In order to this, the results need to be presented to the FMPs concerned.

CRT-07.06.02-VALP-713A.2012: Assess the proportion of the traffic for which the AO 4D trajectory (filed trajectory) can be used without modifications with regards ETFMS calculated 4D trajectory.

This success criteria has not been addressed since it is not needed to achieve V3 e-OCVM maturity level. It will be addressed in V4/V5 (see Section 6.2.2.3.2.1).

6.2.3.2.2.2 OBJ-07.06.02-VALP-713A.2030: Impact of EFPL late updates on predictability

CRT-07.06.02-VALP-713A.2031: The 4D trajectories, calculated by DCB, taking into account last update information are closer to the flown trajectories.

This success criteria has not been addressed since it is not needed to achieve V3 e-OCVM maturity level. It will be addressed in V4/V5 (see Section 6.2.2.3.2.1).

6.2.3.2.2.3 OBJ-07.06.02-VALP-713A.2040: AO 4D (filed trajectory) and NM 4D Trajectories accuracies without PTRs

CRT-07.06.02-VALP-713A.2041: With the implementation of EFPL, DCB Prediction is improved both in areas where PTRs are applied and in areas where PTRs are not applied.

This success criteria has not been addressed since it is not needed to achieve V3 e-OCVM maturity level. It will be addressed in V4/V5 (see Section 6.2.2.3.2.1).

6.2.3.2.2.4 OBJ-07.06.02-VALP-713A.2050: Consequences of the global mixed mode on DCB

CRT-07.06.02-VALP-713A.2051: Validation results provide significant information making it possible to assess whether operating with 4D trajectories based on different sources introduces any bias.

This success criteria has not been addressed since it is not needed to achieve V3 e-OCVM maturity level. It will be addressed in V4/V5 (see Section 6.2.2.3.2.1).

CRT-07.06.02-VALP-713A.2052: On a selection of TVs, validation results allow to compare the same traffic taking into account ICAO FPL only on the one hand and a mixed of ICAO FPL and EFPL on the other hand.

This success criteria has not been addressed since it is not needed to achieve V3 e-OCVM maturity level. It will be addressed in V4/V5 (see Section 6.2.2.3.2.1).

6.2.3.2.2.5 OBJ-07.06.02-VALP-713A.2060: Impact on ATFCM / regulated flights

CRT-07.06.02-VALP-713A.2061: The impact of EFPL (compared to ICAO FPL) on the number of flights impacted by regulations is acceptable.

This success criteria has not been addressed since it is not needed to achieve V3 e-OCVM maturity level. It will be addressed in V4/V5 (see Section 6.2.2.3.2.1).

CRT-07.06.02-VALP-713A.2062: The impact of EFPL (compared to ICAO FPL) on delays is acceptable.

This success criteria has not been addressed since it is not needed to achieve V3 e-OCVM maturity level. It will be addressed in V4/V5 (see Section 6.2.2.3.2.1).

6.2.3.2.2.6 OBJ-07.06.02-VALP-713A.2070: Impact on the reliability of the 4D Trajectory recalculation

CRT-07.06.02-VALP-713A.2071: Validation results provide significant qualitative information on a difference of reliability between these two calculated 4D Trajectories.

This success criteria has not been addressed as this objective was removed and integrated in OBJ-07.06.02-VALP-713A.2010 (see Section 6.2.2.3.2.1).

6.2.3.2.3 Results on validation objectives related to “FIXM Implementation”

6.2.3.2.3.1 OBJ-07.06.02-VALP-713B.1010: Operational feasibility of soft ATC constraint integration

This objective has not been addressed (see Section 6.2.2.3.2.1).

6.2.3.2.3.2 OBJ-07.06.02-VALP-713B.1020: FIXM Implementation feasibility

CRT-07.06.02-VALP-713B.1021: The use of FIXM EFPL extension operates successfully.

Objective reached. The FIXM 3.0 EFPL Extension has been used successfully during the Part-B of VP-713 exercise. The planned verification tests are executed successfully. The EFPL validation, submission and retrieve services were available via the NM and Lido prototypes. The verification tests concluded that the EFPL requests that were issued and processed via the NM EFPL model can also be issued and processed via the FIXM EFPL model.

CRT-07.06.02-VALP-713B.1022: The different types of trajectory exchanged and defined in the FIXM extension are agreed between NM and CFSPs.

The EFPL extension is reviewed and agreed between NM (EUROCONTROL) and the CFSP (Lufthansa Systems). All related services (and required clients) have been developed by NM (EUROCONTROL) and the CFSP (Lufthansa Systems) prior to implementation of the prototypes and successfully used for the FIXM analytical modelling exercise.

6.2.3.2.3.3 OBJ-07.06.02-VALP-713B.2010: PTRs Impact on Predictability

This objective has not been addressed (see Section 6.2.2.3.2.1).

6.2.3.2.4 Results on validation objectives related to Collaborative NOP

For the detailed information on NOP Step 1 Validation report, please refer [26].

6.2.3.2.4.1 OBJ-07.06.01-VALP-GEN1.0100: Assess that any change in stakeholders operational plans can be transmitted to the NOP and the Network Plan can be updated accordingly.

CRT-07.06.01-VALP-GEN1.0103: The Network Manager is able to capture EFPL 4D trajectory information, originated by AU and update the NOP accordingly

FPL Delay (ICAO DLA equivalent) and Change (ICAO CHG) messages were received on the NMVP via the FPL service interfaces and processed successfully

CRT-07.06.01-VALP-GEN1.0104: The NOP has been successfully updated when operating in global mix mode; i.e.; EFPLs and ICAO update messages

The evidence collected showed that mixed mode operations did not have a significant impact on IFPS operators' workload

6.2.3.2.4.2 OBJ-07.06.01-VALP-GEN1.0200: Assess that all partners involved in operations can have easy access to any NOP update with potential impact on their operations.

CRT-07.06.01-VALP-GEN1.0203: The NOP has been successfully updated when operating in global mix mode; i.e.; EFPLs and ICAO update messages

Positive feedback was received from operational users on the published data to build their 4D trajectories:

- IFPS operators considered that the introduction of the EFPL did not impact their Situation Awareness compared to the current ICAO Flight Plan Validation process.

- The information provided by the EFPL (modifications introduced with respect to ICAO FPL) is relevant for the tasks performed by all actors:
    - IFPS Operators mentioned that in the EFPL message there are whole blocks that they don't even consider to understand why the flight went invalid (like performance data for instance). In this case, EFPL provides them even more information than they need for most operations.
    - Dispatchers found the information provided by EFPL relevant; they just need that data to be displayed in a more meaningful way so it improves the efficiency in operations

The system solution to managing the EFPL modification was accepted by all affected actors. Still, as it was mentioned in previously, the EFPL change for AUs side can still be improved with more adequate interface implementations that better support them identifying the FPL changes they have to do in order to get the FPL approved.

CRT-07.06.01-VALP-GEN1.0204: The NOP supports the mixed mode of operations by publishing (via SWIM-B2B and or in the situation display) AO 4D trajectories, ICAO flight plans and derived NM calculated trajectories

Positive feedback was received from the NM on the support of the NOP to Mixed mode of operations:

- IFPS operators considered that the introduction of the EFPL did not impact their Situation Awareness compared to the current ICAO Flight Plan Validation process.
- The information provided by the EFPL (modifications introduced with respect to ICAO FPL) is relevant for the tasks performed by all actors.

CRT-07.06.01-VALP-GEN1.0205: NOP provides confidentiality of commercially sensitive data (Flight Performance data and ToW)

Objective partially reached. The FSPD and the ToW were not visible in the summary queries on the CHMI and NOP Portal. However, it is present in the OPLOG information that can be accessed via the CHMI and the NOP Portal.

Therefore, this objective has not been completely achieved

6.2.3.2.4.3 OBJ-07.06.01-VALP-EFPL.0100: Assess that EFPL 4D trajectory information contributes to the elaboration of the Network Operation Plan with improved network predictability.

CRT-07.06.01-VALP-EFPL.0101: Assess the level of contribution to traffic predictability of each element of the EFPL.

Main conclusions that can be derived are: the use of EFPL (using both the 4D trajectory and flight specific performance data) has in general a balanced impact on traffic volume entry time

CRT-07.06.01-VALP-EFPL.0102: The 4D trajectories, calculated by DCB, taking into account last update information are closer to the flown trajectories

This success criteria has not been addressed.

6.2.3.2.4.4 OBJ-07.06.01-VALP-EFPL.0200: Assess that EFPL 4D trajectory information contributes to the elaboration of the Network Operation Plan with improved DCB assessment/predictions.

CRT-07.06.01-VALP-EFPL.0201: The NOP has received 4D trajectory information from an EFPL, which has been used to better assess traffic demand (with entry traffic counts, Occupancy counts and Flight Lists) supporting the Network Manager in the enhancement of DCB assessment

This success criteria has not been addressed.

CRT-07.06.01-VALP-EFPL.0202: The impact of EFPL (compared to ICAO FPL) on delays is acceptable or delays are reduced

This success criteria has not been addressed.

CRT-07.06.01-VALP-EFPL.0203: The impact of EFPL (compared to ICAO FPL) on the number of flights impacted by regulations is acceptable

This success criteria has not been addressed

6.2.3.2.5 Unexpected Behaviours/Results

6.2.3.2.5.1 Unexpected results

None

6.2.3.2.5.2 Unexpected behaviour:

The sample flight plan messages used for analysis were reduced to avoid the following technical errors from interfering with the analysis results, as described in section 6.2.2.2.2.3.

Unexpected behaviour of the NM systems

- SID/STAR replacement errors due to the fact that the SID/STAR from the A04D insertion into the F15 was sometimes erroneous (e.g. ROUTE 165 LIDCT).
- The 'elapsedTime' values in the accepted trajectory returned by NM were slightly different than the ones sent by AO and the ones kept in the NM systems. Therefore, these values are ignored, and the 'elapsedTime' values supplied by the AO are used during the analysis.

Unexpected behaviour of the CFSP systems

- The ICAO FPL message that is sent as an update message to OPS (ICAO FPL checkpoint Update) has been sent as 'EFPL Create' message to NMVP, which then was rejected because it should have been sent as 'EFPL Update' message.
- Incorrectly formatted B2B request was sent which was not proccessable by the NMVP.
- Invalid Attribute Value (value that does not respect the expected format) was coded in the EFPL message, therefore the EFPL was rejected.
- EFPL Message with missing equipment codes was sent; therefore the EFPL was rejected.

Furthermore, some of the initially foreseen metrics could not be measured due to the validation techniques and limitations of the post-processing tools. The unexpected behaviour led to absence of evidence for achievement of a few success criteria.

6.2.3.3 Confidence in Results of Validation Exercise

6.2.3.3.1 Quality of Validation Exercise Results

6.2.3.3.1.1 Part-A – Gaming Sessions

The qualitative data are judged to be of good quality although the survey responses of AUs were limited by the small number of AUs involved. The number of participants was relative small and this has an impact onto the share of a certain answers in the questionnaire. Every of the participants represents about 8% share of the group of flight dispatchers. Therefore the scaling of results has a reduced granularity. However, these were sufficiently complemented by debriefing notes and post-trial feedback. As the dispatchers had a long years' experience in flight planning, their feedback in regard to the filing procedures can be assumed as being an expert opinion increasing the quality of the result. The concept of the EFPL was new but generally understood by the participants. However the replies to some of the questions of the questionnaire suggest that not all aspects of the EFPL concept were sufficiently made available for them. Therefore some of the replies have to be considered with care.

6.2.3.3.1.2 Part-A – Shadow Mode

This validation exercise was purely based on operational flights that were dispatched by the participating airlines. This brings the validation exercise very close to the real flight operations and significantly increases the quality of the results significantly.

The quality of the quantitative validation exercise results depends on the domain and the type of sessions:

- Quantitative results on flight planning: the results can be considered as highly reliable since it was possible to perform a direct comparison between the shadow mode sessions and the real operations, the operations being considered as the baseline. Moreover the very strong support of flight planning operational experts allows an in-depth analysis of all cases and the verification, case by case, of results. A factor slightly limiting especially the results on flight planning is the fact that the flight dispatchers of the respective airline were only working with the ICAO FPLs only. The validation results for the EFPL were not visible to the respective flight dispatchers. Hence the resulting acceptance rate for the EFPLs could have been higher if the flight dispatchers would intentionally file their flights with the EFPL. This limitation was caused by the setup of this part of the validation exercise where the EFPL was only filed in background.
- Quantitative results on traffic predictability: the results can be considered as of relatively less good quality. Due to the differences in some environment parameters (e.g Meteo, dynamic runway operations, in use,) between operations and the shadow mode sessions there was the need to set-up a complex quantitative assessment process to do a fair evaluation of the impact of EFPL on traffic predictability. This process includes in particular the conduction of multiple post-ops replay sessions chaining flight planning and flow management processes and the use of a model based tool (NEST) to produce some metrics and perform some analysis. This complex process may have introduced some bias[13] in the results produced. Moreover since the process was complex and required manual processing, results have been produced only for one day traffic.

6.2.3.3.1.3 Part-B – FIXM Implementation

[13] However, if some bias exists it should be of limited amplitude. For a set of selected test case flights, an in-depth analysis has been performed involving both operational and system experts and no bias has been detected for these cases.

This part of the validation exercise was only planned to confirm the alignment between the NM EFPL XML format and the FIXM EFPL format. As this was only a one by one comparison of the respective content of the FIXM service replies the results can be assumed of being of high quality.

6.2.3.3.2 Significance of Validation Exercise Results

6.2.3.3.2.1 Part-A – Gaming Sessions

Experienced flight dispatchers were present in this part of the validation exercise. Except three dispatchers all were already familiar with the flight planning system. That means that, in can be assumed that they were able to focus onto the validation of the EFPL concept. For the three remaining flight dispatchers a short introduction into the system was required. Anyhow the validation exercise was setup in a way that all participating flight dispatcher were able to assess the EFPL concept. In result the validation exercise has been performed by very experienced flight dispatchers, representing different types of airlines, like scheduled airlines, low cost airlines, regional air carrier and charter airlines. This composition of flight dispatchers increases the significance of the validation exercise. The only factor that might reduce the significance of the validation result is the slightly low number of participating flight dispatchers. From this perspective the significance of any statistical number (average values; share of reported answers) must be carefully interpreted as every participating flight dispatcher represents almost 8% of the group of dispatchers. Anyhow, individual statements and conclusions made during the validation exercise can be seen as being significant due to the experience of the individual flight dispatchers.

6.2.3.3.2.2 Part-A – Shadow Mode

For the validation exercise their flight planning systems where upgraded and configured to send an EFPL to NMVP, whenever an ICAO flight plan was filed, changed, delayed or canceled. Hence all their operational flights dispatched in the period in which the shadow mode trial of the validation exercise was performed where send to the NMVP and recorded as sample flight. The airlines represent different types of airlines. The list included main airlines, a cargo airline, low cost airlines, regional air carrier and charter airlines. The respective airlines are operating within the whole ECAC area, but also provide intercontinental transport services. The participating airlines are located in different European areas. While most of these airlines are located in Germany (Lufthansa, Lufthansa CityLine, Lufthansa Cargo, germanwings and Condor), participating airlines from other European countries, as Portugal (TAP), Sweden and Belgium (Thomas Cook) and Great Britain (easyJet and Thomas Cook) were joining this validation exercise. All these airlines provided more than 10,000 flights from which about 8,000 were used for the analysis.

6.2.3.3.2.3 Part-B – FIXM Implementation

This part of the validation exercise was rather a verification of the FIXM EFPL related format and services. At CFSP side, only Lufthansa Systems participated (no participation from SABRE). The composition of sample flights was defined to support a technical assessment, rather than an operational assessment of any procedures and processes. The approach that was chosen is a comparison of the EFPLs and related reply messages in the NM EFPL XML format with the corresponding messages for the EFP FIXM format. For that reason a sample with 150 flights mainly departing and arriving within the whole ECAC area was defined to have a good coverage of the European area. Furthermore those flights were calculated in different ways to force the presence of certain flight plan rejects. 2/3 of these flights have been calculated without consideration of the full scope of flight restrictions. This led to a high number of rejects for which the respective reply messages were compared and analyzed. The sample and the related approach ensured that a wide range of reject messages and reject reasons were generated. This increase the significance of the results as variety of observed cases was very high.

6.2.4 Conclusions and recommendations

6.2.4.1 Conclusions

6.2.4.1.1 Conclusions from FOC perspective

The validation exercise has shown that the use of the EFPL for filing is already on a high maturity level. The average acceptance rate of 97% for the EFPL is on a very high level. The reason for having still a lower acceptance rate compared to the ICAO flight plan (about 2% points lower) was mainly driven by the setup of the shadow mode exercise. The EFPL was always provided for the trajectory that was planned to get the acceptance with the ICAO flight plan. In many cases (especially for the major airlines) the current procedures involve the use of predefined routes for each city pair. These predefined routes are in most cases only describing the routing over ground; potentially enriched by some RFLs. On the day of operations these predefined routes are used to generate 4D trajectories that can be filed. These trajectories are built to reduce the probability of getting a reject when filing an ICAO flight plan and must be calculated without consideration of restrictions to avoid that Lido/Flight fails when calculating such trajectories. As some of these trajectories are not considering all constraints they are rejected when using the EFPL for filing while the ICAO flight plan might be accepted. Therefore the lower number of accepted EFPLs compared to the ICAO flight plans discloses rather the number of ICAO flight plans currently accepted with an invalid trajectory that is not known to IFPS. In those cases, the pilot will be briefed with a different trajectory compared to that one that is used by the NM.

On the other hand the validation exercise showed that in case that an ICAO flight plan with a valid trajectory, that is not known to IFPS, is rejected the EFPL will be accepted. In the particular shadow mode exercise the rate of EFPL accepted while the ICAO flight plan was rejected was about 87% in average. When looking more into the details the number of accepted EFPLs for which the ICAO FPL was rejected was higher for airlines that optimize the flight on a daily basis. For those airlines the acceptance rate for EFPLs for which the ICAO flight plan was rejected was at almost 100%. In those cases the EFPL would directly lead to gains in cost efficiency on airspace user side in two ways. On the one hand the flight planning effort is decreasing in cases where the trajectory calculated by the flight planning system is directly accepted. On the other hand the initially planned trajectory might be the most optimal trajectory. If this trajectory is directly accepted the flight cost efficiency should also increase.

During the gaming sessions the potential of the EFPL to decrease the workload by reducing the number of ICAO flight plans rejected although they had a (unavailable) valid trajectory and by a more direct link between a reject reason and the trajectory planned by the airspace user was identified by the participating flight dispatchers. But on the other hand the concern was raised that deviations between the trajectory planned by the airspace user and the trajectory build by NM and returned in the EFPL acceptance message might increase the workload as the airspace user might be required to compare both trajectories in every case and have to assess the impact on the flight efficiency and the fuel amount aboard. As the EFPL filing response and the 4D trajectory is provided in an XML format, the workload must not necessarily increase for the individual dispatcher as it would be possible to automate such comparison. Furthermore it should be considered that such comparison would also be required for current operations where the deviation between the 4D trajectory calculated in the flight planning system for an ICAO flight plan and the 4D trajectory in the NM system should be more significant. In this context it was also pointed out that any trajectory change should be explained by NM by the provision of detail constraint/ restriction information. Such information is required for the airspace user to reconstruct any change made to their trajectory. Furthermore the requirement was raised that the data included in a flight plan reject message should be more detailed to allow a more appropriate reaction on any error. Currently the replies for any EFPL provision are equal to what is received when filing an ICAO flight plan. But the airspace user concluded that this is not appropriate in every case as they would like to have a better correlation between a reject reason and the planned trajectory.

A further conclusion of the validation exercise is that some of the processes, e.g. the communication between the airspace user and the NM, especially in case of a reject appears to not clearly defined from the airspace user perspective. Such definitions would have direct impact onto required tools or – if applicable – specific training of airspace users.

It has to be analyzed which granularity and units are required to sufficiently exchange 4D trajectories. This specifically relates to the question of the trajectory point density. Compared to the ICAO FPL the approach is quite different. While in the ICAO FPL only published waypoints and some requested flight levels are used, the EFPL shall include a 4D trajectory which includes as many points as needed to sufficiently figure out the planned trajectory. For every of these trajectory points the height has to be added to the EFPL. This is a fundamental difference between the ICAO FPL (only indicating requested cruising levels) and the EFPL (indicating every planned level). That already shows that the question about the appropriate granularity and <unit> information has to be discussed again. This should also have some effects on the definition of the FF-ICE concept.

It has to be further analysed whether and how many of certain rejects have been caused by the unit of measure. Such analysis was not possible during the time window of this validation exercise.
This topic also turns the focus again onto the granularity of data that is included in the EFPL. Lido/Flight is calculating information in a higher granularity as being coded in the EFPL. The question should be addressed on the required precision that has to be used in this type of flight plan. This should focus on the use of the data and in the context future initiatives like the integration of RPAS/ UAVs, 4D trajectory enabled trajectory management ATM environment, including Free Routing and Advanced Flexible use of Airspace.

6.2.4.1.2 Conclusions from NM perspective

The following general conclusions can be derived from the results of the exercise and in particular the analysis of the success criteria.

- Operational feasibility of the use of the extended flight plan in NM operations has been proven both at the level of flight planning and flow management.
- Main critical safety requirements are validated. In particular the exercise has demonstrated that the EFPL does not generate general risks in some safety critical processes like flight plan distribution to ANSPs and identification of potential overloads in DCB. Some specific issues in some geographical areas need further analysis and treatment but these can be addressed in implementation case by case
- Some immediate benefits have been evaluated both at the level of flight planning and flow management either in terms of increased transparency and trajectory alignment, less FPL rejections or increased traffic predictability in some specific areas.
- The technical feasibility of EFPL dedicated services has been proven. Dedicated services using the current NM B2B interface were prototyped and successfully used in the context of shadow mode sessions by on AUs on-site legacy flight planning systems.
- Standardisation needs have been covered and the migration to FIXM - the format for the future ICAO FPL - has been tested successfully. The FIXM EFPL verification exercise demonstrated that FIXM needs to mature by aligning further with ICAO definitions and referring to the operational requirements in order to be used for flight planning operations. This feedback and change requests were submitted to the FIXM CCB as the result of the extension development and the exercise.

A number of open points remain:

- The exercise has shown that in a first implementation step, a full alignment of AU and NM trajectories is not possible. In order, to avoid the risk to decrease traffic predictability, NM needs to adapt the AU trajectory in particular to better integrate ATC procedures like LOAs.
- Related to the previous point, in the context of the EFPL information exchanges, NM is providing back to the AU more information about how the PTRs/LOAs are impacting the flight and the resulting trajectory calculated by NM. How this information could be used by the AU, as well as the associated benefits has not been clarified yet.

The open points are not showstoppers and do not need to be necessarily addressed in the first step of implementation of the solution #37. Therefore, considering the results of the exercise VP-713, the solution #37 can be considered of having achieved the E-OCVM V3 maturity status. This conclusion is agreed by all stakeholders involved in the exercise including NM, the CFSPs and AUs.

6.2.4.2 Recommendations

6.2.4.2.1 Recommendations from FOC perspective

From the results of the validation exercise several recommendations can be extracted. Even if the concept is already on a very high maturity level further items should be addressed in future activities that will be required for the introduction of the concept into flight operations.

It was pointed out that differences between the trajectory provided by the airspace user and the one processed and replied by the NM are seen with concerns. Those differences should be further addressed and sorted out as much as possible. Reasons for such differences have already been identified. On the one hand the use of Profile Tuning Restrictions in the NM system and on the other hand deviating implementations of aeronautical data in the different systems are sources for such deviations. It should be investigated how these differences could be reduced or whether special procedures could be designed that lead to a better alignment of both trajectories. However the target should be that the trajectory as planned by the airspace user is directly used by NM without any adaptations. From this perspective it should be investigated in SESAR 2020 how this could be achieved in future.

Furthermore it was pointed out that the information given with the reject message could be improved and enriched as it is not 100% expressive in any case. In addition that information should be available in a way that it could be graphically displayed to a flight dispatcher, for example as overlay to the trajectory that has been planned by flight planning system. It should be investigated whether such reject information can be provided in a more granularity way and how such information can be made available to the flight dispatcher.

The topic “unit of measure” should be addressed as soon as possible. This and the previous validation exercises on the EFPL showed that this topic is of a high importance.

Most of the airspace user pointed out that the definition and standardization of processes, procedures and formats related to the exchange of EFPLs is required and seen as important. Currently the processes related to the EFPL filing were equal to those used for the ICAO flight plan. But further clarification should be achieved on how to deal with differences between the AU planned trajectory and the trajectory replied and processed by NM, how to handle rejects and how to communicate with NM in case of reject, how to deal with PTRs etc. This might require new approaches for the flight plan filing. It is recommended to investigate these aspects and to find appropriate processes and standards that support all actors.

Apart from all the open questions and issues raised before, the EFPL already reaches a very high degree of maturity. Most of the issues could be solved in a step-wise approach, involving as much as possible the end users of the EFPL, the airspace users on the one hand and the NM, ANSPs and airports on the other hand. Such step-wise deployment of the EFPL concept should start as soon as possible. It is a result of the validation exercise that the implementation of the EFPL will be a process that will last some years. Therefore next steps should be started rather soon. A first step could be a more operational approach for EFPL test that offers the airspace user the possibility to plan some flight with the EFPL and to become familiar with the concept. Many of the airspace users expressed that they do not know by 100% which consequences would result from the implementation of the EFPL. Hence an approach involving the airspace users as soon as possible would be appropriate. This would require further training and information events for the airspace users as well as further adaptations to the flight planning systems. For that purpose a workgroup could be established that drives the implementation of the EFPL. Such workgroup could also identify gaps in processes that have to be closed before the full benefit of the EFPL can be achieved.

AU mentioned they would benefit from an improvement in the information contained in the reject message coming from the NM and in the way this information is displayed. They would like to have more detailed information on the reasons behind the FPL rejection, also as a way to prevent to file other FPLs that will get rejected. The information that flight dispatchers mentioned they would like to visualize the were the following: delta fuel between what the filed FPL and what is accepted by NM, restriction details, including taxi time restrictions, integrated with the AUs’ flight plan system and FPL trajectory differences highlighted in the filed version.

AU would also like to get a better overview of the FPLs that were accepted but are significantly different from the filed FPL. The recommendation would be to use a different color code or alert indicating flight dispatchers that a given FPL way filed but with significant

6.2.4.2.2 Recommendations from NM perspective

Two types of recommendation can be derived from the outcomes of the exercise:

- Recommendations concerning the first implementation step planned at short term
- Recommendations regarding longer-term steps of implementation.

Regarding the first implementation step, the following recommendations are:

- To perform pre- operational live trials (V4) with candidate airlines in order to:
    - Minimise the risk of new flight plan rejections in the initial learning phase;
    - Further validate some aspects of the EFPL benefit mechanisms, and in particular the possibility for AUs to optimise todays filed 2D routes and 3D profiles and improve flight efficiency;
    - Identify the best options in terms of EFPL data (Take-off-weight, Performance data and 4D trajectory) to be used by the NM systems in order to optimise traffic predictability improvements and in particular study the non-mandatory provision of the performance data and their influence to the predictability in climb and descent phases.
    - Assess in coordination with concerned ASNPs the impact of EFPLs on flight plan distribution, traffic predictions and capacity in some specific areas.
- To further specify, plan and implement NM HMI improvements in order to support IFPS operators in the management of Extended Flight plans. In particular:
    - The IFPS operator mentioned that during the EFPL processing their assessment was not done as fast as with ICAO FPL. This happens because the EFPL message contains much more information and they have to search in different parts of the EFPL for the fields of information that are really relevant for their assessment. The recommendation to improve operator efficiency while processing EFPL is to have an initial field with a FPL summary with the ICAO FPL fields that contain the main information for them to perform a quick assessment. The message fields that are not so useful for IFPS operators (e.g. aircraft performance data) can be inserted in a collapsible menu below the initial information fields summary.
    - Having a different color code to distinguish the different types of FPL (ICAO FPL and EFPL). to support IFPS operators performance during mixed mode operations;
    - Allow the possibility to choose a position (geopoint) on the EFPL Flight editor of the IFPS NM HMI and that same position is highlighted on the Vertical profile display window and ops map window. This functionality would allow operators to save some searching time and possibly reducing the probability to read the wrong information fields by mistake.
- To plan system developments in NM systems in order to fully satisfy the confidentiality requirement.

Regarding further steps of EFPL implementation the recommendation is to plan additional SESAR validations in SESAR 2020 in order to:

- Assess the feasibility and benefits – in particular in terms of predictability - for AUs to better integrate ATC constraints (PTRs) in the AU planned trajectory included in the EFPL;
- Clarify the needs in terms of more detailed feedback provided by NM to the AUs;

2766 - Validate EFPL distribution services and the use of EFPL data by ATC.

7 References

7.1 Applicable Documents

[1] Template Toolbox - Ed.04.00.00 – 22/03/2014

[2] Requirements and V&V Guidelines – Ed.03.01.00 – 05/02/2014

[3] Templates and Toolbox User Manual – Ed.03.01.01 – 28/02/214

[4] European Operational Concept Validation Methodology (E-OCVM) – Ed.3.0 - February 2010

[5] EUROCONTROL ATM Lexicon https://extranet.eurocontrol.int/http://atmlexicon.eurocontrol.int/en/index.php/SESAR

7.2 Reference Documents

[6] 11.01.05-D31-Contribution to EXE-07.06.02-VP-713- EFPL Step 1 V3 Validation Report LSY

[7] 11.01.05-D31-Contribution to EXE-07.06.02-VP-713- EFPL Step 1 V3 Validation Report SABRE

[8] 07.02 - D30 – Network operations Validation Strategy for SESAR Step 1 Release 5 – Ed.03.00.01 – 03/02/2016

[9] B.01 Integrated Roadmap DS15

[10] 07.02 - D27 - Network Operations Step 1 Release 5 Detailed Operational Description (DOD) - Ed.00.04.01 – 02/05/2016

[11] 07.06.02 – D56 – Step 1 Business trajectory final OSED 2016- Ed.00.05.00 – 01/09/2016

[12] 11.01.02 - D55 - FOC operational and performance requirements for Step 1 (Quick Wins) including the traceability of the AU comments – Ed.00.01.04 – 22/11/2012

[13] 07.06.02 – D57 -Step 1 Business Trajectory final Safety Performance Requirements (SPR)– Ed.00.03.00 – 01/09/2016

[14] 07.06.02 - D02 - Step 1 Business and Mission Trajectory VALP Volume 1 - Ed.00.01.01 - 20/12/2013

[15] 07.06.02 - D88 - Step 1 Business Trajectory Validation Plan for VP-713 - Ed.00.01.01 - 18/12/2015

[16] 07.06.02 - D05 - Step 1 Business Trajectory Validation Report for 2013 2014 – Ed.00.01.01 – 25/07/2014

[17] 07.06.02 – D92 - Step 1 EFPL in NM Systems Technical Specification – Ed.00.01.00 – 30/08/2016

[18] 08.03.10 – D65 - European ATM Service Description for the ExtendedFlightPlanSubmission Service – Ed.00.03.01 – 20/07/2016

[19] 08.03.10 – D65 - European ATM Service Description for the FlightPlanDataDistribution Service – Ed.00.03.01 – 20/07/2016

[20] 07.06.02 – ExtendedFlightPlanSubmission Service Technical Design Document – Ed.00.01 – 10/12/2015

[21] 07.06.02 – FlightPlanDataDistribution Service Technical Design Document – Ed.00.01 – 10/12/2015

[22] 08.01.01 – D48 - SWIM Compliance Report for R5 V&V Exercise 713 – Ed. 00.00.05 – 01/08/2016

[23] 05.05.01 - D843 - Internal Validation Exercise Reports VP832

[24] 13.02.03 - D382 - Step1 eDCB VALR Part II – Ed.00.01.00 – 21/07/2015

[25] 07.06.01 - D47 - Step 1 Validation Plan 2015 – Draft Ed 00.00.09 – 24/10/2015

[26]07.06.01 – D05 - Step 1 EFPL Validation Report – Ed.00.01.01 – 04/08/2016

[27]11.01.05 - D16 - Contribution to EXE-07.06.02-VP-713-EFPL Step 1 V3 Validation Plan – Ed.00.01.00 - 26/06/2015

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

[28]WP C.03, C.03-D03-Regulatory Roadmap Development and Maintenance Process https://extranet.sesarju.eu/Programme%20Library/Forms/General.aspx

[29]WP C.03, C.03-D02-Standardisation Roadmap Development and Maintenance Process https://extranet.sesarju.eu/Programme%20Library/Forms/General.aspx

[30]SESAR Business Case Reference Material https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[31]SESAR Safety Reference Material https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[32]SESAR Security Reference Material https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[33]SESAR Environment Reference Material https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[34]SESAR Human Performance Reference Material https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[35]D07 Guidance on list of KPIs for Step 1 Performance Assessment Ed1 https://extranet.sesarju.eu/Programme%20Library/Forms/Procedures%20and%20Guidelines.aspx

[36]ATM Master Plan https://www.atmmasterplan.eu

Appendix A Human Performance Assessment

Dedicated Human Performance assessments have been performed by HP experts. Refer to the following embedded file.

VP713 VALP
Appendix_ HP Assess

Appendix B Safety Assessment

Dedicated Safety assessments have been performed by Safety experts. A safety assessment report has been delivered as an annexe of the "D57 Step 1 Business Trajectory final Safety Performance Requirements" document (Refer to [13]).

Appendix C Impact of the EFPL on the identification of flights crossing a sector or traffic volume

The following analysis uses the flights on the 29th and the 30th of January 2016. This decision was made taking into account the amount of traffic.

The ICAO (as calculated by DCB – ETFMS via NMVP replay) and AO4D (as received in the EFPL submission message) trajectories were used as inputs.

These two trajectories have been compared to a third trajectory which is the flown trajectory captured from NM OPS. The flown trajectory starts from the last filed flight plan (initial trajectory) and then updated with available radar information whenever the flight deviates from its last filed flight plan by more than any of the pre-determined NMOC thresholds of 5 minutes, 7FL or 20NM.

C.1 The sample

Thomas Cook was not included in the sample due to the small number of flights.

In order to avoid any kind on anomalies not all the traffic could be used for the comparison. Some trajectories were eliminated in the cases were the ICAO and EFPL trajectories were not comparable and also when the flown trajectory did not exist.

The sample contains 2153 flights for the 29th and 1643 flights for the 30th. It was considered that there is sufficient number of flights.

The following section is classified by days.

C.2 Global results

The following table represents the global results per day and per company group.

Airline	Date	TV Impacted	TV with positive impact	TV with negative impact
Lufthansa group [14]	29-01-2016	104	35	69
	30-01-2016	170	76	94
EasyJet group [15]	29-01-2016	100	70	30
	30-01-2016	59	43	16

Table 77: Impact of the EFPL on the identification of flights crossing TVs

[14] Lufthansa group includes the following Airlines: Air Dolomiti, Lufthansa, Lufthansa Cargo and Lufthansa CityLine.
[15] EasyJet group includes the following Airlines: EasyJet Switzerland and EasyJet

C.3 Results on the 29th of January

On the 29th of January:

- Lufthansa group: 1129 flights
- EasyJet group: 955 flights
- Thomas Cook group: 45 flights

Below are the comparisons between the three trajectories for the top 20 TVs with the highest absolute difference in number of flights crossing a TV.

The diagrams show the absolute value of the delta number of flights crossing a TV comparing ICAO full trajectory and EFPL full trajectory with the flown trajectory, i.e. the difference between the prediction of EFPL compared to ICAO.

First diagram shows the negative differences. The second diagram shows the positive differences in prediction.

C.3.1 Result analysis for Lufthansa group

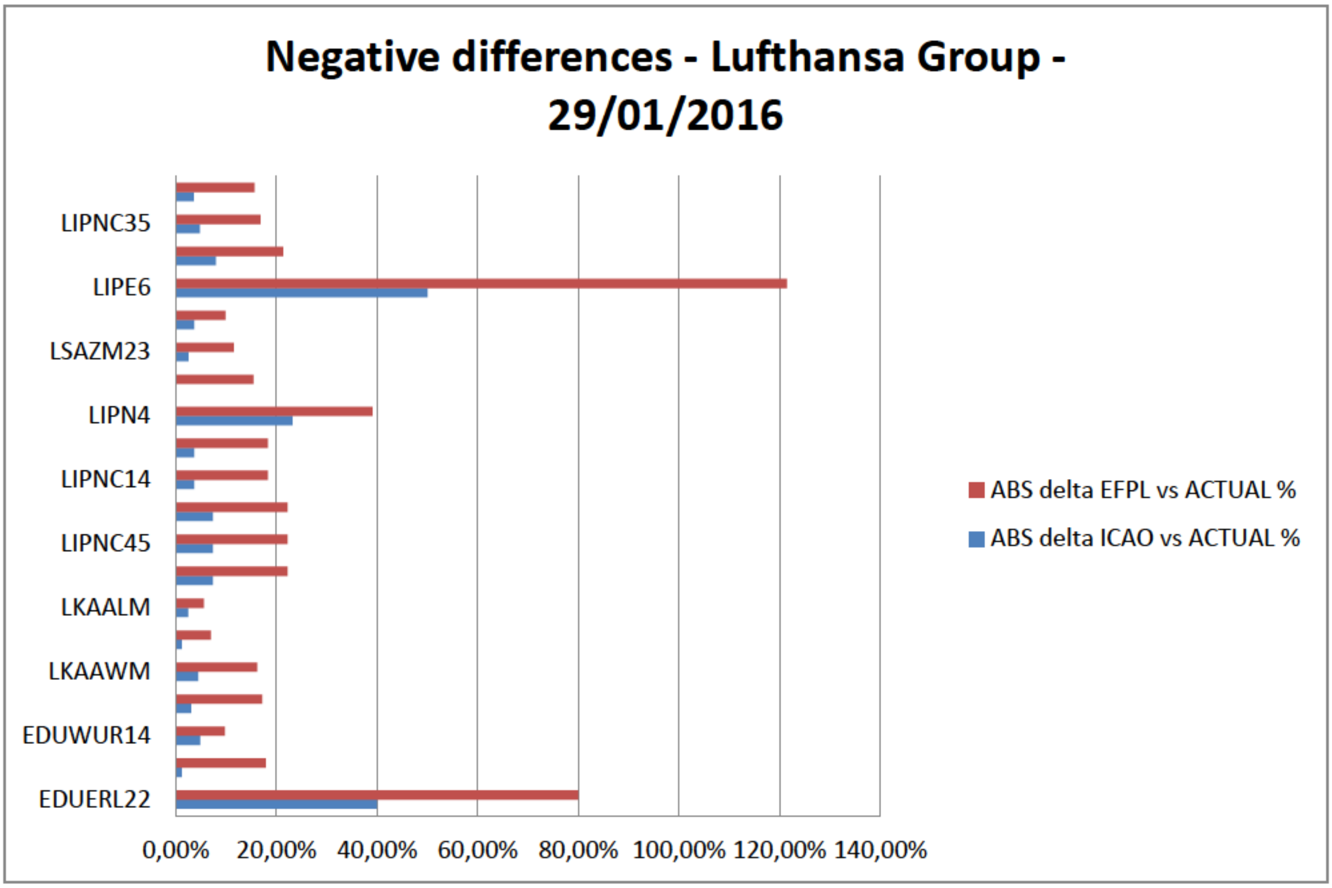
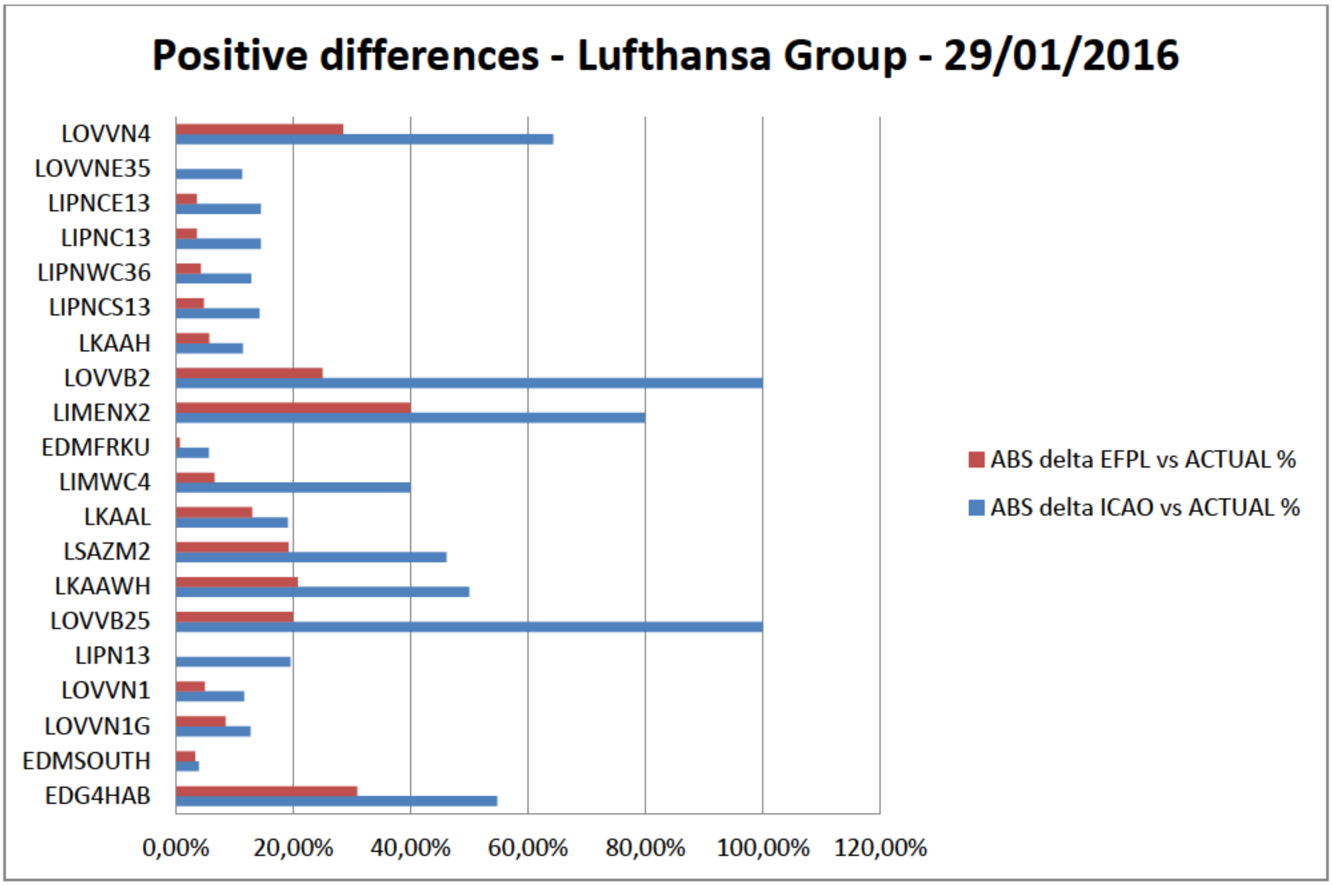


Figure 27: Negative differences between the prediction of EFPL compared to ICAO in terms of number of flights crossing a TV for Lufthansa group on the 29/01/2016



2895

2896 *Figure 28: Positive differences between the prediction of EFPL compared to ICAO in terms of number of flights*
2897 *crossing a TV for Lufthansa group on the 29/01/2016*

2898 In order to fully understand both cases, a more detailed analysis has been done as described in the
2899 following sections.

2900

C.3.1.1 Case 1: EFPL is closer to the Flown trajectory

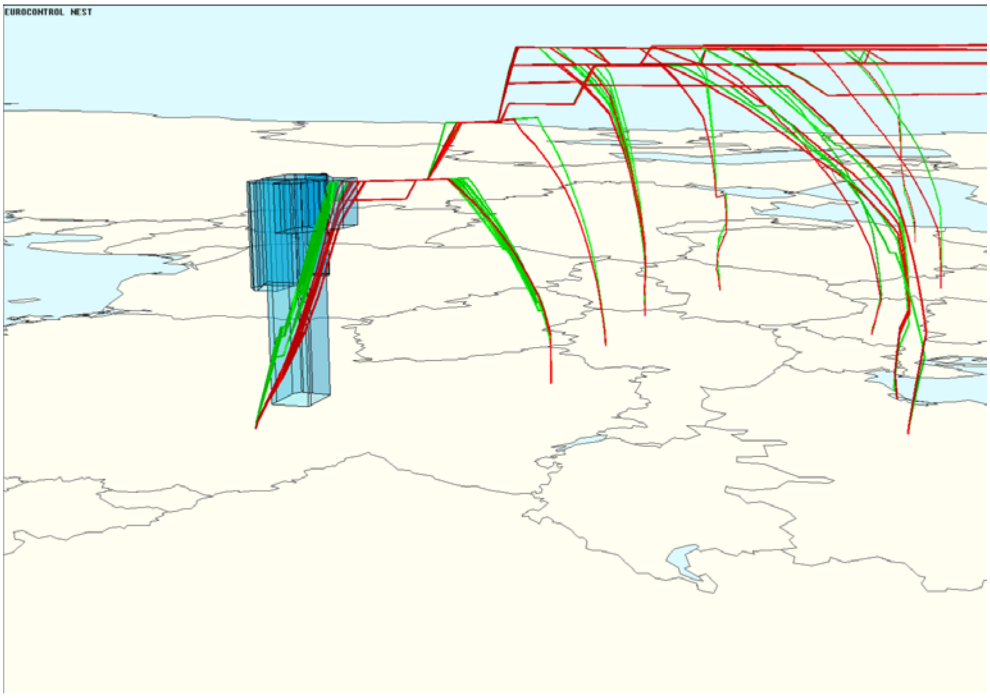
TV ID	ACTUAL	ICAO	EFPL	ABS DIFF	ABS DELTA ICAO VS ACTUAL %	ABS DELTA EFPL VS ACTUAL %	DELTA OF IMPROVEMENT
EDG4HAB	42	19	55	36	54,76%	30,95%	23,81%
EDMSOUTH	151	145	156	11	3,97%	3,31%	0,66%
LOVVN1G	47	53	43	10	12,77%	8,51%	4,26%
LOVVN1	60	67	57	10	11,67%	5,00%	6,67%
LIPN13	46	55	46	9	19,57%	0,00%	19,57%
LOVVB25	10	0	8	8	100,00%	20,00%	80,00%
LKAAWH	24	36	29	7	50,00%	20,83%	29,17%
LSAZM2	26	38	31	7	46,15%	19,23%	26,92%
LKAAL	115	93	100	7	19,13%	13,04%	6,09%
LIMWC4	15	9	16	7	40,00%	6,67%	33,33%
EDMFRKU	142	150	143	7	5,63%	0,70%	4,93%
LIMENX2	5	9	3	6	80,00%	40,00%	40,00%
LOVVB2	8	0	6	6	100,00%	25,00%	75,00%
LKAAH	35	39	33	6	11,43%	5,71%	5,71%
LIPNCS13	63	72	66	6	14,29%	4,76%	9,52%
LIPNWC36	70	61	67	6	12,86%	4,29%	8,57%
LIPNC13	55	63	57	6	14,55%	3,64%	10,91%
LIPNCE13	55	63	57	6	14,55%	3,64%	10,91%
LOVVNE35	53	47	53	6	11,32%	0,00%	11,32%
LOVVN4	14	23	18	5	64,29%	28,57%	35,71%

Table 78: List of TVs where prediction of EFPL is closer to the flown trajectory (compared to ICAO) in terms of number of flights crossing a TV for Lufthansa group

Analysis for the Traffic volume EDG4HAB

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of improvement
EDG4HAB	42	19	55	36	54,76%	30,95%	23,81%

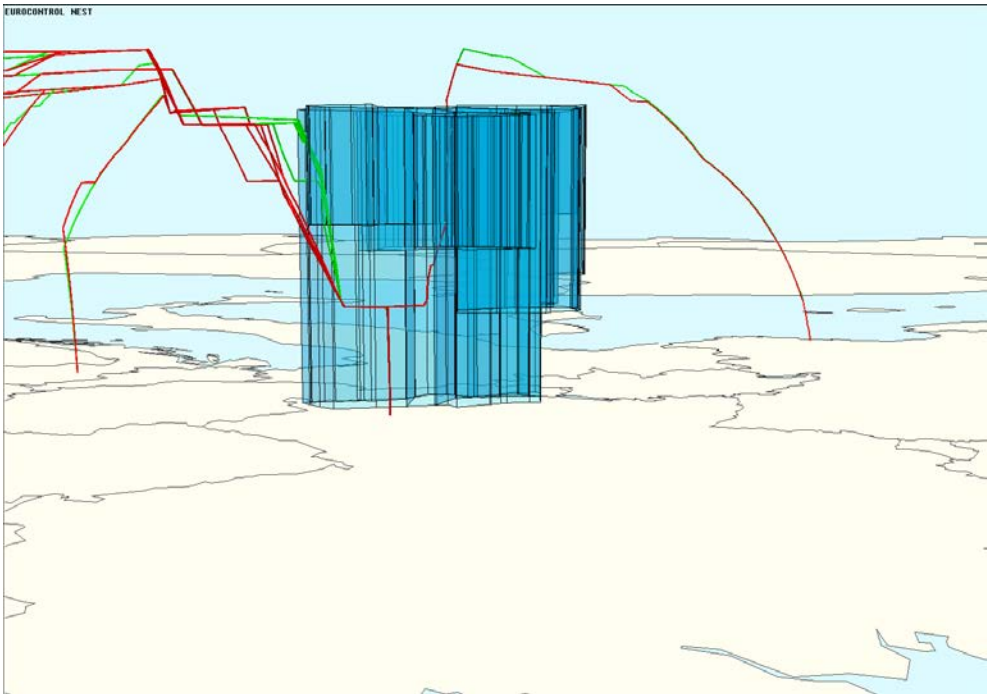
In this TV, traffic predictability was improved by 37 flights. All this flights were landing at EDDF and in the descending phase they were predicted to cross this TV. EFPL is the green trajectory (crossing the TV). ICAO is the red one (not crossing).



Analysis for the Traffic volume EDMSOUTH

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of improvement
EDMSOUTH	151	145	156	11	3,97%	3,31%	0,66%

In this TV, traffic predictability was improved by 14 flights. All the flights were, either landing (9 flights), or taking-off (5 flights) from EDDM. Those flights landing at EDDM were crossing the TV (green trajectories).



C.3.1.2 Case 2: EFPL is further from the Flown trajectory

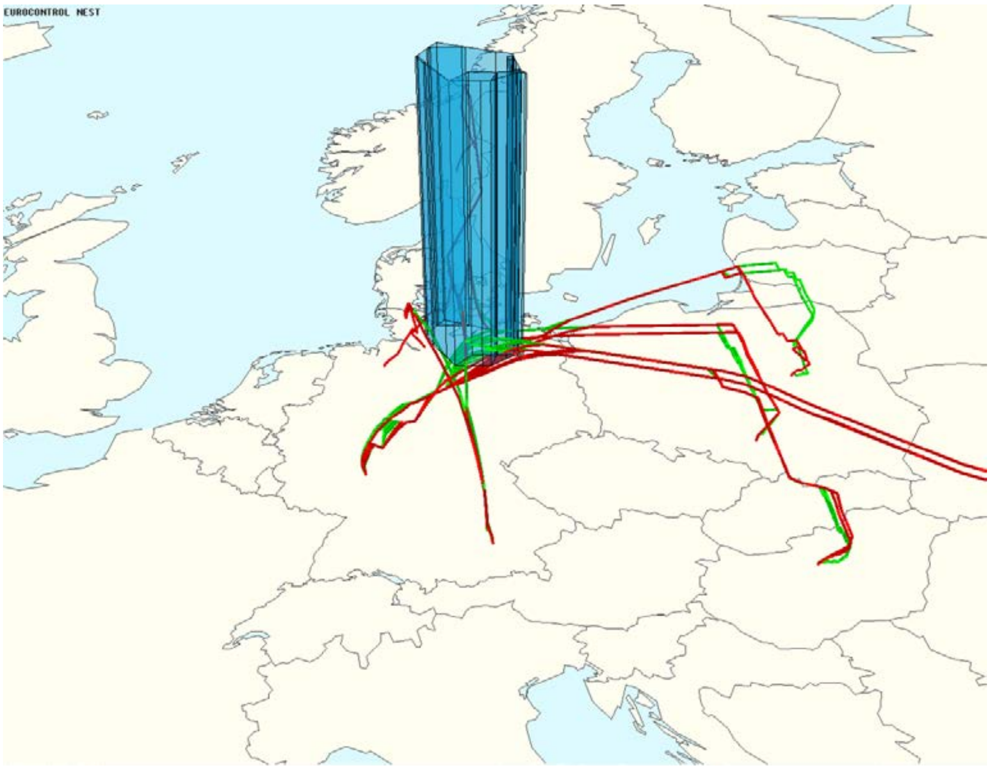
TV ID	ACTUAL	ICAO	EFPL	ABS DIFF	ABS DELTA ICAO VS ACTUAL %	ABS DELTA EFPL VS ACTUAL %	DELTA OF DEGRADATION
EDUERL22	15	9	27	18	40,00%	80,00%	40,00%
LIPN14	78	79	64	15	1,28%	17,95%	16,67%
EDUWUR14	102	107	92	15	4,90%	9,80%	4,90%
LIPNE34	64	66	53	13	3,13%	17,19%	14,06%
LKAAWM	111	106	93	13	4,50%	16,22%	11,71%
LKAAWLM	157	159	146	13	1,27%	7,01%	5,73%
LKAALM	162	166	153	13	2,47%	5,56%	3,09%
LIPN45	81	75	63	12	7,41%	22,22%	14,81%
LIPNC45	81	75	63	12	7,41%	22,22%	14,81%
LIPNCE45	81	75	63	12	7,41%	22,22%	14,81%
LIPNC14	82	79	67	12	3,66%	18,29%	14,63%
LIPNCE14	82	79	67	12	3,66%	18,29%	14,63%
LIPN4	69	53	42	11	23,19%	39,13%	15,94%
LSAZM3	71	71	82	11	0,00%	15,49%	15,49%
LSAZM23	78	76	87	11	2,56%	11,54%	8,97%
LSAZM123	81	78	89	11	3,70%	9,88%	6,17%
LIPE6	14	21	31	10	50,00%	121,43%	71,43%
LIPNC34	75	69	59	10	8,00%	21,33%	13,33%
LIPNC35	83	79	69	10	4,82%	16,87%	12,05%
LIPNCS14	83	80	70	10	3,61%	15,66%	12,05%

Table 79: List of TVs where prediction of EFPL is further from the flown trajectory (compared to ICAO) in terms of number of flights crossing a TV

Analysis for the Traffic volume EDUERL22

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
EDUERL22	15	9	27	18	40,00%	80,00%	40,00%

All these flights are taking off either from EDDF (13 flights) or from EDDM (5 flights). In the climbing phase, EFPL predicted that they would go through the TV EDUERL22 (reference location sector EDUUERL22). In the ICAO the flights are not crossing this TV and they are climbing later. EFPL is then predicting an earlier climb. The red trajectories correspond to ICAO (not crossing) and the green ones to EFPL.

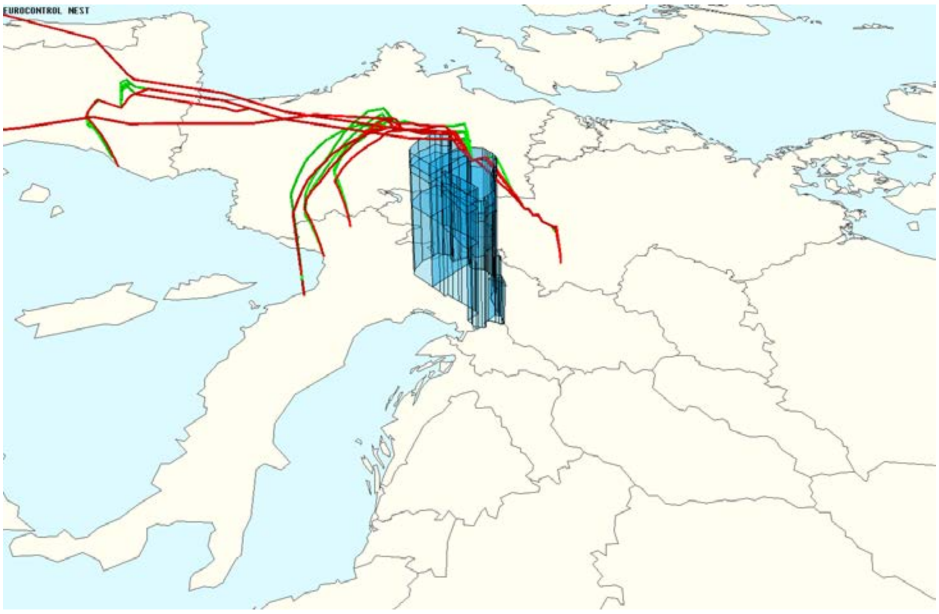


Analysis for the Traffic volume LIPN14

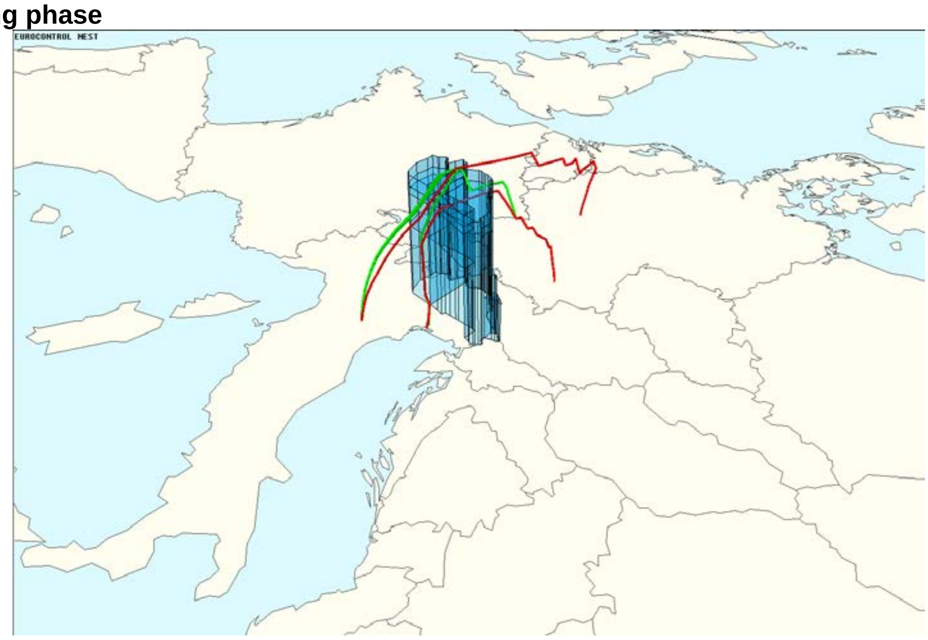
ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
LIPN14	78	79	64	15	1,28%	17,95%	16,67%

This 15 flights missed in the EFPL prediction where all arriving at EDDF (3 flights) or at EDDM (12 flights). In this case 11 flights were missing this TV when climbing and 4 when descending (DLH2EP, DLH4RJ, DLH8XA and DLH5PZ).

Climbing phase



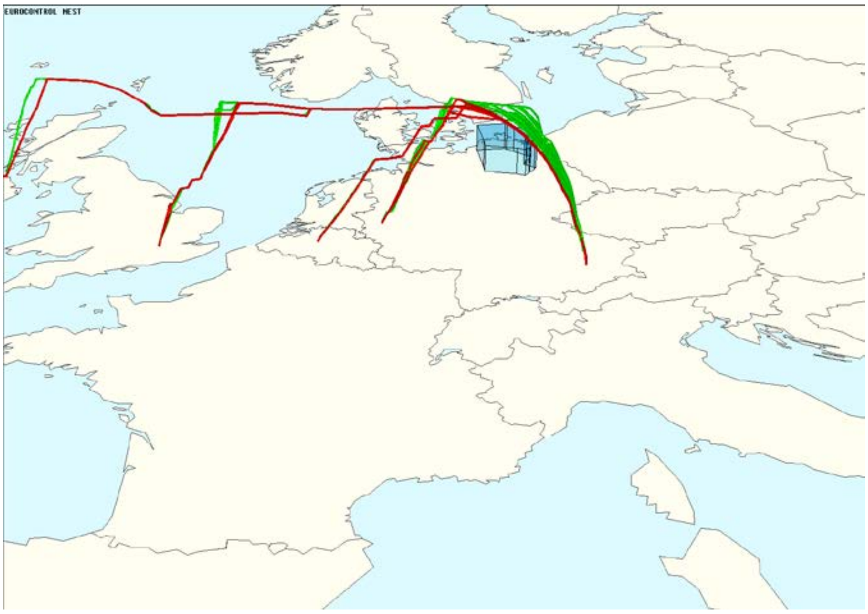
Descending phase



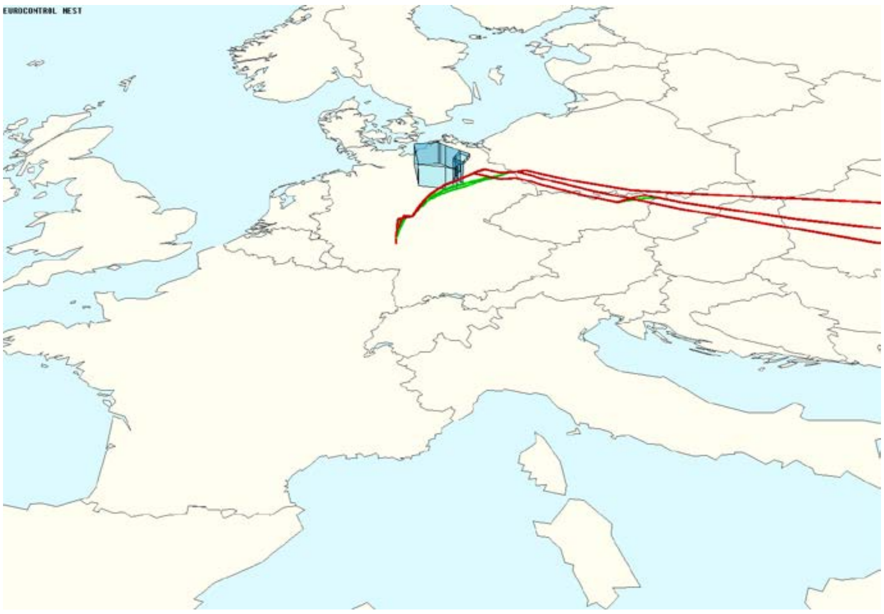
Analysis for the Traffic volume EDUWUR14

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
EDUWUR14	102	107	92	15	4,90%	9,80%	4,90%

In this case there are 19 flights of difference (only 15 callsigns). For the flights that were departing from EDDM (16) EFPL predicted and early climb, and ICAO a later one. Again, we observe that EFPL is anticipating the climbing phase.



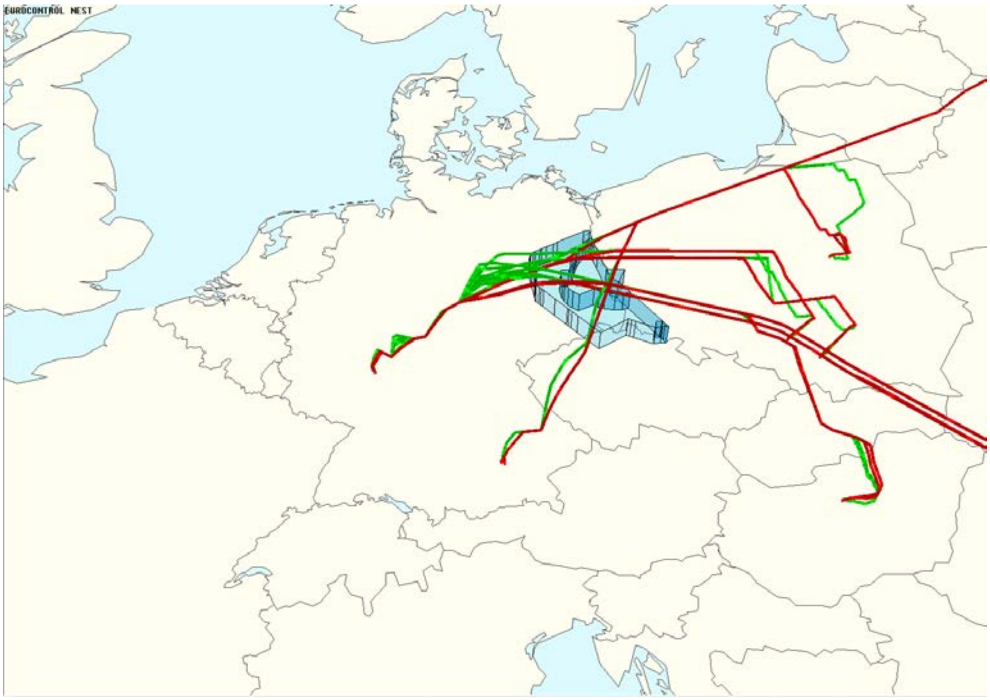
The other flights are all departing from EDDF and it´s the opposite case. EFPL was predicting a later climbing while ICAO predicted a sooner one.



Analysis for the Traffic volumes LKAAWM / LKAAWLM / LKAALM

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
LKAAWM	111	106	93	13	4,50%	16,22%	11,71%
LKAAWLM	157	159	146	13	1,27%	7,01%	5,73%
LKAALM	162	166	153	13	2,47%	5,56%	3,09%

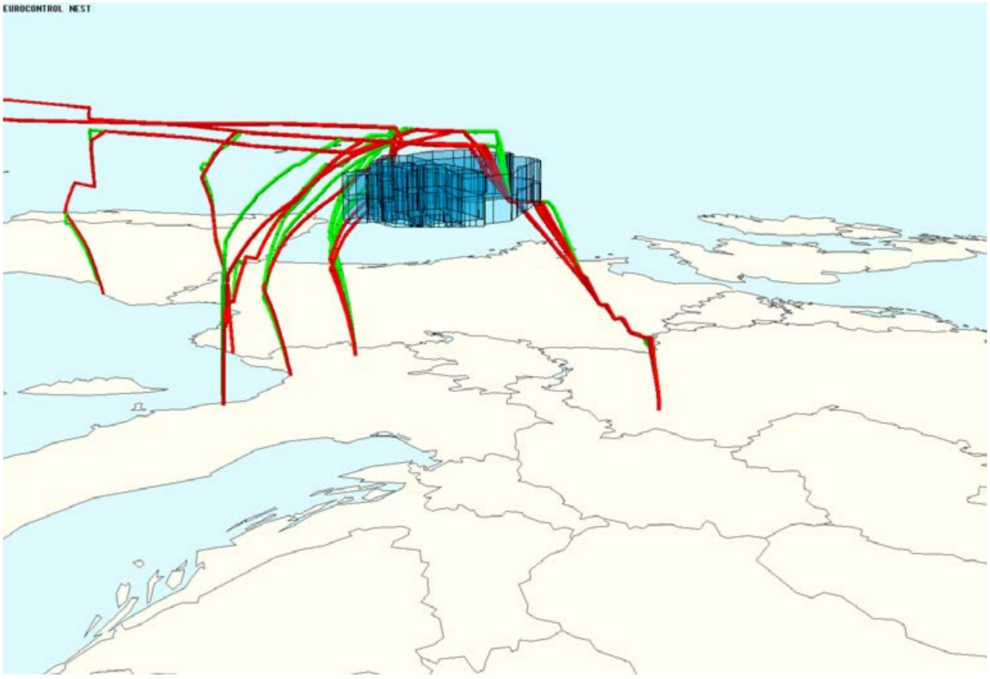
ICAO predicted 14 flights more than EFPL crossing this TV. All of them are departing from EDDF or EDDM. EFPL was predicting and earlier climbing compared to ICAO.



Analysis for the Traffic volumes LIPN45 / LIPNC45 / LIPNCE45

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
LIPN45	81	75	63	12	7,41%	22,22%	14,81%
LIPNC45	81	75	63	12	7,41%	22,22%	14,81%
LIPNCE45	81	75	63	12	7,41%	22,22%	14,81%
LIPNC14	82	79	67	12	3,66%	18,29%	14,63%
LIPNCE14	82	79	67	12	3,66%	18,29%	14,63%

ICAO predicted 13 more flights than EFPL. All these 13 flights are landing in EDDM and for them EFPL predicted a later descend compared to ICAO.

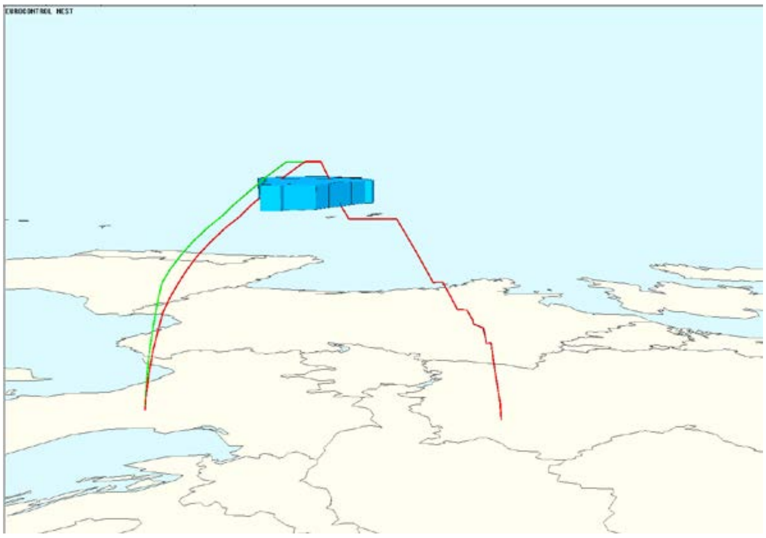


Analysis for the Traffic volume LIPN4

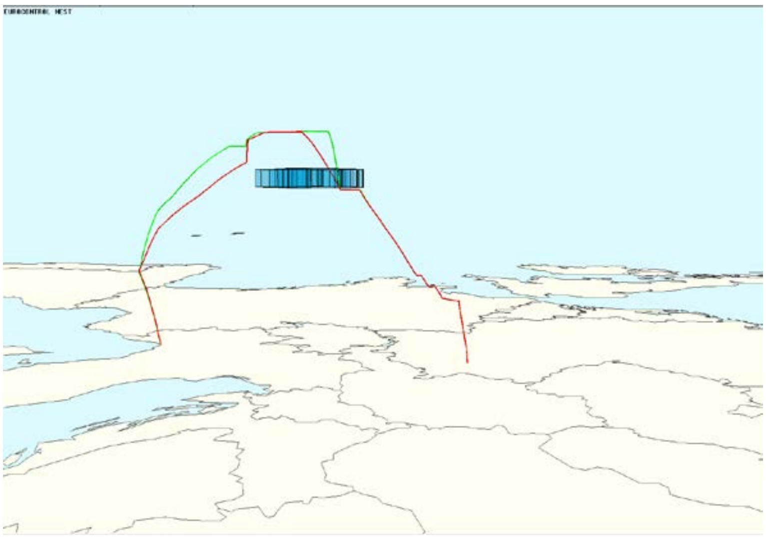
ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
LIPN4	69	53	42	11	23,19%	39,13%	15,94%

In this TV, ICAO predicted 10 more flights than EFPL. All these flights were landing, or taking off from EDDF or EDDM.

Climbing phase: In the picture below flight DLA43LQ, LIPE-EDDM, the EFPL trajectory predicted an early climb than ICAO. This case is the same for DLH2EP, DLH4RJ, DLH8XA (the three of them LIPE-EDDF).



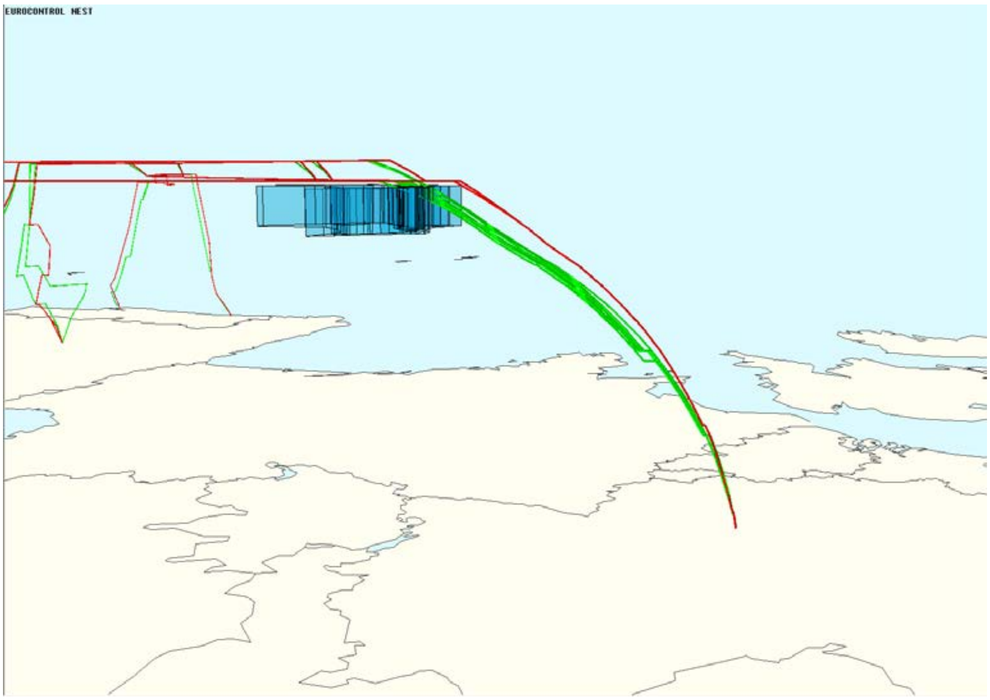
Regarding the descend phase, EFPL predicted a later descend. In the picture flight DLH1VR. This case is the same for DLH1899, DLH1FM, DLH3HT, DLH505, DLH575, DLH9PF, and DLH9TP.



Analysis for the Traffic volumes LSAZM3 / LSAZM23 / LSAZM123

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
LSAZM3	71	71	82	11	0,00%	15,49%	15,49%
LSAZM23	78	76	87	11	2,56%	11,54%	8,97%
LSAZM123	81	78	89	11	3,70%	9,88%	6,17%

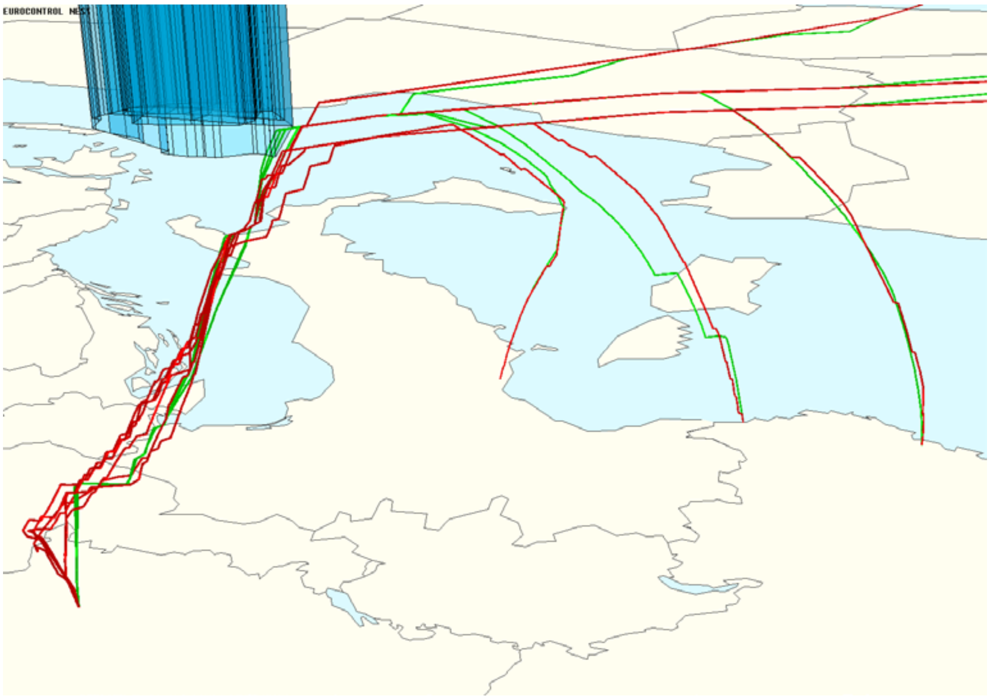
In this TV, EFPL predicted 11 flights more than ICAO. All this flights were taking off from EDDF. EFPL predicted an earlier climbing phase.



Analysis for the Traffic volume LIPE6

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
LIPE6	14	21	31	10	50,00%	121,43%	71,43%

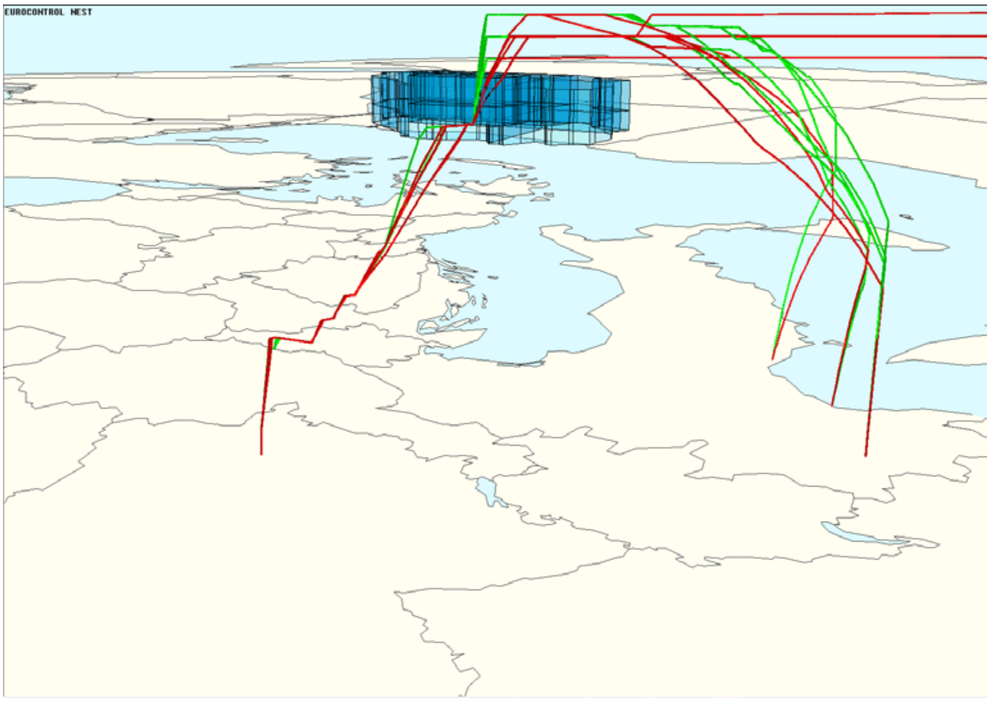
In this TV, EFPL predicted 10 more flights. There are 7 cases landing at EDDM, two departing from EDDM and one landing at EDDF. In the landing phase at EDDM, EFPL predicted a later descend, so the trajectories were crossing this TV (green trajectories).



Analysis for the Traffic volumes LIPNC34 / LIPNC35 / LIPNCS14

ID	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
LIPNC34	75	69	59	10	8,00%	21,33%	13,33%
LIPNC35	83	79	69	10	4,82%	16,87%	12,05%
LIPNCS14	83	80	70	10	3,61%	15,66%	12,05%

In this TV, ICAO predicted 12 more flights. All flights were landing at EDDM and in the descend phase EFPL predicted a later descend (green trajectories are not crossing the TV).



C.3.2 Result analysis for EasyJet group

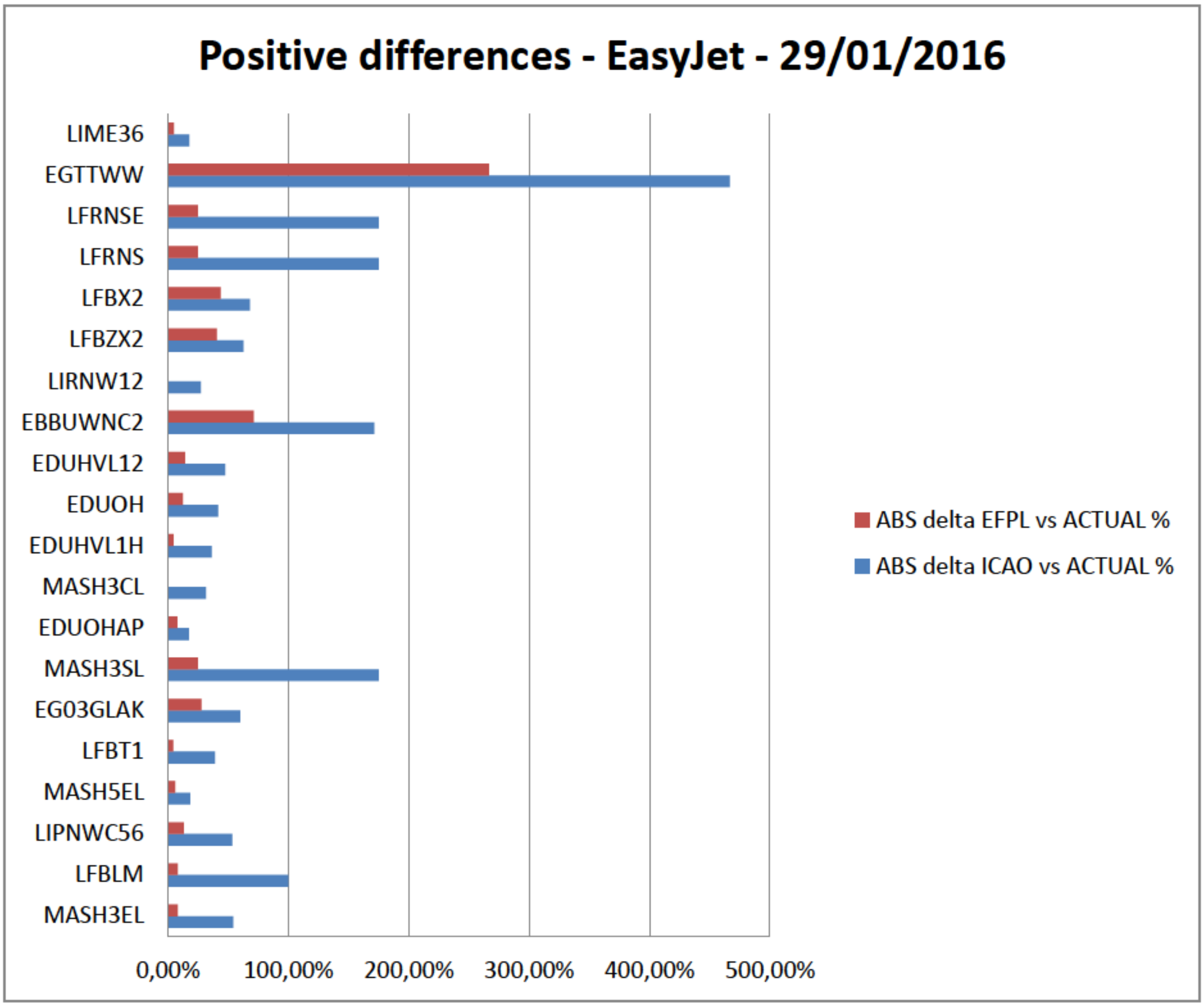


Figure 29: Positive differences between the prediction of EFPL compared to ICAO in terms of number of flights crossing a TV for EasyJet group on the 29/01/2016

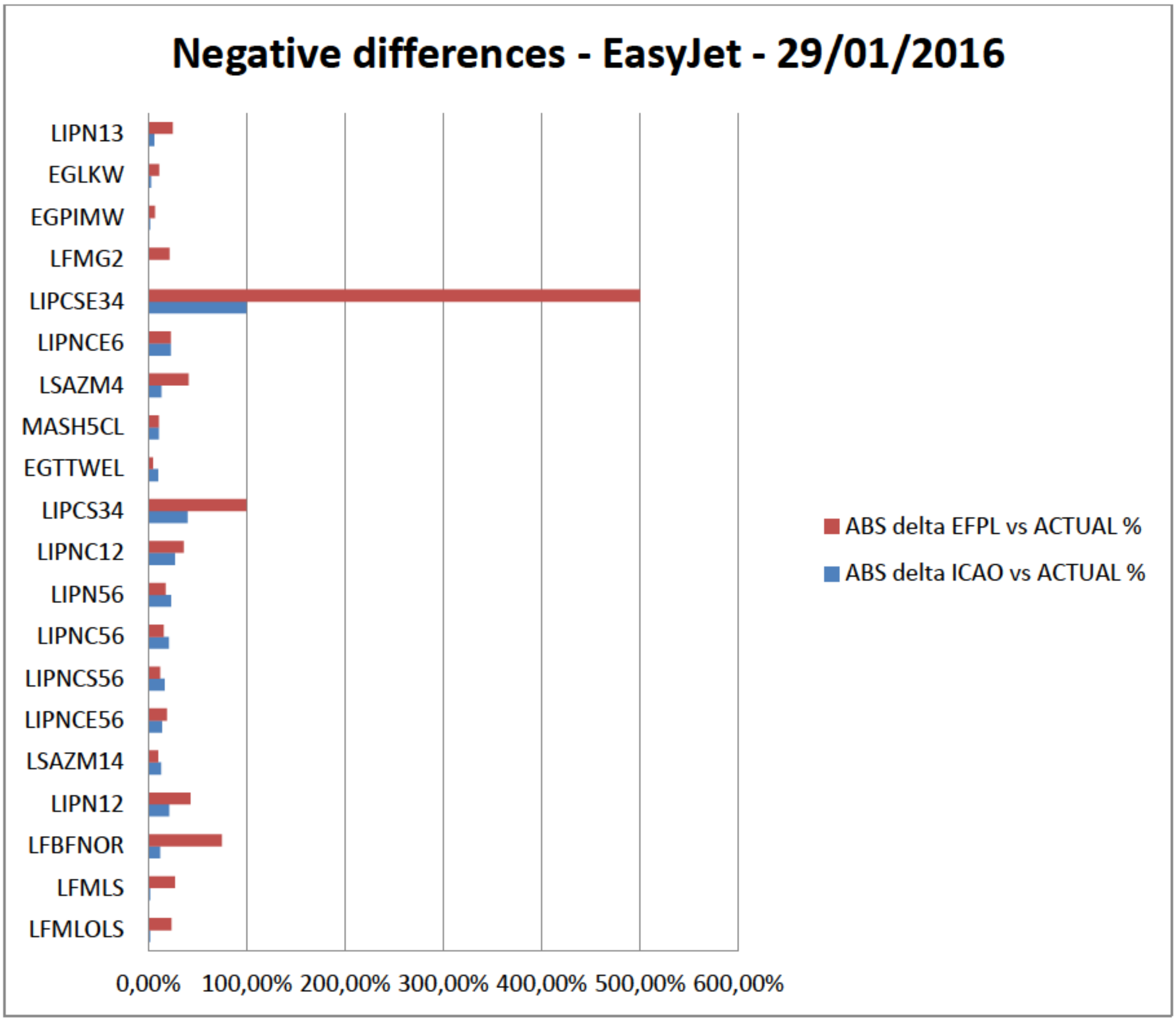


Figure 30: Negative differences between the prediction of EFPL compared to ICAO in terms of number of flights crossing a TV for EasyJet group on the 29/01/2016

C.3.2.1 Case 1: EFPL is closer to the Flown trajectory

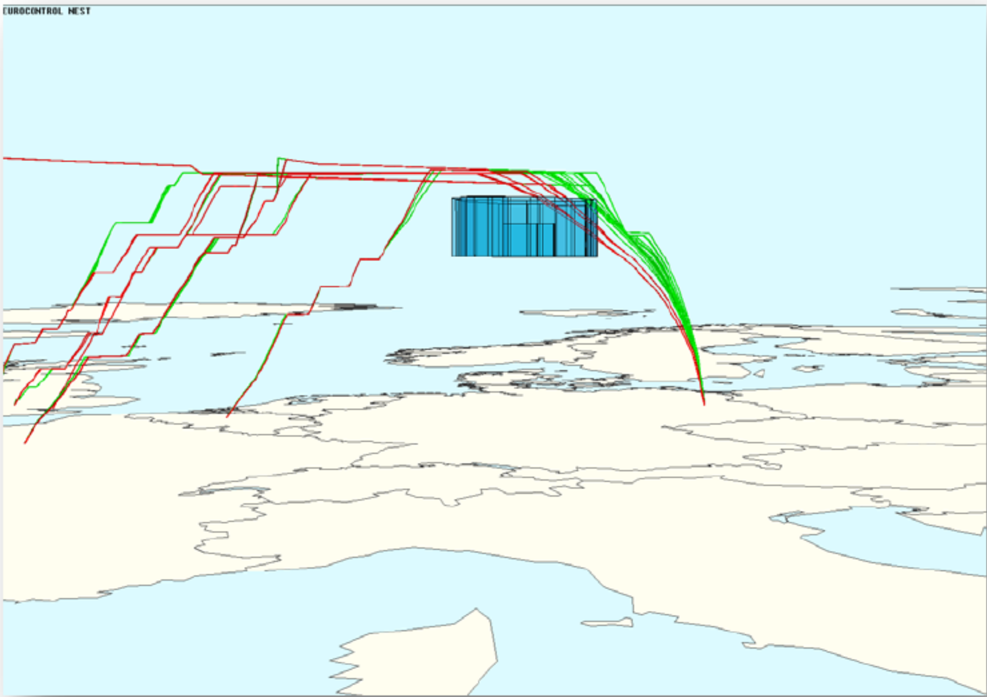
ID (WE IMPROVE)	ACTUAL	ICAO	EFPL	ABS DIFF	ABS DELTA ICAO VS ACTUAL %	ABS DELTA EFPL VS ACTUAL %	DELTA OF IMPROVEMENT
MASH3EL	24	37	22	15	54,17%	8,33%	45,83%
LFBLM	12	0	11	11	100,00%	8,33%	91,67%
LIPNWC56	15	7	17	10	53,33%	13,33%	40,00%
MASH5EL	32	38	30	8	18,75%	6,25%	12,50%
LFBT1	23	32	24	8	39,13%	4,35%	34,78%
EG03GLAK	25	40	32	8	60,00%	28,00%	32,00%
MASH3SL	4	11	3	8	175,00%	25,00%	150,00%
EDUOHAP	75	62	69	7	17,33%	8,00%	9,33%
MASH3CL	22	29	22	7	31,82%	0,00%	31,82%
EDUHVL1H	22	14	21	7	36,36%	4,55%	31,82%
EDUOH	24	14	21	7	41,67%	12,50%	29,17%
EDUHVL12	21	11	18	7	47,62%	14,29%	33,33%
EBBUWNC2	7	19	12	7	171,43%	71,43%	100,00%
LIRNW12	22	16	22	6	27,27%	0,00%	27,27%
LFBZX2	27	10	16	6	62,96%	40,74%	22,22%
LFBX2	25	8	14	6	68,00%	44,00%	24,00%
LFRNS	4	11	5	6	175,00%	25,00%	150,00%
LFRNSE	4	11	5	6	175,00%	25,00%	150,00%
EGTTWW	3	17	11	6	466,67%	266,67%	200,00%
LIME36	39	32	37	5	17,95%	5,13%	12,82%

Table 80: List of TVs where prediction of EFPL is closer to the flown trajectory (compared to ICAO) in terms of number of flights crossing a TV for EasyJet group

Analysis for the Traffic volume MASH3EL

ID (We improve)	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of improvement
MASH3EL	24	37	22	15	54,17%	8,33%	45,83%

All flights taking off from EDDB. EFPL predicted earlier climb.



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3058 *Analysis for the Traffic volume LFBLM*

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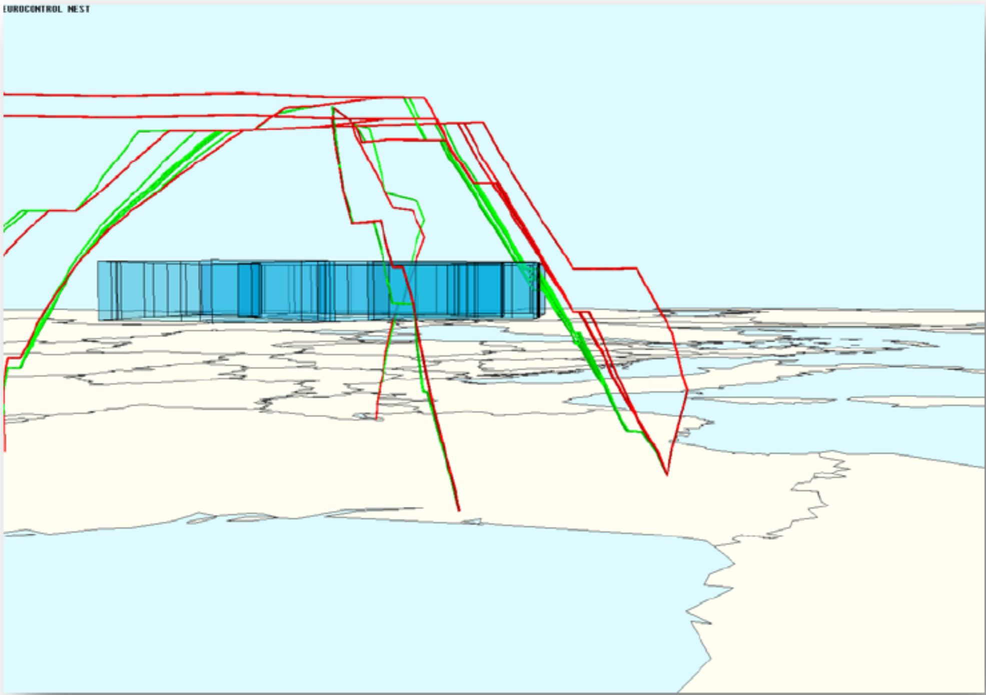
ID (We improve)	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of improvement
LFBLM	12	0	11	11	100,00%	8,33%	91,67%

3061 All flights landing at LFBO. EFPL predicted earlier descend.



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C.3.2.2 Case 2: EFPL is further than the Flown trajectory

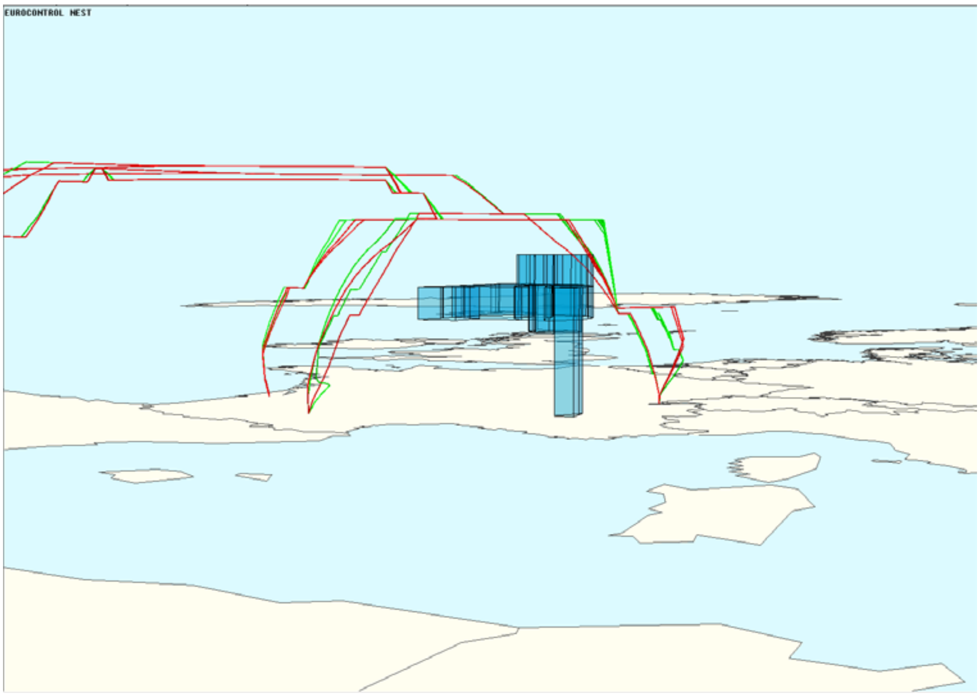
ID (WE DON´T IMPROVE)	ACTUAL	ICAO	EFPL	ABS DIFF	ABS DELTA ICAO VS ACTUAL %	ABS DELTA EFPL VS ACTUAL %	DELTA OF DEGRADATION
LFMLOLS	55	56	42	14	1,82%	23,64%	21,82%
LFMLS	48	49	35	14	2,08%	27,08%	25,00%
LFBFNOR	16	18	28	10	12,50%	75,00%	62,50%
LIPN12	14	17	8	9	21,43%	42,86%	21,43%
LSAZM14	30	34	27	7	13,33%	10,00%	3,33%
LIPNCE56	21	18	25	7	14,29%	19,05%	4,76%
LIPNCS56	24	20	27	7	16,67%	12,50%	4,17%
LIPNC56	19	15	22	7	21,05%	15,79%	5,26%
LIPN56	17	13	20	7	23,53%	17,65%	5,88%
LIPNC12	11	14	7	7	27,27%	36,36%	9,09%
LIPCS34	5	3	10	7	40,00%	100,00%	60,00%
EGTTWEL	40	44	38	6	10,00%	5,00%	5,00%
MASH5CL	28	31	25	6	10,71%	10,71%	0,00%
LSAZM4	22	19	13	6	13,64%	40,91%	27,27%
LIPNCE6	13	10	16	6	23,08%	23,08%	0,00%
LIPCSE34	1	0	6	6	100,00%	500,00%	400,00%
LFMG2	23	23	28	5	0,00%	21,74%	21,74%
EGPIMW	56	57	52	5	1,79%	7,14%	5,36%
EGLKW	36	37	32	5	2,78%	11,11%	8,33%
LIPN13	16	17	12	5	6,25%	25,00%	18,75%

Table 81: List of TVs where prediction of EFPL is further from the flown trajectory (compared to ICAO) in terms of number of flights crossing a TV for EasyJet group

Analysis for the Traffic volumes LFMLOLS / LFMLS

ID (We don´t improve)	ACTUAL	CUSTOM 1 (ICAO)	CUSTOM 2 (EFPL)	abs diff	ABS delta ICAO vs ACTUAL %	ABS delta EFPL vs ACTUAL %	Delta of degradation
LFMLOLS	55	56	42	14	1,82%	23,64%	21,82%
LFMLS	48	49	35	14	2,08%	27,08%	25,00%

All flights landing or taking off at LSGG (Genève). EFPL predicted later descend and earlier climb.



Appendix D Detailed results on traffic prediction

The following table provides the list of monitoring traffic volumes for which the prediction of flight occupancy time is significantly improved using EFPL. Only the traffic volumes handling a significant amount of traffic from the involved airlines (e.g. DLH, EZY) are considered.

Traffic volume	Average Sector Occupancy time error (Seconds) - ICAO	Average Sector Occupancy time error (Seconds) - EFPL	% of error reduction
EDUNTM1N	75	53	29%
LSAGNE	88	66	25%
LSAGLOW	96	72	25%
EGDLD	73	56	23%
EDUERL1R	99	78	21%
LSAZM456	80	64	20%
EDMFRK	101	83	18%
EDMFRKHU	96	79	18%
EDMFUS	65	53	18%
EDMCS3	65	54	18%
LIPNCS36	91	75	18%
EGDLS	74	61	17%
LFMRAWM	65	54	17%
EDUWEST	83	69	16%
LIPNC36	85	72	15%
LIPNCE36	85	72	15%
EDUFFM1F	67	57	15%
EDGG2	91	78	14%
EDMSOUTH	60	51	14%
EGSOUTH	72	63	13%
EDUCNTR	84	73	13%
EGLYS	74	65	13%
EDMSAFR	96	85	12%
EGEAST	75	66	12%
EGLKS	51	45	12%
MASH3EH	129	115	11%
LFMRAW	56	50	11%
LSGL16W	76	68	11%
MASBOLN	42	37	10%
LFBUS34	128	116	10%

Table 82: TVs for which prediction of sector occupancy times are significantly improved using EFPLs

The following table provides the list of monitoring traffic volumes for which the prediction of flight entry times is significantly improved. Only the traffic volumes handling a significant amount of traffic from the involved airlines (e.g. DLH, EZY) are considered.

Traffic volume	Average Entry time prediction error (seconds) ICAO	Average Entry time prediction error (seconds) EFPL	Improvement (% of error reduced)
EDUERL1R	158	110	30%
LFMRAWM	134	109	18%
LOVVWB15	90	72	21%
EDUSAL1A	135	118	13%
LFBUS12	181	167	8%
LFBPT	100	86	15%
EDUWUR1C	105	91	13%
LOVVSC15	109	95	13%
LFMWM	135	122	10%
EDMFRKU	141	129	8%
EDUAP	125	113	9%
LFMRAW	132	121	8%
EDUOHAP	130	119	8%
LOVVNE15	146	135	7%
EDMALB	115	105	8%
LIPNCS36	124	115	8%
MASH5SL	81	72	11%
EDG3GED	140	131	6%
LIMWC	117	108	7%
EDUSAL12	152	144	5%
EDWDBAFL	83	75	10%

Table 83: TVs for which prediction of elapse times from departure are significantly improved using EFPLs

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3094 The following table looks at the impact of EFPLs on elapse time predictions in climbing phase
3095 depending on the departure airport

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Departure airport	Average elapse time prediction error (seconds) ICAO	Average elapse time prediction error (seconds) EFPL	Improvement / degradation in average (Seconds)
LFML	141	119	22
LIRQ	93	73	20
EDDH	69	49	20
EGKK	163	146	17
LFLL	127	111	16
LIPE	75	60	15
EDDB	100	85	15
LFSB	132	118	14
LIMC	93	80	13
EDDM	75	63	12
EDDF	87	76	10
EGSS	165	155	10
EKCH	112	104	9
LIPZ	98	91	7
EGAA	81	76	5
LIRF	65	61	4
LFBO	127	126	1
EGGD	118	119	-1
LEMD	63	65	-2
LSGG	77	81	-4
EBBR	100	106	-6
EGLL	83	89	-7
EGPH	66	73	-7
LFPO	72	80	-8
LFMN	84	94	-10
LEBL	65	78	-13
LIMF	75	89	-13
LFPG	93	111	-18
EGCC	102	121	-20
EGGW	228	259	-30

3097 *Table 84: impact of EFPLs on elapse time predictions in climbing phase depending on the departure airport*
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The following table provides an overview of the impact of using EFPL taxi-time on the accuracy of sectors entry time prediction accuracy. Results are presented per departure airport.

AIRPORT	AVERAGE ENTRY TIME ERROR USING EFPL TAXI-TIME (SECONDS)	AVERAGE ENTRY TIME ERROR USING NM TAXI-TIME (SECONDS)	IMPROVEMENT / DEGRADATION OF PREDICTABILITY (IN SECONDS)
EDDF	567	557	-11
EDDM	326	472	146
LEBL	396	396	0
LIRF	452	516	65
LIPE	505	505	0
EDDH	681	689	8
LFMN	311	228	-83
EGLL	543	452	-90
LIRQ	323	323	0
LFML	164	164	0
LIMF	301	387	86
LEMD	253	214	-39
LFBO	298	298	0
EDDT	392	379	-13
LIPZ	238	195	-43
EKCH	194	257	63
ENGM	363	325	-38
EDDV	256	156	-100
LHBP	459	445	-14
LIRN	575	575	0
ESGG	315	315	0
EDDW	309	284	-24
EDDL	232	319	87

Table 85: Impact of EFPL taxi time per ADEP airport on traffic volumes entry time predictions accuracy

Appendix E Remaining “in progress” requirement status

The following table Table 86 provides the status of requirements which remain in progress. They are either out of the scope of solution #37 or can be validated in the industrial phase.

(grey)	Out of the scope of solution #37
(yellow)	Planned to be validated in V4
(pink)	Validated at V3 level. Further validation required at V4 level

REQUIREMENT ID	REQUIREMENT TITLE	REQUIREMENT TYPE	PART OF THE SOLUTION #37 (YES/NO)	PLANNED WAY FORWARD TO VALIDATE THE REQUIREMENT
REQ-07.06.02-SPR-FPP1.0010	NM flight planning service - Availability requirement	Reliability	Yes	Validation planned in V4
REQ-07.06.02-SPR-FPP1.0015	NM flight planning service - Recovery following a service failure	Reliability	Yes	Validation planned in V4
REQ-07.06.02-SPR-FPP1.0020	NM flight planning service - Reliability requirement	Reliability	Yes	Validation planned in V4
REQ-07.06.02-SPR-FPP1.0030	NM flight planning service - Maintainability requirement	Maintainability	Yes	Validation planned in V4
REQ-07.06.02-SPR-FPP1.0040	NM flight planning service - Maintainability requirement for major upgrade	Maintainability	Yes	Validation planned in V4
REQ-07.06.02-SPR-FPP1.0050	NM flight planning service - Security requirement	Security	Yes	Validation planned in V4
REQ-07.06.02-SPR-FPP1.0055	NM flight planning service - Restricted access by airspace user	Security	Yes	Validation planned in V4
REQ-07.06.02-SPR-FPP1.0060	NM flight planning service - Processing times	Performance	Yes	Validation planned in V4
REQ-07.06.02-SPR-DCP1.0090	DCB services - Availability requirement	Reliability	Yes	Validation planned in V4
REQ-07.06.02-SPR-DCP1.0100	DCB services - Improved prediction of airspaces crossed by a flight	Performance	Yes	Validation planned in V4
REQ-07.06.02-SPR-FPS1.0006	AU flight planning transmission-Integrity of EFPL data used by ATC	Safety	No AUO-0226	To be validated in S2020 exercises.
REQ-07.06.02-SPR-FPS1.0011	NM flight planning service - ICAO FPL data/Filed Trajectory Inconsistency	Safety	No AUO-0226	Prerequisite to distribution ATC to be validated in S2020
REQ-07.06.02-SPR-FPS1.0013	NM flight planning service - Appropriate assurance level for FPL/EFPL services	Safety	Yes	EFPL assurance level to be validated at V4 maturity in NM 20.5 release for submission service.
REQ-07.06.02-SPR-FPP1.0140	Processing EFPL messages	Performance	Yes	Validation planned in V4

Requirement ID	Requirement Title	Requirement type	Part of the solution #37 (yes/no)	Planned way forward to validate the requirement
REQ-07.06.02-SPR-FPP1.0150	EFPL information retrieval upon request	Performance	Yes	This was verified in the VP-713 part B. Validation planned in V4 in the context of NM 21 release
REQ-07.06.02-SPR-FPP1.0170	Confidential distribution of sensitive FSPD information	Security	Yes	Validation planned in V4 in the context of NM 21 release

3113 *Table 86: Remaining "In progress" requirement status*

-END OF DOCUMENT-