Contribution to EXE-07.06.02-VP-713 – EFPL Step 1 V3 Validation Report

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Abstract

This document contains the contribution from **Lufthansa Systems** (WP11.1 member) perspective for the Validation Report of the Validation Exercise EXE-07.06.02-VP-713, which is performed in the context of OFA03.01.04: Business and Mission Trajectory. This validation exercise aims at exploring the feasibility of the EFPL (Extended Flight Plan) data exchange between airspace users and the Network Manager. In particular this validation exercise takes a look onto flight plan processing, predictability, DCB and human performance. This exercise was therefore performed in close collaboration with a number of airspace users that provided EFPL data for their operational flights. Apart from that the feasibility to provide EFPLs in a FIXM format was explored. To that end, Lufthansa Systems and EUROCONTROL developed prototype systems that were able to provide and handle EFPLs in a FIXM format.

Authoring & Approval

Prepared By - *Authors of the document.*		
Name & Company	Position & Title	Date
[redacted] Lufthansa Systems	[redacted]	20/07/2016

Reviewed By – *Reviewers internal to the project.*		
Name & Company	Position & Title	Date
[redacted] Lufthansa Systems	[redacted]	14/06/2016
[redacted] Lufthansa Systems		14/06/2016
[redacted] Lufthansa Systems		20/07/2016
[redacted] Airbus		18/07/2016

Reviewed By – *Other SESAR projects, Airspace Users, staff association, military, Industrial Support, other organisations.*		
Name & Company	Position & Title	Date
[redacted] EUROCONTROL	[redacted]	01/06/2016
[redacted] EUROCONTROL		01/06/2016
[redacted] EUROCONTROL		01/06/2016
[redacted] EUROCONTROL		13/07/2016
[redacted] EUROCONTROL		13/07/2016
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[redacted] Air France		13/07/2016
[redacted] HOP!		13/07/2016*
[redacted] British Airways		13/07/2016*
[redacted] Lufthansa		13/07/2016
[redacted] El Al		13/07/2016
[redacted] IATA		13/07/2016
[redacted] EasyJet		13/07/2016
[redacted] EasyJet		13/07/2016
[redacted] germanwings		13/07/2016*
[redacted] TAP Portugal		13/07/2016*
[redacted] SJU		13/07/2016
[redacted] SJU		13/07/2016
[redacted] SABRE		13/07/2016

**No feedback received*

Approved for submission to the SJU By – *Representatives of the company involved in the project.*		
Name & Company	Position & Title	Date
[redacted] Lufthansa Systems	[redacted]	20/07/2016
[redacted] Airbus		21/07/2016

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

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Executive summary

The present document describes the Lufthansa Systems contribution to the validation report for the validation exercise EXE-07.06.02-VP-713 from WP11.1 FOC perspective. This exercise, led by EUROCONTROL, has been performed in the context of the OFA03.01.04: Business and Mission Trajectory. This validation exercise aims at exploring the feasibility of the EFPL (Extended Flight Plan) data exchange between airspace users and the Network Manager. This validation exercise explored this data exchange, based on the NM EFPL XML format on a V3 maturity level. In particular this validation exercise takes a look onto flight plan processing, predictability, DCB and human performance. It was therefore performed in close collaboration with a number of airspace users that provided EFPL data for their operational flights. Apart from that the feasibility to provide EFPLs in a FIXM format was explored. To that end, Lufthansa Systems and EUROCONTROL developed prototype systems that were able to provide and handle EFPLs in a FIXM format. This exercise has been performed on a V2 maturity level.

From an airspace user and FOC perspective several aspects were focused on in this exercise: 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 EFPL format for the exchange of EFPL data. For this purpose several trials have been performed in the context of this exercise. The first trial was a “gaming session” in which flight dispatchers were filing flights using the EFPL. The target was to assess how the EFPL would impact the flight dispatch processes. This exercise involved 12 flight dispatchers from different airlines representing different type of airspace user business models (mainline airlines, charter airlines, cargo airlines, regional airlines, and low cost airlines).
The second trial was performed as a so-called “shadow mode” exercise, involving 6 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 were 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 more than 14,000 EFPLs were provided to the NMVP that were based on operational flights. The third trial was solely performed by Lufthansa Systems and EUROCONTROL. During this trial the exchange of EFPL data in a FIXM format was verified.

In summary, from a WP11.1 perspective the main objectives related to the FOC/AU could be successfully validated with a good statistically and operational significance. It was shown that the introduction of the EFPL provides clear benefits in regard to the alignment of the different trajectories used by the airspace user on the one hand and the trajectories used by the NM on the other hand. Even if the target concept – the direct use of the airspace users’ trajectory provided in the EFPL – has not been realised yet, the current validation results suggest that the EFPL concepts validated in this validation exercise are a big step forward towards achieving this target. Some of the factors preventing the NM from directly using the trajectory from the EFPL are different aeronautical data implementations and the application of profile tuning restrictions (PTR) in the NM systems for predictability purposes.

1 Introduction

1.1 Purpose of the document

This document provides the WP11.1 contribution to the Validation Report for EXE-07.06.02-VP-713 assessing the maturity of the EFPL (Extended Flight Plan) filing concept. This validation exercise is performed in the context of OFA 03.01.04: Business and Mission Trajectory. It describes the results of validation exercise EXE-07.06.02-VP-713 from the WP11.1 perspective; in particular from Lufthansa Systems perspective. The content will be integrated in the overall Validation Report that is prepared by EUROCONTROL [13].

EXE-07.06.02-VP-713 has the purpose to validate the EFPL concept. It is the third validation exercise dealing with the use of the EFPL itself. The EFPL is a new flight plan format that includes, besides the flight plan data of the ICAO flight plan, a 4D trajectory and – optional – flight specific performance data. The 4D trajectory describes the trajectory that has been planned by the airspace user in a very high granularity. The flight specific performance data describes the unconstrained climb and descent rates that can be achieved by the aircraft.

The related concept has been validated in two preceding validation exercises. The EXE-07.06.02-VP-713 shall assess now whether this concept has already reached maturity level V3. This is done in a first part of the validation exercise. In a second part it is assessed whether the EFPL can also be exchanged in the FIXM format. For that reason a flight plan filing service interface in FIXM format was developed, based on FIXM version V3.0, extended by a EUROCONTROL EFPL extension. This part of the validation exercise has been performed as verification exercise.

The present document summarizes all activities that have been performed by Lufthansa Systems and a number of its customers and the results of the validation activities from the WP11.1 perspective.

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;
- P11.01.03 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;
- P16.06.0x and project B05 for Benefit and Impact Mechanisms;
- And more generally, the SESAR JU community.

1.3 Structure of the document

This document is structured in the following way:

- **Chapter 1** gives a general introduction to the document;
- **Chapter 2** gives a short introduction to the validation activities;
- **Chapter 3** is the chapter that describes how the single validation exercises are conducted in the context of the overall validation activities. This chapter is only referencing to the respective chapter in the overall EFPL validation report as prepared by EUROCONTROL [13].
- **Chapter 4** summarizes the results of EXE-07.06.02-VP-713 as recorded by Lufthansa Systems or makes a reference to the EFPL validation report as prepared by EUROCONTROL [13] if rather general aspects are concerned;
- **Chapter 5** refers to the EFPL validation report as prepared by EUROCONTROL [13] as it describes the conclusions and recommendations that are deduced from all validation exercises that have been performed in this context;
- **Chapter 6** includes the detailed validation report from Lufthansa Systems/ WP11.1 perspective;
- **Chapter 7** lists documents that have been used as reference in this document.

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 realize ICAO-compliant manned or unmanned flight operations whereas military airspace users realize usually ICAO non-compliant manned or unmanned flight operations. Military airspace users realize ICAO-compliant manned or unmanned flight operations when they operate State aircraft using civil air traffic rules.	WP11.1

Term	Definition	Source
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
Extended Flight Plan (EFPL)	Is a flight plan that includes • The ICAO flight plan; • The 4D trajectory; and • Flight specific performance data. The EFPL will be provided to the ATM system in XML format.	P07.06.02 Step 1 OSED
NM EFPL XML	A flight plan message in XML format defined by EUROCONTROL that is used to send the EFPL to NM.	WP11.1
filing	The submission of a flight plan to NM or ATC.	P07.06.02 Step 1 OSED
FIXM EFPL	A flight plan message in XML format used to send the EFPL in FIXM format to ANSPs/ NM.	WP11.1
Flight Operations Centre (FOC)	Flight Operations Centre is a part (department, employee) of an Airspace user or a system used by an Airspace user providing FOC services and support like operational control, flight planning, pre-flight briefing, in-flight support and post-flight analyses in accordance to AU's Operational Manual and Standard Operating Procedures.	WP11.1
Flight Plan Receptor	The flight plan receptors are NM, an ANSP or airport that provide air traffic services.	WP11.1
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

Term	Definition	Source
ICAO Flight Plan	Is a type of flight plan that is defined by ICAO in PANS-ATM Doc. 4444 [15]. 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
Profile Tuning Restrictions (PTR)	See soft constraints.	
Reference Business Trajectory (RBT)	The business trajectory which the airspace user agrees to fly and the ANSP and Airports agree to facilitate (subject to separation provision). Most times indicated in the RBT are estimates, some may be target times (TTA) to facilitate planning and some of them may become constraints (CTA, CTO) to assist in queue management when appropriate, e.g. at AMAN horizon.	ATM lexicon
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
Wrongly accepted ICAO flight plan	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
Wrongly rejected ICAO flight plan	This refers to any ICAO flight plan rejected by IFPS or the IFPUV although it is based on a 4D trajectory that is in accordance to all constraint or restriction.	WP11.1

1.5 Acronyms and Terminology

Term	Definition
4D	Four Dimensional
4DT	Four Dimensional Trajectory
ADD	Architecture Definition Document
AFUA	Advanced Flexible Use of Airspace
ANSP	Air Navigation Service Provider
AOC	Airline Operations Centre
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATM	Air Traffic Management
ATSU	Air Traffic Service Unit
AU	Airspace User
CBA	Cost Benefit Analysis
CFMU	Central Flow Management Unit
CHMI	CFMU Human Machine Interface
CRT	(Success) Criterion
DCB	Demand Capacity Balancing
DOD	Detailed Operational Description
DOT	Day of transmission
E-ATMS	European Air Traffic Management System
E-OCVM	European Operational Concept Validation Methodology
EFPL	Extended Flight Plan
ETO	Estimated Time Over
FIXM	Flight Information eXchange Model
FPL	Flight Plan

Term	Definition
HMI	Human Machine Interface
ICAO	International Civil Aviation Organization
ID	Identifier
IFPS	Initial Flight Plan Processing System
IFPUV	IFPS Unified Validator
IRS	Interface Requirements Specification
INTEROP	Interoperability Requirements
LOA	Letter of Agreement
LSY	Lufthansa Systems
NM	Network Manager
NMVP	Network Manager Validation Platform
OBJ	(Validation) Objective
OFA	Operational Focus Areas
OSED	Operational Service and Environment Definition
PI	Performance Indicator
PTR	Profile Tuning Restriction
RAD	Route Availability Document
RFL	Requested Flight Level
SESAR	Single European Sky ATM Research Programme
SESAR Programme	The programme which defines the Research and Development activities and Projects for the SJU.
SJU	SESAR Joint Undertaking (Agency of the European Commission)
SJU Work Programme	The programme which addresses all activities of the SESAR Joint Undertaking Agency.
SPR	Safety and Performance Requirements
SUT	System Under Test
TAD	Technical Architecture Description
TOW	Take-Off Weight

Term	Definition
TS	Technical Specification
UOM	Unit Of Measure
VALP	Validation Plan
VALR	Validation Report
VALS	Validation Strategy
VP	Verification Plan
VR	Verification Report
VS	Verification Strategy

2 Context of the Validation

2.1 Concept Overview

The aim of the EFPL is an alignment of the views on the trajectory that has been planned by the airspace user between the AU FOC system and the NM systems. That shall lead to an improvement of the traffic prediction on NM, ANSP and airport side and shall reduce flight plan rejects on AU side. Nowadays all ATM actors (airspace users, network manager, ANSPs and airports) require four dimensional trajectory data for their work. While the airspace users had to plan 4D trajectories since decades, the increase of traffic density throughout Europe forced the ATM stakeholders also to balance demand and capacity based on 4D trajectories. The issue with that was and still is that neither ANSPs, nor the Network Manager, nor the airports have a clear picture of the 4D trajectories that are planned by the airspace users, which should be the gold standard for the ATM stakeholders. 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 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. This procedure improved during the last years but has never been able to close the gaps between the flight planning system of the airspace user and the flight plan processing systems of the ATM stakeholders. Most differences are related to the accurate estimation of estimated times over the locations used as waypoints of the trajectory, as well as the accurate estimation of the flight level or altitude on any of the waypoints during climb and descent phases.

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. This need was especially identified in the context of the SESAR programme, which also tries to implement new approaches in regard to flight planning like a full free route enabled environment and the advanced flexible use of airspace (AFUA) concept. Both will require a very accurate planning of the trajectories as well as the provision of very accurate flight plan data by the airspace users to the ATM stakeholders.

As airspace users are filing the flight plans to the IFPS that is operated by the NM, which subsequently distributes the flight plan data to the concerned airports and ANSPs[1], the first step is the development, validation and implementation of an enhanced flight plan data exchange between the airspace users and the Network Manager. Therefore, the Extended Flight Plan concept was developed. The extended flight plan concept is based on the exchange of three different conceptual data elements:

- The ICAO flight plan (for legal reasons and backward compatibility);
- The 4D trajectory (which describes the 4D trajectory planned by the airspace user in high resolution); and optionally
- The Flight Specific Performance Data (which describes the climb/descent capabilities of the aircraft as planned for the filed flight).

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 [6] and in the P11.01.02 Step 1 OSED [7].

The concept of the use of the EFPL instead of the ICAO flight plan for flight plan filing has been validated throughout the last few years. The main partners involved throughout the development and validation are EUROCONTROL, Lufthansa Systems and Sabre. The three partners performed a number of validation exercises and developed the EFPL concept up to the V2 maturity level. More information in regard to that can be found in the Step 1 Business Trajectory Validation Report (VALR) [8] that reports about the previous activities of the EFPL validation. The next step before working on

[1] The statement is only valid for traffic within the ECAC area. Traffic beyond the ECAC area requires the involvement of the individual non-ECAC ANSPs and airports.

the implementation of the EFPL in operations is the proof of the V3 maturity level. For that reason a validation as close as possible to the real flight operations was performed.

This included a gaming session where dispatchers of some airlines were invited to participate as well as a shadow mode session during which EFPLs were sent from operational flight planning systems (as used by a number of airspace users) to the NMVP in parallel to the ICAO FPL was used of operational filing to the NM OPS system.

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. For that reason a verification of a FIXM EFPL implementation was performed in the context of EXE-07.06.02-VP-713. Anyhow, this part of the validation was related to the filing and validation processes of the EFPL and was intended 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.

Table 1 summarizes the scope of EXE-07.06.02-VP-713.

Validation Exercise ID and Title	EXE-07.06.02-VP-713: Enhance Current Flight Planning Processes – V3
Leading organization	EUROCONTROL
Validation exercise objectives	Achieve V3 maturity status related to the use of the EFPL for Flight plan validation and DCB traffic prediction improvement.
Rationale	The current ICAO flight plan format is insufficient to express the actually planned trajectory as it is created by the FOC and provisioned to the flight crew
Supporting DOD / Operational Scenario / Use Case	07.06.02 OSED Step1 - §2.1 & §2.2.2 & §6.2
OFA addressed	OFA03.01.04: Business and Mission Trajectory
OI steps addressed	- AUO-0203-A: Initial Shared Business Trajectory (iSBT) Only short term planning is covered and only civil traffic - AUO-223 dealing with harmonisation of trajectories and the use of PTR. - DCB-0103-A: Collaborative NOP for Step 1
Enablers addressed	AOC-ATM-20 Sharing of trajectory data between AOC/WOC and the ATM world using B2B web services NIMS-21a Initial flight Planning management enhanced to support 4D for Step 1. PRO-096b Airline Operational Procedures for creating and updating the Shared Business/ Mission Trajectory. SWIM-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	Refer to the Validation plan for EXE-07.06.02-VP-713
Validation Technique	Shadow mode; analytical modeling
Dependent Validation Exercises	EXE-07.06.02-VP-311EXE-07.06.02-VP-616

Table 1: Concept Overview

2.2 Summary of Validation Exercise/s

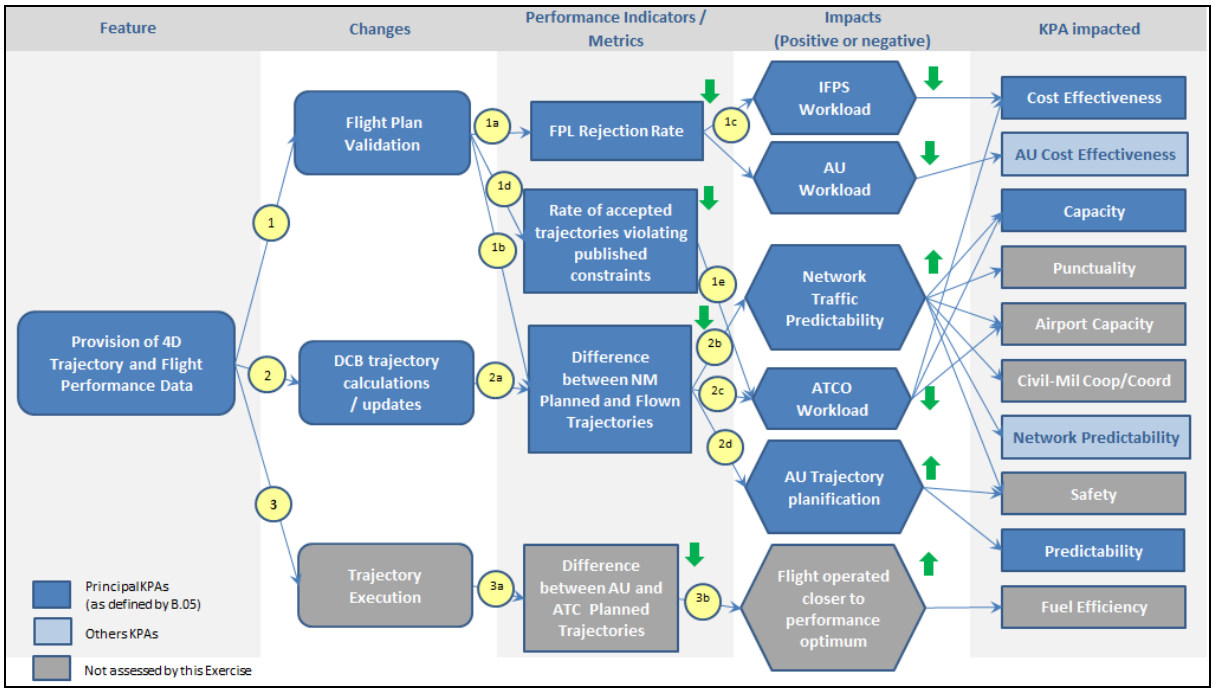
2.2.1 Summary of Expected Exercise/s outcomes

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 flight plan rejection rate	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 difference between intended and flown profiles. Though it is of utmost importance to understand that the vast majority of the differences between planned and executed trajectories are due to the fact that what is flown cannot be planned.	EXE-07.06.02-VP-616 EXE-07.06.02-VP-713
			Investment cost effectiveness	Benefits of improved operation outweigh the cost of implementation and operation of the concept.	EXE-07.06.02-VP-616 EXE-07.06.02-VP-713
		Provision of EFPL data	Reduction of the falsely rejected flight plans. Clearer information about correctly rejected flight plans.	Reduction of FPL filing rejection rate, obtain 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
CFSP	Internal	Provision of EFPL data	Workload reduction, possibility to perform local DCB	Enhanced traffic predictability	EXE-07.06.02-VP-616 EXE-07.06.02-VP-713
		Provisioning of an FOC system that supports the EFPL provisioning	Improve the possibilities to transmit efficient flight plans and increase the probability that efficient flight plans can actually be executed.	Reduction of flight plan filing rejection rate, obtain a clear picture why the executed trajectory deviates from the planned trajectory. Avoidance of duplicate technical implementations and global governance to avoid the duplicate implementation of similar regional concepts	EXE-07.06.02-VP-616 EXE-07.06.02-VP-713

Table 2: Summary of expected exercise outcomes

2.2.2 Benefit mechanisms investigated

The following figure illustrates the benefit mechanism including the AU view as well as the Network Manager view.



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 EFPL 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 AOC 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 1: Benefit mechanism of the EFPL Concept

2.2.3 Summary of Validation Objectives and success criteria

Summary from the contribution document to the EXE-07.06.02-VP-713 VALP

The following table summarizes the validation objectives and success criteria as specified in the contribution document to the EXE-07.06.02-VP-713 validation plan [10] prepared by P11.01.

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
OBJ-07.06.02-VALP-0001.0200	Measure the impact of the EFPL 4D trajectory usage on the rate of flight plans being accepted / rejected in the validation process by IFPS and on the type of error in case of rejection.	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.
OBJ-07.06.02-VALP-0001.0300	Assess whether EFPL 4DT data can help reducing the number of false flight plan rejections and acceptances related 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.
OBJ-07.06.02-VALP-0001.0700	Assess the percentage of flights where the EFPL can be used without ANY modifications to the 4DT within the ETFMS.	CRT-07.06.02-VALP-0001.0601	A quantitative result on the direct EFPL usage in ETFMS.
OBJ-07.06.02-VALP-0001.0800	Assess whether EFPLs can be submitted with negative geodetic airport altitudes in the 4DT.	CRT-07.06.02-VALP-0001.0601	EFPLs with negative geodetic airport altitudes are accepted.
OBJ-07.06.02-VALP-0001.0900	Assess and identify the reasons why the actually executed trajectory deviates laterally and vertically from the planned trajectory in the EFPL.	CRT-07.06.02-VALP-0001.0601	A qualitative result showing why the executed trajectory deviates from the planned trajectory.
OBJ-07.06.02-VALP-0001.0950	Assess the capability of ETFMS to use all trajectory points provided by the AU in the EFPL.	CRT-07.06.02-VALP-0001.0601	All trajectory points provided in the EFPL are used within ETFMS and no lateral or vertical differences are produced.
OBJ-07.06.02-VALP-0002.0301	Assess what additional information needs to be provided to the CFSPs to move the 4DT contained in the EFPL closer to the trajectory that	CRT-07.06.02-VALP-0002.0301	Validation results provide significant qualitative information on a difference of reliability between these two calculated 4D Trajectories.

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
	is actually flown.		
OBJ-07.06.02-VALP-0002.0500	Determine which conditions (e.g. on take-off weight variations) should trigger the transmission of EFPL updates (in addition to situations where ICAO FPLs are currently updated).	CRT-07.06.02-VALP-0002.0501	Conditions and thresholds (e.g. on take-off weight) associated to EFPL transmission updates have been identified.
OBJ-07.06.02-VALP-0002.0600	Assess the benefits of having Profile Tuning Restrictions published with an applicability dimension (probability and/or time slices) and taking them into account when filing extended flight plans.	CRT-07.06.02-VALP-0002.0601	Profile Tuning Restrictions are included in the flight planning process only when applicable in the real evolution of the flight.

Table 3 Summary of validation objectives and success criteria as specified in the contribution document to the EXE-07.06.02-VP-713 validation plan (P11.01)

Summary from the EXE-07.06.02-VP-713 VALP

The following table summarizes the validation objectives and success criteria as specified in the contribution document to the EXE-07.06.02-VP-713 validation plan [10] prepared by P11.01.

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
OBJ-07.06.02-VALP-713A.1010	Confirm in operational conditions that the introduction of EFPLs improves the Flight Plan Validation Process.	CRT-07.06.02-VALP-713A.1011	The number of wrongly rejected current ICAO Flight Plans due to a mis-interpretation of flight intents is reduced. Accepted EFPLs while ICAO have been rejected are judged as valid by IFPS Operators experts.
OBJ-07.06.02-VALP-713A.1010	Confirm in operational conditions that the introduction of EFPLs improves the Flight Plan Validation Process.	CRT-07.06.02-VALP-713A.1012	The number of wrongly accepted current ICAO Flight Plans due to a mis-interpretation of flight intents is reduced. Rejected EFPLs while ICAO have been accepted are judged as valid by IFPS Operators experts.
OBJ-07.06.02-VALP-713A.1010	Confirm in operational conditions that the introduction of EFPLs improves the Flight Plan Validation Process.	CRT-07.06.02-VALP-713A.1013	The difference between AO 4D trajectory and accepted IFPS 4D trajectory is reduced in terms of Time and vertical profiles.
OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of 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.
OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of 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.
OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of 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.
OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL	CRT-07.06.02-VALP-	The Flight Planning negotiation process

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
	to EFPL on the work of FOC staff.	713A.1024	(communication) for FOC Staff is acceptable compared to current operating method where ICAO FPL is used.
OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of FOC staff.	CRT-07.06.02-VALP-713A.1025	The new operating methods support FOC Staff in performing their tasks in an efficient way.
OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of FOC staff.	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	Assess the impact of changing from ICAO FPL to EFPL on the work of 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.
OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	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.
OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	CRT-07.06.02-VALP-713A.1033	The error propensity IFPS operators is not increased compared to current operating method where ICAO FPL is used.
OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	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.
OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	CRT-07.06.02-VALP-713A.1035	The new operating methods support IFPS operators in performing their tasks in an efficient way.
OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	CRT-07.06.02-VALP-713A.1036	The HMI supports efficiently the IFPS operators in handling the EFPL.
OBJ-07.06.02-VALP-713A.1060	Validate that all FPL modifications (Delay, Change and Cancel) are operationally feasible with the introduction of the EFPL.	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

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
			(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).
OBJ-07.06.02-VALP-713A.1060	Validate that all FPL modifications (Delay, Change and Cancel) are operationally feasible with the introduction of the EFPL.	CRT-07.06.02-VALP-713A.1062	The system solution for managing EFPL modification is accepted by all affected actors.
OBJ-07.06.02-VALP-713A.1060	Validate that all FPL modifications (Delay, Change and Cancel) are operationally feasible with the introduction of the EFPL.	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	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO update message.	CRT-07.06.02-VALP-713A.1071	The HMI supports efficiently the IFPS operators in mixed mode operations.
OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO update message.	CRT-07.06.02-VALP-713A.1072	The workload of IFPS operators is not increased due to mixed mode of operations.
OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO update	CRT-07.06.02-VALP-713A.1073	IFPS operators are able to maintain a good SA level in mixed mode of operations.

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
	message.		
OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO update message.	CRT-07.06.02-VALP-713A.1074	The error propensity of IFPS operators is not increased due to mixed mode of operations.
OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO update message.	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.
OBJ-07.06.02-VALP-713A.1090	Validate that confidentiality for commercially sensitive data (Flight Performance data and TOW) is ensured.	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.
OBJ-07.06.02-VALP-713A.1100	Assess if the use of EFPLs by NM has any impact on the 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.
OBJ-07.06.02-VALP-713A.2010	Assess if the EFPL has a positive impact on predictability.	CRT-07.06.02-VALP-713A.2011	The contribution of each EFPL elements to network predictability in DCB is assessed. Assess the level of contribution to the predictability of each element of the EFPL (4D Trajectory, TOW, Performance data), each of them being taken individually or through a combination of them (which ones or which combination of them are the more important to

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
			improve predictability in various operational contexts).
OBJ-07.06.02-VALP-713A.2010	Assess if the EFPL has a positive impact on predictability.	CRT-07.06.02-VALP-713A.2012	Assess the proportion of the traffic for which the AO 4D trajectory can be used without modifications with regards ETFMS calculated 4D trajectory.
OBJ-07.06.02-VALP-713A.2030	Assess if an EFPL late update (e.g. last hour before take-off which should take into account meteo and TOW) sent by the Airspace User allows to improve 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.
OBJ-07.06.02-VALP-713A.2040	Assess whether the AO 4D Trajectory sent by the aircraft operators in the EFPL is closer (or not) to the trajectory actually flown than the NM DCB trajectory without taking into account any LOA 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.
OBJ-07.06.02-VALP-713A.2050	Study the potential consequences (e.g. erroneous traffic predictions) of operating in an environment where calculated 4D trajectories rely on sources of different natures (namely ICAO FPLs and EFPLs).	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.
OBJ-07.06.02-VALP-713A.2050	Study the potential consequences (e.g. erroneous traffic predictions) of operating in an environment where calculated 4D trajectories rely on sources of different natures (namely ICAO FPLs and EFPLs).	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	Evaluate the impact of EFPL 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.

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
OBJ-07.06.02-VALP-713A.2060	Evaluate the impact of EFPL on ATFCM / regulated flights.	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	Assess what additional information needs to be provided to the CFSPs to move the 4DT contained in the EFPL closer to the trajectory that is actually flown.	CRT-07.06.02-VALP-713A.2071	Validation results provide significant qualitative information on a difference of reliability between these two calculated 4D Trajectories.
OBJ-07.06.02-VALP-713B.1010	Show the operational feasibility of the integration of soft ATC constraints in the AU trajectory.	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”.
OBJ-07.06.02-VALP-713B.1010	Show the operational feasibility of the integration of soft ATC constraints in the AU trajectory.	CRT-07.06.02-VALP-713B.1012	The decision criteria to apply PTRs are clarified for the studied cases.
OBJ-07.06.02-VALP-713B.1010	Show the operational feasibility of the integration of soft ATC constraints in the AU trajectory.	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.
OBJ-07.06.02-VALP-713B.1010	Show the operational feasibility of the integration of soft ATC constraints in the AU trajectory.	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	Use of new international FIXM EFPL extension, which shall improve worldwide interoperability, is assessed as feasible between NM and AU	CRT-07.06.02-VALP-713B.1021	The use of FIXM EFPL extension operates successfully.
OBJ-07.06.02-VALP-713B.1020	Use of new international FIXM EFPL extension, which shall improve worldwide interoperability, is assessed as feasible between NM and AU	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	Assess the benefits of the integration of soft ATC constraints in the AU trajectory in terms of	CRT-07.06.02-VALP-713B.2011	The validation provides a quantitative measure of the benefit to apply some selected PTRs to

Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion
	predictability and flight efficiency.		better predict flight EETs, vertical profile and fuel consumption.
OBJ-07.06.02-VALP-713B.2010	Assess the benefits of the integration of soft ATC constraints in the AU trajectory in terms of predictability and flight efficiency.	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 4 Summary of validation objectives and success criteria as specified in the EXE-07.06.02-VP-713 validation plan (P07.06.02)

2.2.3.1 Choice of metrics and indicators

2.2.3.1.1 EXE-07.06.02-VP-713-A

The A part of the validation exercise was separated in two parts. The first part was a 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 questionnaire that has been used for the human assessment of the EFPL concept can be found in Appendix C. This questionnaire tried to assess the impact on workload and situational awareness. Furthermore, it was used to ask for feedback in regard to the maturity of the concept.

The second part was a shadow mode trial where the operational flight planning systems of a number of Lufthansa Systems customers were enabled to send out an EFPL whenever an ICAO flight plan was send to IFPS. Based on that the acceptance rates for the different types of flight plans have been used to indicate the difference between the ICAO FPL and EFPL filing. This was done for all flights of the sample. In addition, the EFPL acceptance rate for flights for which the ICAO flight plan was rejected by IFPS on the NM OPS system was assessed to have an indication of the share of flights that are wrongfully rejected when filed with the ICAO flight plan.

2.2.3.1.2 EXE-07.06.02-VP-713-B

This part of the validation exercise had rather a verification character. This part of the trial can be seen as a trial that supports standardization by demonstrating that NM EFPL submission service can migrate to FIXM without impacting flight plan validation and processing negatively. From this perspective the approach was that the flight plan processing results of the EFPL in the NM EFPL XML format are compared with those in the FIXM EFPL format. Both types of flight plans have been provided for the same trajectory. Based on this the following indicators have been generated and analyzed. First of all the flight plan acceptance rate for both flight plan formats have been generated and compared. In a second step it was analyzed for how many flights the same flight plan validity status (valid vs. invalid) has been received for both flight plan formats. In a third step it was checked for all flights that were invalid with both flight plan formats whether the same reject reasons led to the rejects of the flight plans.

2.2.4 Summary of Validation Scenarios

The scenarios used for the validation are specified in the EXE-07.06.02-VP-713 Validation Report [13] prepared by EUROCONTROL.

2.2.5 Summary of Assumptions

Identifier	Title	Type of Assumption	Description	Justification	Flight Phase	KPA Impacted	Source	Value(s)	Owner	Impact on Assessment
ASS-07.06.02-VP-713-S1-001	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-VP-713-S1-002	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	Interoperability	Expert opinion			Medium

Table 5: Validation Assumptions

2.2.6 Choice of methods and techniques

Supported Metric / Indicator	Platform / Tool	Method or Technique
EXE-07.06.02-VP-713 – A		
For the assessment a questionnaire with multiple choice answers was used. The share of every answer was used for the analysis enriched by comments made during the validation exercise.	NMVP with EFPL prototype based on NM 19.5 release LSY Flight Planning prototype	Gaming/ Human in the loop
EFPL acceptance rate; EFPL acceptance improvement rate; EFPL acceptance degradation rate.	NMVP with EFPL prototype based on NM 19.5 release LSY Flight Planning operational systems with EFPL extension	Shadow mode
EXE-07.06.02-VP-713 – B		
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 with FIXM EFPL prototype based on NM 19.5 release LSY Flight Planning prototype With FIXM extension	Analytical modeling

Table 6: Methods and Techniques

2.2.7 Validation Exercises List and dependencies

For more details on this chapter please refer to the overall EFPL validation report prepared by project P07.06.02 [13].

3 Conduct of Validation Exercises

For more details on this chapter please refer to the overall EFPL validation report prepared by project P07.06.02 [13].

3.1 Exercises Preparation

For more details on this section please refer to the overall EFPL validation report prepared by project P07.06.02 [13].

3.2 Exercises Execution

For more details on this section please refer to the overall EFPL validation report prepared by project P07.06.02 [13].

3.3 Deviations from the planned activities

For more details on this section please refer to the overall EFPL validation report prepared by project P07.06.02 [13].

3.3.1 Deviations with respect to the Validation Strategy

For more details on this section please refer to the overall EFPL validation report prepared by project P07.06.02 [13].

3.3.2 Deviations with respect to the Validation Plan

For more details on this section please refer to the overall EFPL validation report prepared by project P07.06.02 [13].

4 Exercises Results

4.1 Summary of Exercises Results

4.1.1 Exercise Results based on the contribution document to the EXE-07.06.02-VP-713 VALP as prepared by P11.01.05 [10]

Table 7 summarizes the exercise results for EXE-07.06.02-VP-713 based on the validation objectives and criteria that have been defined by P11.01 in the contribution document for the EXE-07.06.02-VP-713 VALP [10]. These results represent the conclusions made by Lufthansa Systems as part of the fly4D consortium/ P11.01. These objectives and success criteria have been adopted to ensure alignment with the contribution document to the EXE-07.06.02-VP-713 VALP.

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0001.0200	Measure the impact of the EFPL 4D trajectory usage on the rate of flight plans being accepted / rejected in the validation process by IFPS and on the type of error in case of rejection.	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.	In the VP-713-A gaming session it was shown that the time required to identify and solve rejects was reduced. This was mainly caused by the fact that the trajectory used by NMVP was closer to the one calculated in the flight planning system. That improved the ability to merge the reject reason and the affected part of the planned trajectory. In the VP-713-A shadow mode session the reject rate of the EFPL was slightly increased compared to the reject rate of the ICAO FPL. This was mainly caused by the setup of the shadow mode and expectable. Anyhow, the acceptance rate of the EFPLs was about 93%. This is – especially for this type of setup – a very high value.	OK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
					Therefore, this criterion can be assessed as being achieved from AU perspective.	
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0001.0300	Assess whether EFPL 4DT data can help reducing the number of false flight plan rejections and acceptances related 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.	This criterion has been explored in the gaming session of the validation exercise part A. This analysis showed that rejections caused by differences in the vertical profile can be reduced with the EFPL. Rejects related to ETO differences were reduced, except in the cases where the taxi times were misinterpreted by the NMVP)	OK
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0001.0700	Assess the percentage of flights where the EFPL can be used without ANY modifications to the 4DT within the ETFMS.	CRT-07.06.02-VALP-0001.0601	A quantitative result on the direct EFPL usage in ETFMS.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0001.0800	Assess whether EFPLs can be submitted with negative geodetic airport altitudes in the	CRT-07.06.02-VALP-0001.0601	EFPLs with negative geodetic airport altitudes are accepted.	During the first run of EXE-07.06.02-VP-713-A “Shadow Mode” (conducted in January 2016) this issue still occurred. During the second run of this exercise (conducted in March 2016)	OK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
		4DT.			this issue was not occurring again; confirming that this it has been solved. From this perspective this validation exercise confirms the feasibility to file EFPLs for flights operating to/ from airports with a negative elevation.	
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0001.0900	Assess and identify the reasons why the actually executed trajectory deviates laterally and vertically from the planned trajectory in the EFPL.	CRT-07.06.02-VALP-0001.0601	A qualitative result showing why the executed trajectory deviates from the planned trajectory.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0001.0950	Assess the capability of ETFMS to use all trajectory points provided by the AU in the EFPL.	CRT-07.06.02-VALP-0001.0601	All trajectory points provided in the EFPL are used within ETFMS and no lateral or vertical differences are produced.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0002.0301	Assess what additional information needs to be provided to the CFSPs to move the 4DT contained in the EFPL closer to the trajectory that is actually flown.	CRT-07.06.02-VALP-0002.0301	Validation results provide significant qualitative information on a difference of reliability between these two calculated 4D Trajectories.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0002.0500	Determine which conditions (e.g. on take-off weight variations) should trigger the transmission of EFPL updates (in addition to situations where ICAO FPLs are currently updated).	CRT-07.06.02-VALP-0002.0501	Conditions and thresholds (e.g. on take-off weight) associated to EFPL transmission updates have been identified.	This criterion was not analyzed during the validation exercise. For more information see 6.1.2.3 Deviation from the planned activities.	
EXE-07.06.01-VP-713	OBJ-07.06.02-VALP-0002.0600	Assess the benefits of having Profile Tuning Restrictions published with an applicability dimension (probability and/or time slices) and taking them into account when filing extended flight plans.	CRT-07.06.02-VALP-0002.0601	Profile Tuning Restrictions are included in the flight planning process only when applicable in the real evolution of the flight.	This criterion was not analyzed during the validation exercise. For more information see 6.1.2.3 Deviation from the planned activities.	

Table 7: Summary of Validation Exercises Results based on the contribution document to the EXE-07.06.02-VP-713 VALP as prepared by P11.01

4.1.2 Exercise Results based on the EXE-07.06.02-VP-713 VALP as prepared by P07.06.02

Table 8 summarizes the exercise results for EXE-07.06.02-VP-713 based on the validation objectives and criteria that have been defined by P07.06.02 in the EXE-07.06.02-VP-713 VALP [9]. The results listed in Table 8 represent the conclusions made by Lufthansa Systems as part of the fly4D consortium/ P11.01. These objectives and success criteria have been adopted to ensure alignment with the EXE-07.06.02-VP-713 VALP which is prepared by EUROCONTROL.

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	Confirm in operational conditions that the introduction of EFPLs improves the Flight Plan Validation Process.	CRT-07.06.02-VALP-713A.1011	The number of wrongly rejected current ICAO Flight Plans due to a mis-interpretation of flight intents is reduced. Accepted EFPLs while ICAO have been rejected are judged as valid by IFPS Operators experts.	The validation exercise showed during the gaming session as well as during the shadow mode sessions performed for the A-part of the exercise that correctly planned trajectories that are rejected when using the ICAO flight plan are accepted in case that the EFPL is used.	OK
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1010	Confirm in operational conditions that the introduction of EFPLs improves the Flight Plan Validation Process.	CRT-07.06.02-VALP-713A.1012	The number of wrongly accepted current ICAO Flight Plans due to a mis-interpretation of flight intents is reduced. Rejected EFPLs while ICAO have been accepted are judged as valid by	The validation exercise showed during the gaming session as well as during the shadow mode sessions performed for the A-part of the exercise that wrongly planned trajectories that are accepted when using the ICAO flight plan are rejected in case that the EFPL is used.	OK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
				IFPS Operators experts.		
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1010	Confirm in operational conditions that the introduction of EFPLs improves the Flight Plan Validation Process.	CRT-07.06.02-VALP-713A.1013	The difference between AO 4D trajectory and accepted IFPS 4D trajectory is reduced in terms of Time and vertical profiles.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of 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.	The EFPL is not changing the filing procedure compared to the ICAO flight plan. The majority of dispatchers that joined the gaming session of the A-part of the exercise concluded that the workload is not changing; respectively should decreased. The reduction of Wrongly rejected ICAO flight plans also leads to the conclusion that this kind of workload can also be reduced.	OK
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of 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 dispatchers that joined the gaming session of the A-part of the exercise concluded that the situational awareness is not changing with the EFPL as it is used currently. Apart from that they concluded that the EFPL delivers the potential to increase the situational awareness, if the content in the IFPS reply messages is improved.	OK
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO	CRT-07.06.02-VALP-713A.1023	The error propensity of FOC	The majority of participants joining the gaming session of EXE-07.06.02-VP-	OK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
		FPL to EFPL on the work of FOC staff.		Staff is not increased compared to current operating method where ICAO FPL is used.	713-A do not expect an increase of the error propensity. This conclusion can be seen as expert opinion based on the experiences made during the EFPL trial.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of 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.	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 setup for this validation exercise. Hence this criterion cannot be evaluated yet.	NOK
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the work of FOC staff.	CRT-07.06.02-VALP-713A.1025	The new operating methods support FOC Staff in performing their tasks in an efficient way.	A little bit more as half of the participants of the gaming session of EXE-07.06.02-VP-713-A conclude that this success criterion is fulfilled. But the remaining participants think that this criterion was not applicable to the validation exercise. From this perspective this criterion cannot be counted as successfully validated.	NOK
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1020	Assess the impact of changing from ICAO FPL to EFPL on the	CRT-07.06.02-VALP-713A.1026	The HMI supports efficiently the FOC Staff in preparing	7 of 11 participants of the gaming session of EXE-07.06.02-VP-713-A replied that this criterion is fulfilled. The	OK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
		work of FOC staff.		the EFPL.	remaining four participants replied with "not fulfilled". But it has to be pointed out that the HMI in the Lido/Flight flight planning system has not been adapted. That means that the EFPL could be used in a first step without changing the flight planning's' system HMI in a first step. That means that a complete change of the HMI is not necessarily required but might be desired.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of 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.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	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.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	CRT-07.06.02-VALP-713A.1033	The error propensity IFPS operators is not increased compared to	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
				current operating method where ICAO FPL is used.		
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	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 criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	CRT-07.06.02-VALP-713A.1035	The new operating methods support IFPS operators in performing their tasks in an efficient way.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1030	Assess the impact of changing from ICAO FPL to EFPL on the work of IFPS operators.	CRT-07.06.02-VALP-713A.1036	The HMI supports efficiently the IFPS operators in handling the EFPL.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1060	Validate that all FPL modifications (Delay, Change and Cancel) are operationally feasible with the introduction of the EFPL.	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	This criterion has not been tested with the participants of the gaming session of EXE-07.06.02-VP-713-A directly as the prototype had not the required technical capabilities. But the shadow mode exercise of the gaming session of EXE-07.06.02-VP-713-A confirmed that these procedures are fully working.	OK

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
				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).	Besides that it must be pointed out that the procedures do not change due to the new flight plan format.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1060	Validate that all FPL modifications (Delay, Change and Cancel) are operationally feasible with the introduction of the EFPL.	CRT-07.06.02-VALP-713A.1062	The system solution for managing EFPL modification is accepted by all affected actors.	During the whole validation exercise it got visible that all tools are already there to manage the EFPL modifications in an acceptable way. But it was also pointed out that the EFPL – concept-wise – should also offer the possibility to improve details of the processes. It was pointed out that – for example – the content of any reject reason should be more granular to make it possible to graphically indicate issues with an trajectory. In conclusion it can be said that this criterion is fulfilled, but that improvements should be explored and introduced to get the maximal benefit out of the EFPL concept.	OK
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1060	Validate that all FPL modifications (Delay, Change and Cancel) are operationally	CRT-07.06.02-VALP-713A.1063	The information provided by EFPL (modifications introduced with	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
		feasible with the introduction of the EFPL.		respect to ICAO FPL) is relevant for the tasks to be performed by all actors.		
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO update message.	CRT-07.06.02-VALP-713A.1071	The HMI supports efficiently the IFPS operators in mixed mode operations.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an	CRT-07.06.02-VALP-713A.1072	The workload of IFPS operators is not increased due to mixed mode of operations.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
		EFPL message is followed by an ICAO update message.				
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO update message.	CRT-07.06.02-VALP-713A.1073	IFPS operators are able to maintain a good SA level in mixed mode of operations.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO	CRT-07.06.02-VALP-713A.1074	The error propensity of IFPS operators is not increased due to mixed mode of operations.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
		update message.				
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1070	Assess the feasibility of the two mixed mode of operation: The Global mixed mode where some AUs provide EFPLs whereas other continue to transmit ICAO FPLs; and, the Individual mixed mode of operation for one flight, where an EFPL message is followed by an ICAO update message.	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 criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1090	Validate that confidentiality for commercially sensitive data (Flight Performance data and TOW) is ensured.	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 criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.1100	Assess if the use of EFPLs by NM has any impact on the 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	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
				FPLs and the ATC distribution list based on EFPLs.		
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2010	Assess if the EFPL has a positive impact on predictability.	CRT-07.06.02-VALP-713A.2011	The contribution of each EFPL elements to network predictability in DCB is assessed. Assess the level of contribution to the predictability of each element of the EFPL (4D Trajectory, TOW, Performance data), each of them being taken individually or through a combination of them (which ones or which combination of them are the more important to improve predictability in various operational contexts).	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2010	Assess if the EFPL has a positive impact on predictability.	CRT-07.06.02-VALP-713A.2012	Assess the proportion of the traffic for which the	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this*	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
				AO 4D trajectory can be used without modifications with regards ETFMS calculated 4D trajectory.	*contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2030	Assess if an EFPL late update (e.g. last hour before take-off which should take into account meteo and TOW) sent by the Airspace User allows to improve 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 criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2040	Assess whether the AO 4D Trajectory sent by the aircraft operators in the EFPL is closer (or not) to the trajectory actually flown than the NM DCB trajectory without taking into account any LOA 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 criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2050	Study the potential consequences (e.g. erroneous traffic predictions) of	CRT-07.06.02-VALP-713A.2051	Validation results provide significant information making it possible to	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
		operating in an environment where calculated 4D trajectories rely on sources of different natures (namely ICAO FPLs and EFPLs).		assess whether operating with 4D trajectories based on different sources introduces any bias.		
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2050	Study the potential consequences (e.g. erroneous traffic predictions) of operating in an environment where calculated 4D trajectories rely on sources of different natures (namely ICAO FPLs and EFPLs).	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.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2060	Evaluate the impact of EFPL 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 criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	

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.2060	Evaluate the impact of EFPL on ATFCM / regulated flights.	CRT-07.06.02-VALP-713A.2062	The impact of EFPL (compared to ICAO FPL) on delays is acceptable.	*This criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713A.2070	Assess what additional information needs to be provided to the CFSPs to move the 4DT contained in the EFPL closer to the trajectory that is actually flown.	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 criterion refers to the processing of flight plans on EUROCONTROL side and cannot be evaluated in this contribution to the overall VALR [13].*	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1010	Show the operational feasibility of the integration of soft ATC constraints in the AU trajectory.	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”.	This criterion was not analyzed during the validation exercise. For more information see 6.1.2.3 Deviation from the planned activities.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1010	Show the operational feasibility of the integration of soft ATC constraints in the AU trajectory.	CRT-07.06.02-VALP-713B.1012	The decision criteria to apply PTRs are clarified for the studied cases.	This criterion was not analyzed during the validation exercise. For more information see 6.1.2.3 Deviation from the planned activities.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1010	Show the operational feasibility of the	CRT-07.06.02-VALP-713B.1013	The CFSP experts are confident that	This criterion was not analyzed during the validation exercise. For more	

Exercise ID	Validation Objective ID	Validation Objective Title	Success Criterion ID	Success Criterion	Exercise Results	Validation Objective Status
		integration of soft ATC constraints in the AU trajectory.		such a scenario can be at least partly automated in the future to avoid increase of operator workload.	information see 6.1.2.3 Deviation from the planned activities.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1010	Show the operational feasibility of the integration of soft ATC constraints in the AU trajectory.	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.	This criterion was not analyzed during the validation exercise. For more information see 6.1.2.3 Deviation from the planned activities.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.1020	Use of new international FIXM EFPL extension, which shall improve worldwide interoperability, is assessed as feasible between NM and AU	CRT-07.06.02-VALP-713B.1021	The use of FIXM EFPL extension operates successfully.	Generally it was possible to use FIXM EFPLs for the exchange of EFPL data. But it there was still a number of occurrences where the validity of a trajectory was different when using a FIXM EFPL compared to an NM EFPL XML message. Those issues are mainly caused by technical issues that either have been solved already or can simply be solved after addressing them. For approximately 95% of the cases the same flight plan validity result has been achieved with both formats.	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-713B.1020	Use of new international FIXM EFPL extension, which shall improve worldwide interoperability, is assessed as feasible between NM and AU	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.	For the time being the flight plan creation, validation and retrieval. All related services (and required clients) have been agreed and developed by NM (EUROCONTROL) and the CFSP (Lufthansa Systems) and successfully used for the FIXM analytical modeling exercise.	OK
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.2010	Assess the benefits of the integration of soft ATC constraints in the AU trajectory in terms of predictability and flight efficiency.	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.	This criterion was not analyzed during the validation exercise. For more information see 6.1.2.3 Deviation from the planned activities.	
EXE-07.06.02-VP-713	OBJ-07.06.02-VALP-713B.2010	Assess the benefits of the integration of soft ATC constraints in the AU trajectory in terms of predictability and flight efficiency.	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).	This criterion was not analyzed during the validation exercise. For more information see 6.1.2.3 Deviation from the planned activities.	

Table 8: Summary of Validation Exercises Results based on the EXE-07.06.02-VP-713 VALP as prepared by P07.06.02

4.1.3 Results on concept clarification

Please review section 6.1.3.1.1 summarizing the results on concept clarification for EXE-07.06.02-VP-713 from airspace user perspective.

4.1.4 Results per KPA

Please review section 6.1.3.1.2 summarizing the results per KPA for EXE-07.06.02-VP-713 from airspace user perspective.

4.1.5 Results impacting regulation and standardisation initiatives

Please review section 6.1.3.1.3 summarizing the results impacting regulation and standardization initiatives for EXE-07.06.02-VP-713 from airspace user perspective.

4.2 Analysis of Exercises Results

Please review section 6.1.3.2 analyzing the exercise results for EXE-07.06.02-VP-713 from airspace user perspective.

4.2.1 Unexpected Behaviours/Results

Please review section 6.1.3.2.4 summarizing unexpected behavior during EXE-07.06.02-VP-713.

4.3 Confidence in Results of Validation Exercises

4.3.1 Quality of Validation Exercises Results

Please review section 6.1.3.3.1 discussing the quality of the exercise results for EXE-07.06.02-VP-713 from airspace user perspective.

4.3.2 Significance of Validation Exercises Results

Please review section 0 discussing the significance of the exercise results for EXE-07.06.02-VP-713 from airspace user perspective.

5 Conclusions and recommendations

5.1 Conclusions

Please review section 6.1.4.1 summarizing the conclusions for EXE-07.06.02-VP-713 from airspace user perspective.

5.2 Recommendations

Please review section 6.1.4.2 summarizing the recommendations for EXE-07.06.02-VP-713 from airspace user perspective.

6 Validation Exercises reports

In chapter 6 and its sections the contribution of project WP11.1 to the validation report of EXE-07.06.02-VP-713 [13] is documented. This contribution to the validation report focuses in particular on airspace user related aspects as well as flight planning system related aspects. Its content will be included into the overall validation report for EXE-07.06.02-VP-713 prepared by project P07.06.02.

6.1 Validation Exercise EXE-07.06.02-VP-713 Report

6.1.1 Exercise Scope

The validation exercise that is documented in this VALR document had two different scopes. On the one hand the proof of the maturity level V3 of the EFPL concept is 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 airline flight dispatchers to file flights using EFPL messages in a gaming session. 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 exercise streams 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 trial has been performed as analytical modeling trial. This part of the validation exercise is called:

- EXE-07.06.02-VP-713-B “FIXM Analytical Modeling”.

6.1.2 Conduct of Validation Exercise

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-713- A	Extended flight plan exchange in operations – gaming session.	21/09/2015	25/09/2015	11/01/2016	15/02/2016
EXE-07.06.02-VP-713- A	Extended flight plan exchange in operations – shadow mode session. (1st trial)	25/01/2016	31/01/2016	04/04/2016	29/042016
EXE-07.06.02-VP-713- A	Extended flight plan exchange in operations – shadow mode session. (2nd trial)	23/03/2016	24/03/2016	04/04/2016	29/042016
EXE-07.06.02-VP-713- B	Extended flight plan exchange in the FIXM EFPL. – analytical modelling	11/01/2016	19/01/2016	09/05/2016	27/05/2016

Table 9: Summary of validation exercise conduction dates

6.1.2.1 Exercise Preparation

6.1.2.1.1 EXE-07.06.02-VP-713-A “Gaming Sessions”

The main preparatory activities were:

- Platform Installation
  - Setup of the Lido/Flight flight planning system and enabling of the EFPL filing (Lufthansa Systems);
- Scenario preparation
  - Definition of the trial scenarios for the gaming session (Lufthansa Systems);
  - Preparation of flight lists in the flight planning systems (Lufthansa Systems).
- Dry runs
  - Dry run with Lido/Flight

6.1.2.1.2 EXE-07.06.02-VP-713-A “Shadow Mode”

The main preparatory activities were:

- Platform Installation
  - Installation of the EFPL minimum version of the Lido/Flight system (Lufthansa Systems) for each participating airspace user,
  - Setup of Lido/Flight to enable the EFPL filing for each participating airspace user;
- Dry runs
  - Dry run with a specified airspace user operating Lido/Flight.

6.1.2.1.3 EXE-07.06.02-VP-713-B “FIXM Analytical Modeling”

The main preparatory activities were:

- Development
  - Data model and format definition
  - Development of IFPS evolutions/ FIXM EFPL creation service, FIXM EFPL retrieval service and FIXM EFPL validation service development.
  - Development of Lido/Flight system evolution/ FIXM EFPL creation service client, FIXM EFPL retrieval service client and FIXM EFPL validation service client development.
- Platform Installation
  - Deployment/ Installation of the FIXM EFPL services on NMVP;
  - Deployment/ Installation of the FIXM EFPL services clients on the Lido/Flight prototype platform.
- Scenario preparation
  - Definition of a flight list to be calculated by Lido/Flight during the trial.
- Dry runs
  - Common dry run between EUROCONTROL (NMVP) and Lufthansa Systems (Lido/Flight).

6.1.2.2 Exercise execution

6.1.2.2.1 EXE-07.06.02-VP-713-A "Gaming Sessions"

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. A description of the trial run at this location is out of scope for this validation report as it only focuses on the aspects related to the validation exercise from an AU and CFSP perspective. The other two locations were the premises of Lufthansa Systems on the one hand and of Sabre on the other hand. These two locations were hosting the gaming sessions for the particular airspace users. The following descriptions only refer to EXE-07.06.02-VP-713-A "Gaming Session" as performed at the premises of Lufthansa Systems.

The validation exercise was conducted at the Lufthansa Systems Headquarter in Raunheim Germany. To better support the participating airspace users the number of participants was reduced to maximum three airlines a day, 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. Therefore, it was possible to organize trial runs on 4 of the dedicated 5 days. The airspace users that joined the validation exercise are mainly Lufthansa Systems customers. Apart from these participants, two further airlines (novair and Hop!) joined this gaming session although they are not Lufthansa Systems customers and hence not familiar with the Lido/Flight flight planning system. The validation exercise was supported by a SESAR colleague working for the innovate consortium, who was responsible for the human performance assessment during the trial. On two days colleagues from EUROCOTROL were also joining the gaming session to get in contact with the "end user of the EFPL concept", the airspace users. Table 10 gives an overview about the scheduled trial days and the participating partners.

	21/09/2015	22/09/2015	23/09/2015	24/09/2015	25/09/2015
Lufthansa Systems	Lufthansa		Thomas Cook	TAP Portugal	Hop!
	El Al		germanwings	Air France	
	easyJet		novair		
	innovate		innovate	innovate	
			EUROCONTROL	EUROCONTROL	

Table 10: Schedule of the EFPL gaming sessions

Scenarios

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.

Flight Samples

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.

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.

	ADEP	ADES	Call Sign	A/C Type	Payload [kg]	STD	STA
Morning session	LGSR	LGMK	DLH*001	A320	10000	1015	1040
	LFBO	LEMD	DLH*002	A319	10000	1000	1200
	LFBO	LEMD	DLH*003	A321	10000	1000	1200
	LSGG	ESSA	DLH*004	A319	10000	1025	1300
	EDDM	LIRP	DLH*005	A319	10000	1300	1400
	LGIR	EGKK	DLH*006	A320	10000	2023	2359
	LGIR	EGKK	DLH*007	A321	10000	2024	2359
	HLLQ	DTTA	DLH*008	A320	10000	1800	2230
	LBSF	EBCI	DLH*009	A319	4000	0300+1	0530+1
	LBSF	EBCI	DLH*010	A320	4000	0300+1	0530+1
	LBSF	EBCI	DLH*011	A319	10000	0300+1	0530+1
	LBSF	EBCI	DLH*012	A320	10000	0300+1	0530+1
	LLBG	LEMD	DLH*013	A321	10000	1400	1920
Afternoon session	LGSR	LGMK	DLH*014	A320	10000	1415	1440
	LFBO	LEMD	DLH*015	A319	10000	1400	1600
	LFBO	LEMD	DLH*016	A321	10000	1400	1600
	LSGG	ESSA	DLH*017	A319	10000	1525	1800
	EDDM	LIRP	DLH*018	A319	10000	1600	1700
	LGIR	EGKK	DLH*019	A320	10000	2023	2359
	LGIR	EGKK	DLH*020	A321	10000	2024	2359
	HLLQ	DTTA	DLH*021	A320	10000	1800	2230
	LBSF	EBCI	DLH*022	A319	4000	0300+1	0530+1
	LBSF	EBCI	DLH*023	A320	4000	0300+1	0530+1
	LBSF	EBCI	DLH*024	A319	10000	0300+1	0530+1
	LBSF	EBCI	DLH*025	A320	10000	0300+1	0530+1
	LLBG	LEMD	DLH*026	A321	10000	1600	2120

Table 11: Flight schedule of the EXE-07.06.02-VP-713-A “Gaming Session”

Table 11 lists all flights that have been used for the EXE-07.06.02-VP-713-A “Gaming Session”. As described above the city pairs of the morning session flight schedule and the afternoon session flight schedule are identical. Another thing that can be observed is that within the two flight lists some flights seem to be included several times. But when going more into the details some differences can be recognized directly:

In some cases a different aircraft type is used for two flights linking the same city pair. Those flights shall be used to assess the impact of the aircraft related performance data onto the validity of the flight plan. In the particular cases the item 15 information in the ICAO flight plan is the same but the ICAO flight plan is rejected if one aircraft type is used and accepted if the other aircraft is used.

In other cases the payload has been adapted to have different climb and descend profiles for the same aircraft type to assess the impact of this onto the flight plan validity and how to assess how a flight dispatcher would resolve related rejects.

When time was permitting the flight dispatchers were invited to plan flights individually and to discuss these cases within the validation exercise group.

Systems under test

For this part of the validation exercise only a single flight planning system was used. It was provided and is operated by Lufthansa Systems itself. The system was operated with Lido/Flight Version V5.8.3 and had two different configurations.
During the morning session the Lido/Flight system was enabled to file flight plans in the ICAO format only using the "Flight Plan Creation", "Flight Plan Update", "Flight Plan Cancellation", and "Filing Status" requests of the FlightFiling Service and the "Flight Retrieval" request of the FlightManagement Service of NM release 19.5 as installed on the NMVP platform.
During the afternoon session the Lido/Flight system was operated in the second configuration that enabled the system to use the "Extended Flight Plan Creation" and the "Filing Status" requests of the FlightFilingService and the "Flight Retrieval" request of the FlightManagement Service of NM release 19.5 as installed on the NMVP.
In both cases the system was connected to all operational data feeds that are used by Lido/Flight system used in flight operations. Hence the operational data base was close to any Lido/Flight environment operated by an airline[2].

The Lido/Flight system was connected to the NMVP as well as to the NM PREOPS platform via the internet using the dedicated B2B web services provided by EUROCONTROL.

6.1.2.2.1 EXE-07.06.02-VP-713-A "Shadow Mode" session

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 29th 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 airlines using either Lufthansa Systems' Lido/Flight flight planning system or Sabre's Flight Plan Manager flight planning system. Table 12 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.

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

	1st trial run (25th – 31th of January 2016)	2nd trial run (21th – 25th of March 2016)
Lufthansa Systems	easyJet	
	Lufthansa	
	Lufthansa Cargo	
	Lufthansa CityLine	
	Thomas Cook/ Condor	TAP Portugal

Table 12: Airline schedule of the EXE-07.06.02-VP-713-A "Shadow Mode" exercise

Scenarios

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.

Reference scenario

In the reference scenario 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.

Solution scenario

In the solution scenario the flight planning system has sent EFPL messages to the NMVP whenever a 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.

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 12 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[3] 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 2 shows the number of flights for which at least one EFPL has been sent 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 as well as on the 23rd of March. The other variations of the number of flights are rather referring to the number of dispatched flights on the individual days.

[3] 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.

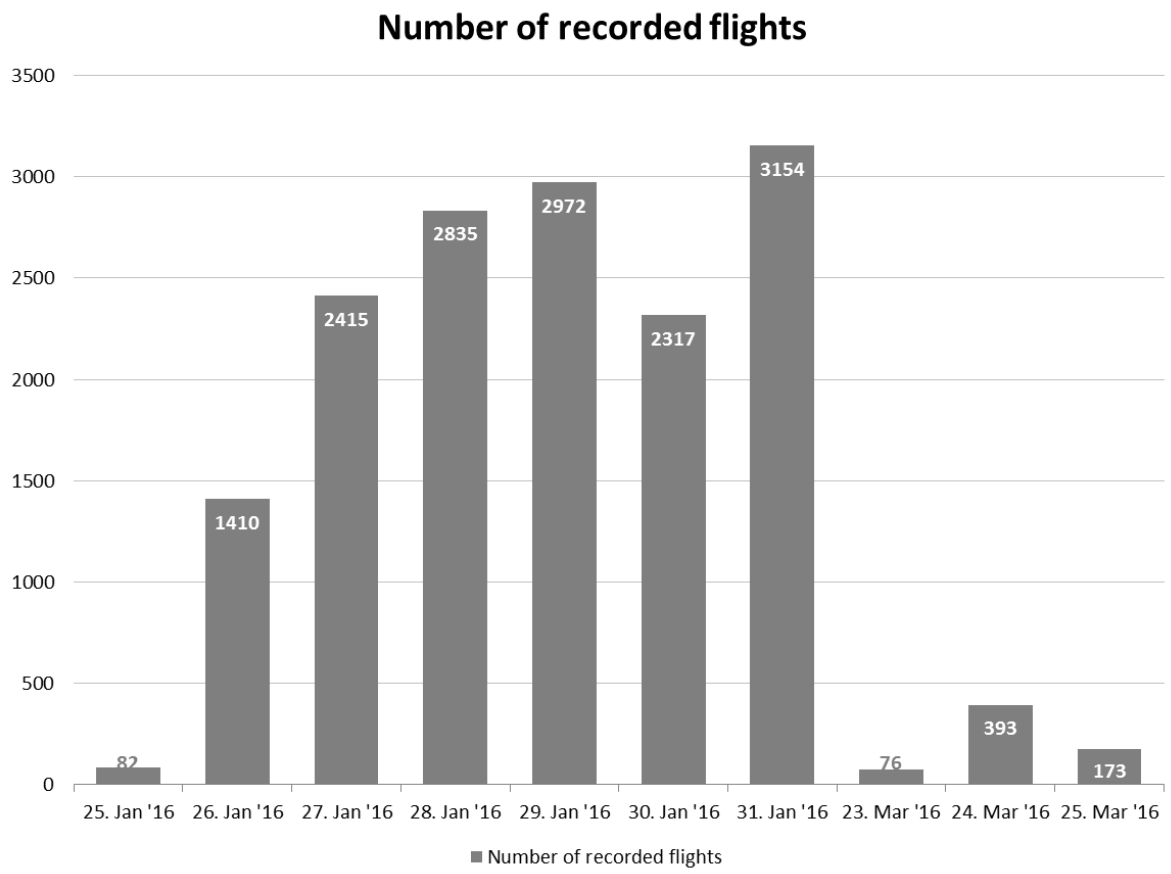


Figure 2: Number of recorded flights during EXE-07.06.02-VP-713-A “Shadow Mode” trials

During the 10 days 15,827 flights have been provided by the contributing airspace users. Figure 3 gives overview about the share of flights from the respective airspace user in reference to the number of recorded flights.

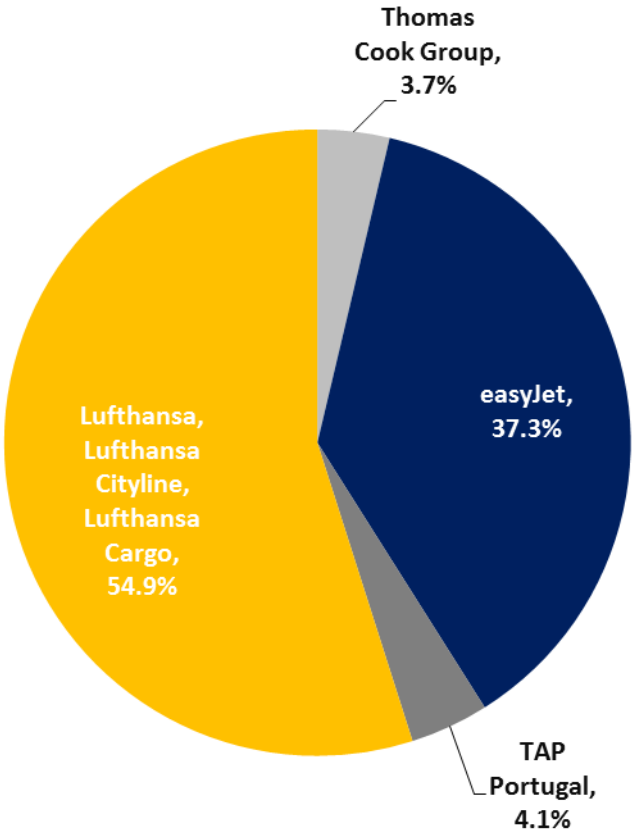


Figure 3: Share of recorded flights per airspace user

To get meaningful results some of the flights had to be sorted out. First of all the flights of the respective airspace users that were reported on the day of setup have been removed if their number was quite low. This was done to avoid that the validation result is falsified by effects that purely relate to the setup procedure. As an example, on the day of setup only about 200 flights have been recorded for easyJet, while more than 800 or 1000 flights have been reported on other days.
Another reason leading to a removal of flights from the flight sample is the timing of flight plan filing, the EFPL setup and a flight plan update. 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. Those flights have also been removed from the flight sample.
On the other hand some flights have been removed from the sample due to the fact that not all the EFPLs 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 flights 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. An example is the following issue:

INVALID_INPUT: INVALID_ATTRIBUTE_VALUE RECEIVED: 763D CONSTRAINT: value does not respect the expected format: ' once the character sequence of one lower or upper case letter A to Z followed by one to three times either one lower or upper case letter A to Z or one digit 0 to 9'

In this particular case a wrong ICAO aircraft indicator was coded in Lido/Flight which is a data issue and not related to the trajectory itself. Hence it is not possible to really assess the objective of the validation exercise as this – more technical – issue is referring to a verification of the prototypes. Another example is the following issue that is related to the NMVP:

INVALID_INPUT INVALID_ATTRIBUTE_VALUE RECEIVED: -3 CONSTRAINT: value must be greater or equal to: '0'

In those cases the NMVP rejected EFPL that included a negative altitude at the airport of Amsterdam. In the particular cases the reject was triggered if the Flight Specific Performance Data in the EFPL included a negative elevation at the airport. This has been identified as issue on NMVP side as the airport Amsterdam Schiphol has a negative elevation as Figure 4 below is indicating. In the particular case the runway 04-22 has an elevation of -13.0 - -13.8ft below the MSL. This picture is extracted from the aerodrome obstacle chart as published by the Netherlands. For more information please consult the respective publications [11].

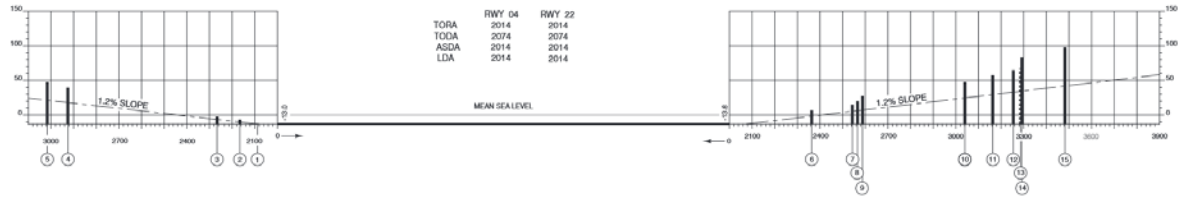


Figure 4: Extract from the “AD 2 EHAM AERODROME OBSTACLE CHART TYPE A RWY 04-22” [11]

In sum approximately 89% of the flights 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 11% of flights that have been removed from the “validation sample” has been done nevertheless to address necessary technical improvements identified during the validation exercise.

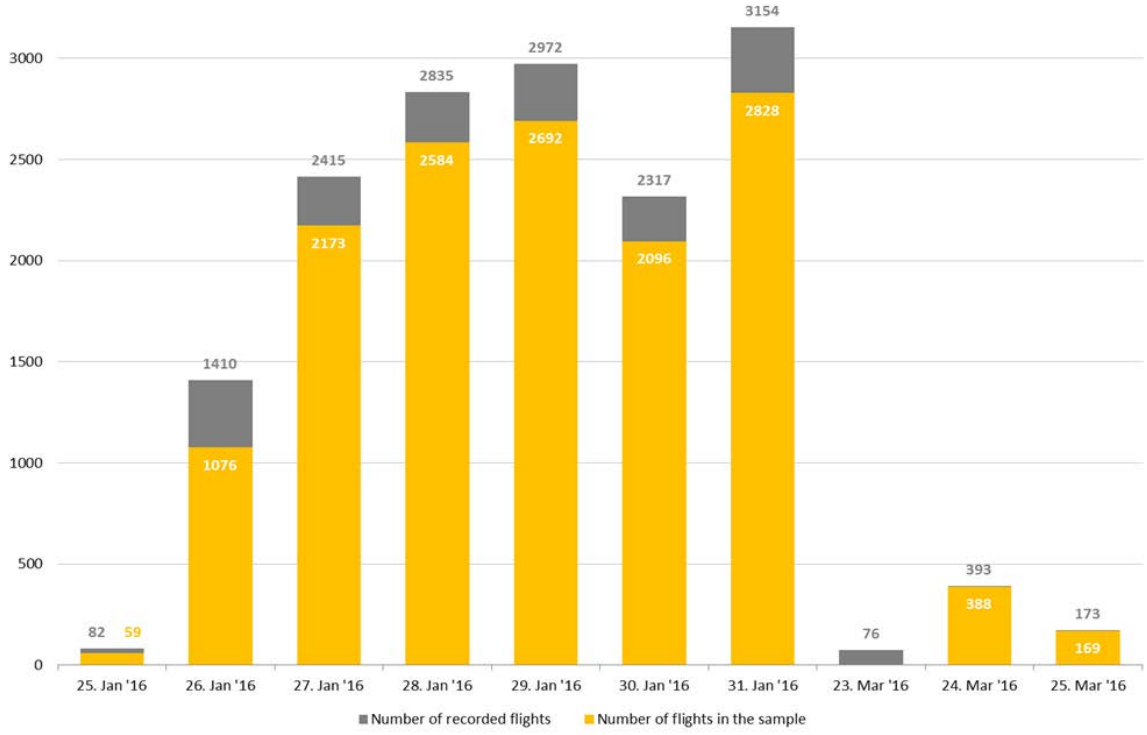


Figure 5: Comparison of the number of recorded flights and number of flights in the validation sample of EXE-07.06.02-VP-713-A “Shadow Mode” trials

Figure 5 shows for every trial day the number of recorded flights for this day as well as the number of flights that have been considered in the flight sample. Only on the 23rd of March none of the flights was considered in the sample as the number of recorded flights was very low (due to the setup procedure) on this day. In result, 14,065 flights have been considered in the validation sample.

Systems under test

The shadow mode trial runs have been conducted from the Lido/Flight 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 Lido/Flight systems used in these trial runs were completely operational systems. The EFPL message transition functionalities have been fully integrated into the respective operational Lido/Flight versions as background functionalities. Figure 6 briefly describes the Lido/Flight EFPL functionality as integrated into the operational Lido/Flight versions.

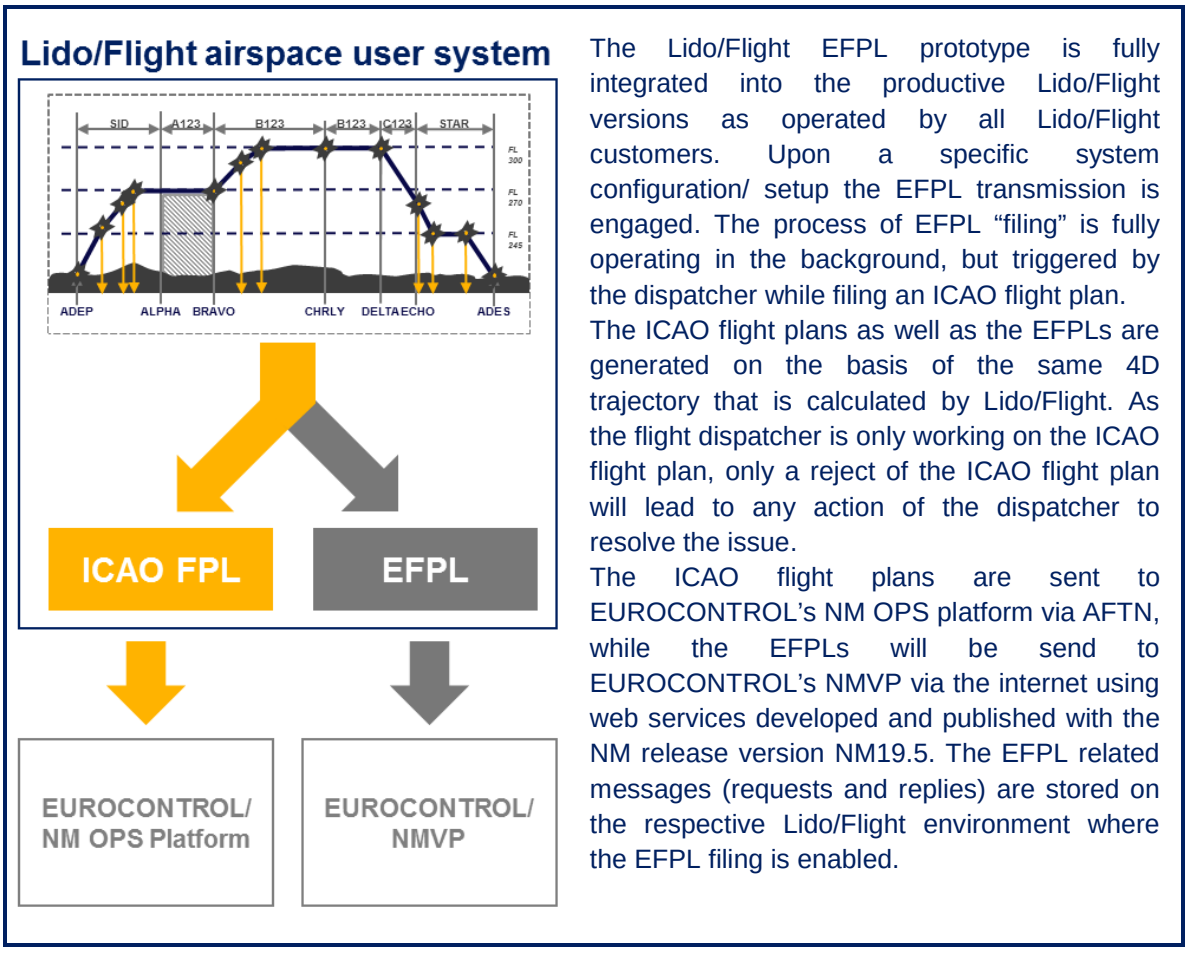


Figure 6: Description of the Lido/Flight EFPL prototype for the EXE-07.06.02-VP-713-A "Shadow Mode" exercise

6.1.2.2.1 EXE-07.06.02-VP-713-B "FIXM Analytical Modeling"

This part of EXE-07.06.02-VP-713 was performed by EUROCONTROL in collaboration with Lufthansa Systems. It is an extension of the scope of this exercise and relates to a technical validation of the EFPL concept based on FIXM provisions. Hence this part of the validation is rather a kind of verification-like validation. However, this part of the validation exercise cannot be seen solely as it directly relates to the A-part of EXE-07.06.02-VP-713. The A-part of EXE-07.06.02-VP-713 should be understood as a trial that supports standardization by demonstrating that NM EFPL XML submission service can migrate to FIXM without impacting flight plan validation and processing negatively.

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 only involved Lufthansa Systems with their flight planning system Lido/Flight.

Scenarios

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.

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 XML 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 in the flight list (see Table 24 in Appendix B.1) 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. In Appendix B.1 you can find Table 24 listing all flights that have been used in this trial of the validation exercise.

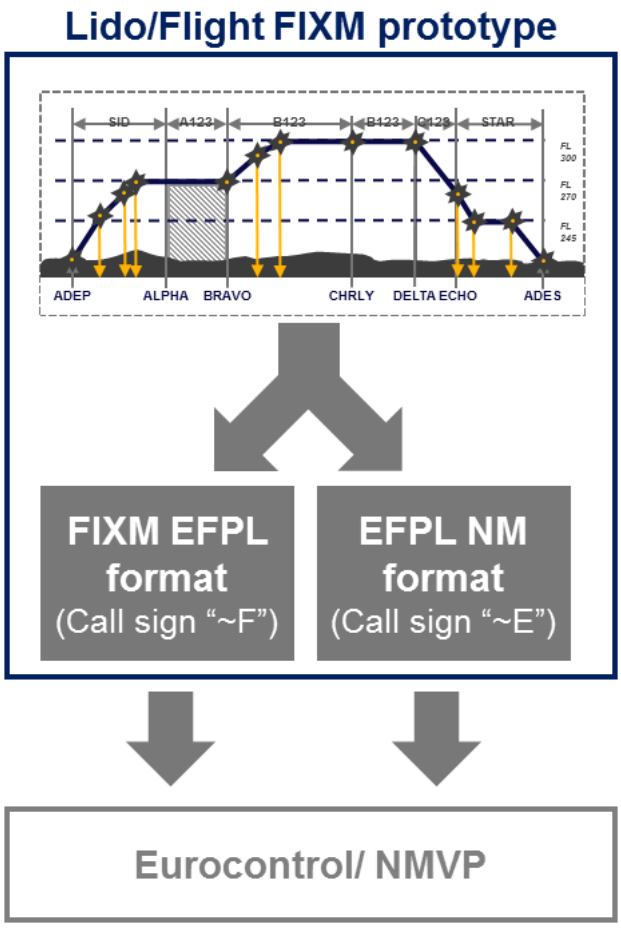
During this validation exercise all reply messages that have been received from the NMVP have been recorded for the NM EFPL XML as well as for the FIXM EFPL. Based on this recorded data the size of the sample was adapted again as some flight had to be sorted out. But there was only a single reason for filtering out flight from the sample. In some cases there was no reply message recorded for the NM EFPL XML 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.

System under test

For this part of the validation exercise only a single flight planning system was used. It was provided and is operated by Lufthansa Systems itself. The system uses Lido/Flight Version V5.8.3.
This system was enhanced to allow the flight plan filing, flight plan status retrieval and flight plan validation of FIXM EFPL messages and NM EFPL XML messages in parallel.
During the trial run the system was connected to all operational data feeds that are used by the Lido/Flight systems in flight operations. Hence the operational data base was close to any Lido/Flight environment operated by any airline[4]. Figure 7 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 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 XML 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 7: Description of the Lido/Flight FIXM EFPL prototype for the EXE-07.06.02-VP-713-B "FIXM Analytical Modeling" exercise

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

6.1.2.3 Deviation from the planned activities

6.1.2.3.1 OBJ-07.06.02-VALP-0002.0301

Deviating from the EXE-07.06.02-VP-713 VALP [9] 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.

For that reason it was not possible to consider the PTRs in the validation exercise.

6.1.2.3.2 OBJ-07.06.02-VALP-0002.0500

“Determine which conditions (e.g. on take-off weight variations) should trigger the transmission of EFPL updates (in addition to situations where ICAO FPLs are currently updated).”

This objective has not been explored by Lufthansa Systems in this validation exercise. The validation exercise only confirmed that the airspace user can trigger EFPL updates (change/ delay) and cancelations in flight operations.

6.1.3 Exercise Results

6.1.3.1 Summary of Exercise Results

A summary of exercise results can be found in chapter 4.1 in Table 7.

6.1.3.1.1 Results on concept clarification

From an airspace user perspective the use of the EFPL for flight plan data exchange with the NM seems to bring benefits compared to the use of the ICAO flight plan standard. The main benefit of this concept is that the view onto the 4D trajectory that the AU on the one hand and the NM on the other hand have can be synchronized on the basis of the higher granularity of the flight plan data included in the EFPL. The validation exercise showed that the NM is still not able to use the 4D trajectory provided in the EFPL directly in their systems. But the validation exercise showed that, based on the 4D trajectory data included in the EFPL, the NM is able to generate a 4D trajectory which is much closer to the 4D trajectory planned by the AU, as a 4D trajectory generated based on ICAO FPL data. Differences between the 4D trajectory generated by the AU and the 4D trajectory generated by the NM system based on the EFPL data is some aeronautical data that is covered in a different way in the NM system and the PTRs that have not been implemented in the flight planning systems of the airspace users. Hence NM adapted the vertical profiles of the 4D trajectories included in the EFPLs to cope with those restrictions. However it was pointed out by the airspace users that participated to the validation exercise that any change of the trajectory planned by the airspace user on NM side is seen critical as this might have impact on the fuel aboard and hence on the flight cost efficiency and partly on flight safety. But it must be pointed out that those differences between the trajectory planned in the FOC and the trajectory build by NM is not a result of the EFPL. This issue also relates to the ICAO FPL and is the reason of many wrongly accepted and wrongly rejected ICAO FPLs. That means that

the EFPL draws attention onto the fact that NM is acting on a different trajectory as planned by the airspace user, especially in case of ICAO FPL based flight plan data transmission. The EFPL shows that the differences between the trajectory planned by the FOC and the trajectory build by NM can significantly be reduced, what should lead to a gain in safety and cost efficiency.

However the validation exercise already showed that based on the EFPL data the NM already gets a much better look onto the 4D trajectory as planned by the airspace user, even if the 4D trajectory was not directly adopted from the EFPL. In case of the rejection of a trajectory it was now possible to identify the issue in the 4D trajectory in the flight planning system. This was especially related to the fact that ETOs and the vertical profile of the 4D trajectory in Lido/Flight and that one used by IFPS for the flight plan validation where almost congruent to each other as with the ICAO flight plan. During the EXE-07.06.02-VP-713-A “gaming session” it was more obvious how to solve some of the rejects as for the ICAO flight plan.

An important indicator for the usability of the EFPL is the IFPS flight plan acceptance rate. As any reject on airspace user side will cause additional effort to resolve related issues and will therefore increase the workload on airspace user side. The flight plan acceptance rate of the EFPL was below the acceptance rate of the ICAO FPL. This was mainly driven by the setup of the validation exercise, as the trajectories used, especially in the EXE-07.06.02-VP-713-A “Shadow Mode” were prepared for the ICAO FPL filing. From this perspective a reduction of the acceptance rate for the EFPL was expectable. Anyhow, the recorded EFPL acceptance rate was approximately 93%, which is already a very good result. In comparison the ICAO FPL acceptance rate was approximately 97%. Even if the EFPL acceptance rate is 4%-points lower as the ICAO FPL acceptance rate, the following can be concluded. The EFPL acceptance rate is still on an acceptable level that can be managed by the flight dispatch of an airline. Considering that some of the rejects were caused by the setup of this exercise and the good result with regard to the EFPL acceptance rate in case of an ICAO FPL rejection it can be assumed that the EFPL acceptance rate can be increased significantly when bringing it to operations. In the EXE-07.06.02-VP-713-A “Gaming Session” it was concluded by the flight dispatchers that the EFPL can help to reduce the number of wrongly rejected ICAO flight plans and can help to increase the flight plan acceptance rate, especially when planning a trajectory from the scratch.

Even if the effect on wrongly rejected ICAO flight plans on the ICAO flight plan has not been analyzed in detail, there are a number of cases that can be used to evaluate this topic. Wrongly rejected ICAO flight plans are mainly a consequence of the interpolation of a 4D trajectory out of the ICAO FPL data, which is not in every case leading to a 4D trajectory that corresponds to the 4D trajectory planned with the flight planning system. In some cases the resulting 4D trajectory is offending against any regulation or restriction raising a reject, while the airspace user has planned a 4D trajectory that is in accordance with all regulations and constraints. In the cases where an ICAO FPL was rejected (e.g. in the EXE-07.06.02-VP-713-A “Shadow Mode”) the share of corresponding EFPLs accepted by IFPS was approximately 19%. This number might appear very low but due to the fact that the setup of the “shadow mode”, which was based on operational flights that were filed by the dispatchers with the ICAO flight plan[5], the number of recorded ICAO FPL rejects and therefore the size of the used sample was already very low (172 corresponding to approximately 3% of all flights recorded on the respective trial days). However, already this analysis suggests that the number of Wrongly rejected ICAO flight plans can be reduced significantly.

The main issues observed within the validation exercises are primarily of a technical nature and can be solved step-wise. This relates to the technical systems on both sides; the flight planning system on the one hand (Lido/Flight) and NM system (IFPS, ETFMS) on the other hand. The overall results show the use of the EFPL can deliver benefits for the airspace users as it can reduce the workload for flight dispatchers due to a higher accuracy of the IFPS validation response and the ability of the filing of trajectories that are rejected when using an ICAO FPL. The higher degree of synchronization of the views onto the 4D trajectory between NM and the airspace use seems to be a milestone for the implementation of new operating concepts as Free Routing and Advanced Flexible Use of Airspace both require a higher accuracy in regard to the vertical and time profile of the trajectory. Both (vertical and time-wise accuracy) can be achieved with the EFPL what confirms already the high benefit and high degree of usability of the EFPL.

[5] The EFPL was in these cases send to NMVP in the background of the flight planning system and the flight dispatchers had now view onto the respective flight plan validity results.

6.1.3.1.2 Results per KPA

As only EXE-07.06.02-VP-713-A was assessing the EFPL concept[6] only results from this part of the validation exercise can be considered here. In accordance with the benefit mechanism – described in chapter 2.2.2 – the following KPAs, relevant for the AU operations and in scope of this validation exercise, are discussed in this document. For further information related to the remaining KPAs please consult the EXE-07.06.02-VP-713 VALR [13] provided by project P07.06.02.

6.1.3.1.2.1 AU cost effectiveness

The AU cost effectiveness as being assessed during this validation exercise 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 exercise 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 files an ICAO flight plan to NM. In some cases NM interpolates a 4D trajectory – out of the provided ICAO flight plan data – that 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 4% 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 93% has been achieved. Acceptance rate values above 90% are assumed to be bearable in flight operations. This reduction in acceptance rate would most likely only concern an EFPL introduction phase. This was proven by manually analyzing respective cases. In most of the cases the enabling of respective types of restriction during the trajectory calculation process would lead to trajectories that are accepted when filed in the EFPL format. This is due to the fact that almost all cases were caused by vertical profiles not being in accordance with all restrictions. In some cases the Lido/Flight system was unable to calculate a correct trajectory if all restrictions are considered. This already confirms that the reduction of acceptance rate when using the EFPL can be avoided simple by enabling respective types of restrictions in the system. Concluding that the EFPL could lead to an flight plan acceptance rate that is close or equal to those observed for the ICAO FPL. For the cases were the ICAO flight plan was rejected (about 2%) during the EXE-07.06.02-VP-713-A "Shadow Mode") it was shown that a significant number (about 19%) 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. These cases offer the potential to increase the overall flight plan acceptance rate when using the EFPL instead of the ICAO FPL for filing.

Contrary to this the concerned 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

[6] EXE-07.06.02-VP-713-A is the validation exercise used to validate the EFPL concept by using NM EFPL XML messages. EXE-07.06.02-VP-713-B was rather a verification assessing whether the use of FIXM EFPL messages can be used as opposed to NM EFPL XML messages.

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.

6.1.3.1.2.2 Safety

As mentioned in chapter 6.1.3.1.2.1 the acceptance rate for the EFPL decreased by about 5% points compared to the ICAO FPL. This is mainly caused by the fact that some of the ICAO FPL wrongfully accepted by IFPS regardless that the trajectory planned by the AU is not fully compliant with all restrictions. In those cases the NM plans with a 4D trajectory that is different compared to the 4D trajectory that has been planned by the airspace user. But the airspace user will provide the trajectory planned in the flight planning system to the flight crew, hence the ANSPs and the flight crews might have a different view onto the intended trajectory. This could in exceptional cases reduce the safety of the flight, especially in case of a radio communication failure. Even if this case is a very rare scenario, the alignment of the view onto the planned trajectory on both sides can potentially increase the safety of flights.

From flight dispatchers perspective the safety was also assessed in regard to two aspects. The first one was the question whether the situational awareness of the dispatcher is impacted; the second one was the question whether the propensity of making errors in flight planning would increase. In case of the situational awareness about half of the participating flight dispatchers assume that the EFPL will not have any impact, about one third of the participating flight dispatchers assume that EFPL might increase it. The main driver of these results was the fact that the EFPL has a very high granularity. The limiting factor was the fact that replies sent by the NM in case of a reject include the same information as that included in a reject for an ICAO FPL. The flight dispatchers expressed the expectation that the flight plan validation reply includes more granular information. Apart from that it would be a big advantage if the reject reason would be provided in a full digital format. Currently the reject reason is a free text embedded in a digital message.

In case of the question whether the EFPL filing could increase the propensity of making errors more than two thirds of the flight dispatcher assume that EFPL will not have any negative impact or even no impact. This result was mainly driven by the limited granularity of the NM reply messages for rejects again as they were not as clear as they could be in every case.

The main concern in regard to the safety is related to differences in the AU and NM trajectories. Such differences could have negative impact on the fuel that is planned for a flight and hence seen critical. It must be repeated that the differences between the trajectories when filing the EFPL should be less than the differences when filing the ICAO flight plan. From this perspective the situation should already improve. Anyhow the target has to be that the trajectories are identical. In this regard the AUs concluded that the trajectory provided by the AU should be adopted by the NM.

6.1.3.1.2.3 Predictability

This KPA was not directly assessed during the validation exercise as the consideration of the PTRs was not performed and a direct comparison of planned and flown trajectory was not done.

6.1.3.1.3 Results impacting regulation and standardization initiatives

Results on standardization can be found in the EXE-07.06.02-VP-713 VALR [8] provided by EUROCONTROL.

6.1.3.2 Analysis of Exercise Results

6.1.3.2.1 NM Flight Plan Acceptance Rate Results

The flight plan validation results were analyzed from different perspectives. On the one hand a direct comparison of the NM flight plan acceptance rate for the EFPL and for the ICAO FPL has been done. On the other hand an analysis of the NM flight plan acceptance rate of the EFPLs in case the ICAO flight plan was rejected was performed.

6.1.3.2.1.1 Flight Plan Acceptance Rates

The EFPL acceptance rate was directly measured based on the IFPS flight plan validation replies sent back by the NMVP when the first EFPL filing was done. In such a case the result was either a "valid" or an "invalid_rejected"[7]. For the ICAO flight plan the respective IFPS flight plan validation results were not directly visible to Lufthansa Systems. Therefore a method was developed to indirectly measure the ICAO FPL acceptance rate. The method used considered the way the ICAO filing procedure is implemented in Lido/Flight as well how the EFPL filing is linked to the filing of an ICAO FPL. Apart from that the behavior of the NMVP/ IFPS was also considered to identify the number of ICAO FPLs that have been accepted/ rejected. The filing of an EFPL is directly linked to the filing of an ICAO flight plan. That means for every flight plan transmission triggered for the ICAO FPL (filing, change, delay, and cancelation) the corresponding message for the EFPL was also send. If the ICAO flight plan was accepted by IFPS, an EFPL creation request was only followed by either an EFPL update request or a flight cancelation request (or no further request). In case of an ICAO FPL reject the airline was required to file a new ICAO flight plan subsequently. That means that an EFPL creation request was followed by an EFPL creation request in the case that the ICAO FPL was rejected during the first filing. Considering this relation the ICAO FPL acceptance rate could also be measured. After the respective flight plan acceptance rates have been measured for every day and individual airline a daily average value for the respective flight plan acceptance rates was calculated. As the individual airlines dispatched different numbers of flights, the respective acceptance rates were considered in a weighted way in the overall daily acceptance rates. The weighted flight plan acceptance rates were calculated with the following formula:

$$R_{acc} = \frac{\sum_i (R_{acc,i_i} * n_i)}{\sum_i n_i}$$

where R_{acc} represents the entire flight plan acceptance rate for all airlines i, $R_{acc,i}$ represents the flight plan acceptance rate for the individual airline i, n_i represents the number of flights of airline i.

[7] Usually the NMVP responded – in case of a reject – with "invalid_queued_for_correction" first as a reject was triggered with a slight delay. Therefore the validation result had to be retrieved after a while.

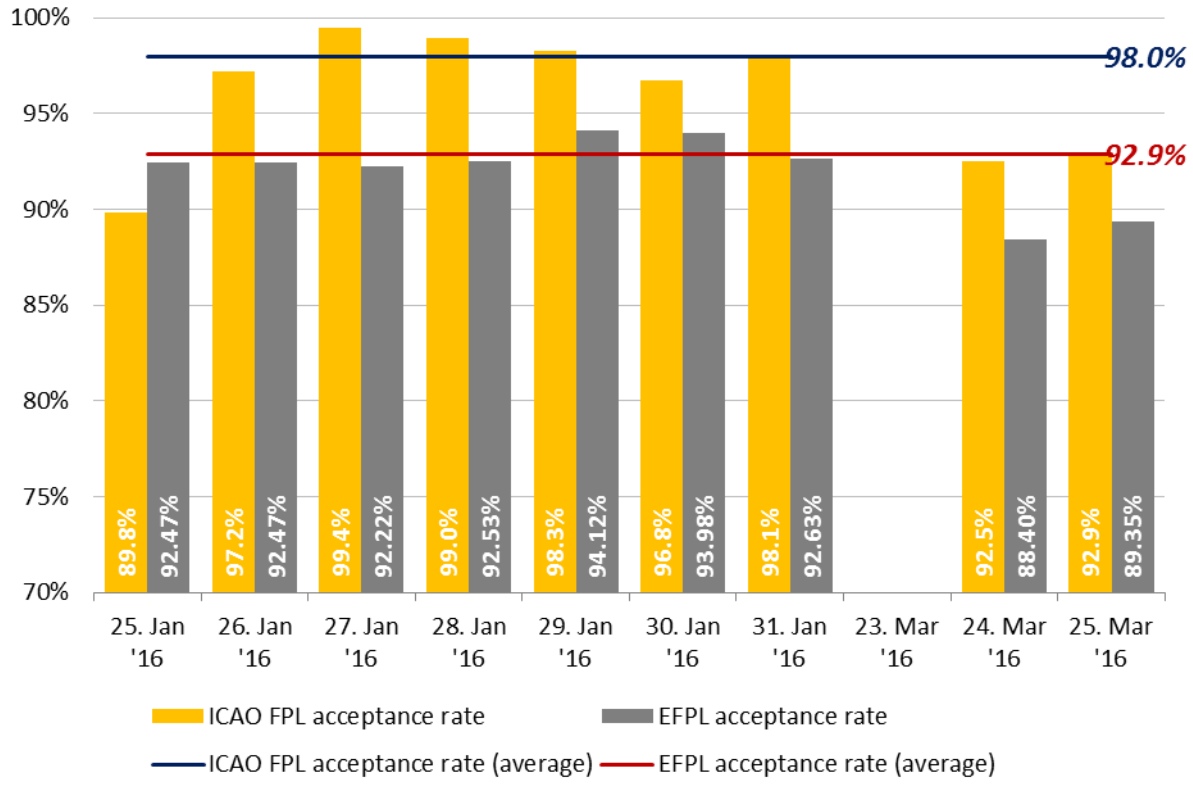


Figure 8: ICAO flight plan and EFPL acceptance rates

Figure 8 shows the acceptance rates for the ICAO flight plan and EFPL for every day of the EXE-07.06.02-VP-713-A Shadow Mode exercise as average over all airlines. It is directly visible that the EFPL acceptance rate is below the value for the ICAO flight. The reason for that is very simple. This part of the exercise was performed as so-called shadow mode exercise with operational flight planning systems. The flight dispatchers still worked with ICAO flight plans. Hence they were only working towards getting the ICAO flight plans accepted by IFPS. Due to the inconsistencies between the 4D trajectory in the flight planning system on the one hand and the 4D trajectory in the IFPS system on the other hand that is caused by the fuzziness of the ICAO flight plan the following 4 scenarios can happen.

Scenario 1: The trajectory is calculated by the flight planning system without respecting all constraints/ restrictions, but nevertheless accepted when filing an ICAO flight plan. In such a case the corresponding EFPL would be rejected.

Scenario 2: The trajectory is wrongly calculated by the flight planning system and the ICAO flight plan as well as the EFPL is rejected.

Scenario 3: The trajectory is correctly calculated by the flight planning system but nevertheless rejected with the ICAO flight plan. In such a case the EFPL should be accepted by the IFPS.

Scenario 4: The trajectory is correctly calculated by the flight planning system and the ICAO flight plan as well as the EFPL is accepted by IFPS.

It is visible that in case of the EFPL an acceptance and a reject should always correlate with the correctness of the trajectory calculation. But this is not given with the ICAO flight plan. But as the dispatchers in the shadow mode exercise had only a look onto the ICAO flight plan filing results and all filed trajectories were provided in a way that the probability of an ICAO flight plan rejection is minimized it is obvious that mostly the scenario 1 and the scenario 4 happened during the trial. That leads to the following conclusion. With the given setup the flight plan acceptance rate for the EFPL

can only be equal or worse in comparison to the ICAO flight plan acceptance rate and is rather identifying cases were the ICAO flight plan is wrongly accepted by IFPS.

In average the EFPL acceptance rate is about 5% points below the acceptance rate of the ICAO flight plan what is a small deviation if the setup of the trial is considered. These 5% points are the additional effort that would result from the switch from ICAO FPL fling to EFPL filing. This number represents the share of ICAO flight plans that get an Wrongly accepted ICAO flight plan.

6.1.3.2.1.2 EFPL acceptance rate for rejected ICAO flight plans

Regardless the fact that it was expected that scenario 1 and scenario 4 as described above will be observed in the majority of cases, it makes sense to have a look onto the cases where the ICAO flight plan was rejected when the dispatcher filed a flight plan to the IFPS. In these cases scenario 2 and scenario 3 have been observed. As we had no direct view onto the flight plan validity status of the ICAO FPL it was not possible to directly link a rejected ICAO FPL with a corresponding accepted EFPL. Therefore we used respective information from EUROCONTROL.

As explained in the section 6.1.3.2.1.1 the number of cases that relate to scenario 2 and 3 were relatively low caused by the setup of the validation exercise. However in 247 cases either scenario 2 or scenario 3 occurred, making it possible to assess the number of cases where an ICAO flight plan was rejected but the related EFPL was directly accepted. In those cases it can be assumed that the workload of the dispatcher is directly decreased if the EFPL is directly accepted and the flight cost efficiency[8] is potentially increased under the assumption that the ICAO FPL reject prevents the flight dispatcher to file the most optimal trajectory in those cases.

As the individual airlines dispatched different numbers of flights, resulting in different numbers of occurrences for scenario 2 and 3, the respective EFPL acceptance rates for rejected ICAO FPLs were considered in a weighted way in the overall daily acceptance rates. The weighted EFPL acceptance rates were calculated with the following formula:

$$R_{EFPL} = \frac{\sum_i (R_{EFPL,i} * n_{acc,i})}{\sum_i n_{acc,i}}$$

where R_{EFPL} represents the entire EFPL acceptance rate for rejected ICAO FPLs for all airlines *i*, $R_{EFPL,i}$ represents the EFPL acceptance rate for the individual airline *i*, $n_{occ,i}$ represents the number of occurrences where the ICAO FPL was rejected for an airline *i*.

[8] The term flight cost efficiency is not defined by the ATM Master Plan [12] but required to assess the benefit of SESAR concepts from airspace user perspective. A good explanation of this term can be found in the WP11.1 contribution document to the validation report of VP-710 [14].

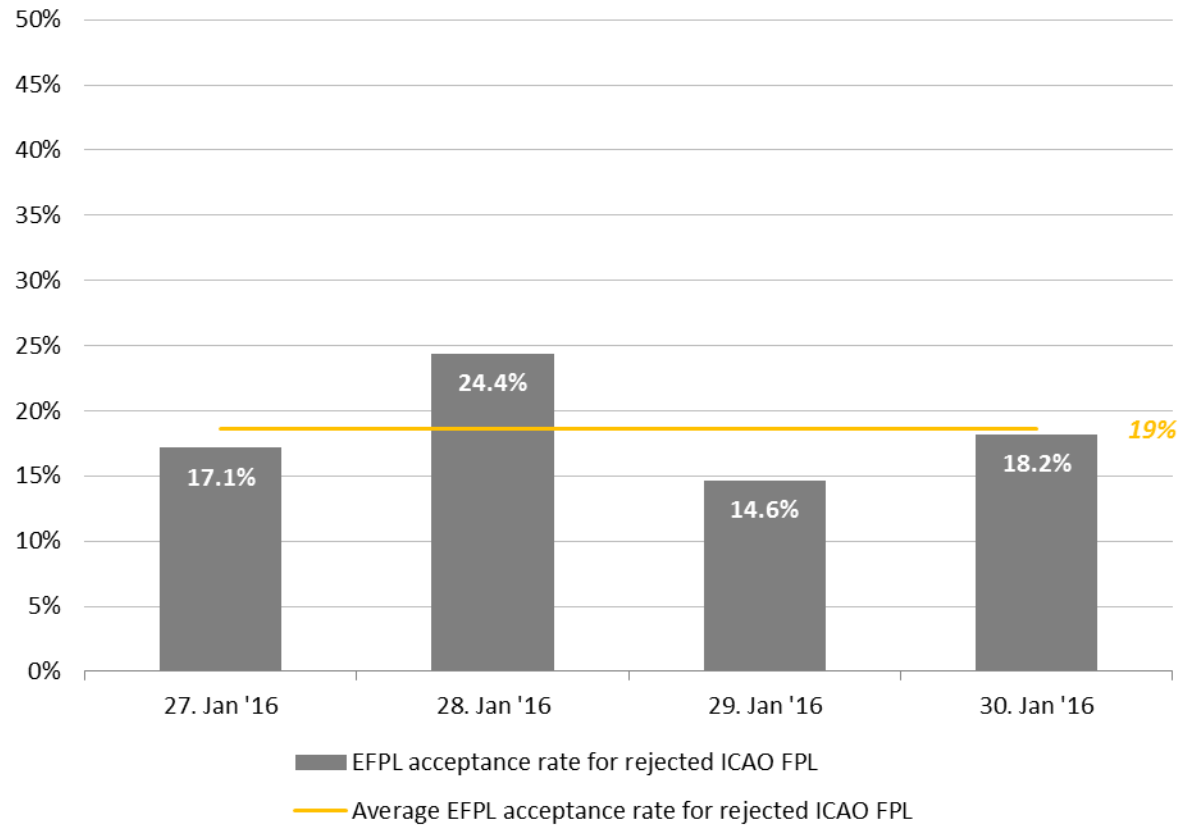


Figure 9: EFPL acceptance rate in case of rejected ICAO FPL

Figure 9 gives an overview of the recorded EFPL acceptance rates for cases where the ICAO FPL was rejected by IFPS. Considering all occurrences the average EFPL acceptance rate in case that the ICAO FPL was rejected is about 19%. The statistics is based on data recorded by EUROCONTROL on the days from the 27th January 2016 to the 30th January 2016 are displayed. Further data referring to the remaining days of the 1st trial and referring to the 2nd trial have not been delivered by EUROCONTROL. The values itself seem to be low on the first view. But when looking into the records two aspects can be identified that influence this value. Firstly the number of rejected ICAO flight plans – which is the basis for this analysis – is very low. As illustrated in Figure 8 the ICAO FPL reject rate is only about 2% in average. For the four days that are illustrated in Figure 9 172 flights have been recorded where the ICAO FPL was rejected by the NM OPS system. The number of flights that have been planned and filed on these four days was 5364. That means that the data displayed in Figure 9 represents about 3.2% of the flights planned on the four days.
On the other hand it has to be stated that the validation exercise as it was used for this “shadow mode” exercise was not defined to identify the number of wrongly rejected ICAO FPLs. As explained in chapter 6.1.3.2.1.1 the sample of the shadow mode exercise was based on operational flights for which the flight dispatcher only try to get an acceptance for the ICAO FPL. As an ICAO FPL that is accepted by NM can be based on a trajectory that is not fulfilling all ATM constraints as well as on a 4D trajectory that is fulfilling all ATM constraints, it was assumed that there will not be any or only a minor number of cases where the ICAO FPL is rejected (regardless whether the planned 4D trajectory fulfils all ATM constraints or not). From this perspective it can be assumed that the corresponding cases in the sample of the statistics illustrated in Figure 9 are rather special cases. However, even with this setup it was shown that there are about 19% of cases where an ICAO FPL reject was not correct.

6.1.3.2.2 Questionnaire based assessment of the EFPL concept

The following results are based on the subjective assessment of the EFPL concept by the dispatchers who participated in the EXE-07.06.02-VP-713-A "Gaming Session" trial at Lufthansa Systems in Raunheim. It is based on the answers given to a questionnaire provided by the innovate consortium who supervised the single gaming session trials. After every gaming session questionnaires with 17 questions were provided to the individual participants. In sum 12 questionnaires were filled. This chapter will summarize the respective replies that have been gathered after the individual trials.

Question #1: How would you consider the introduction of EFPL on your operational process?

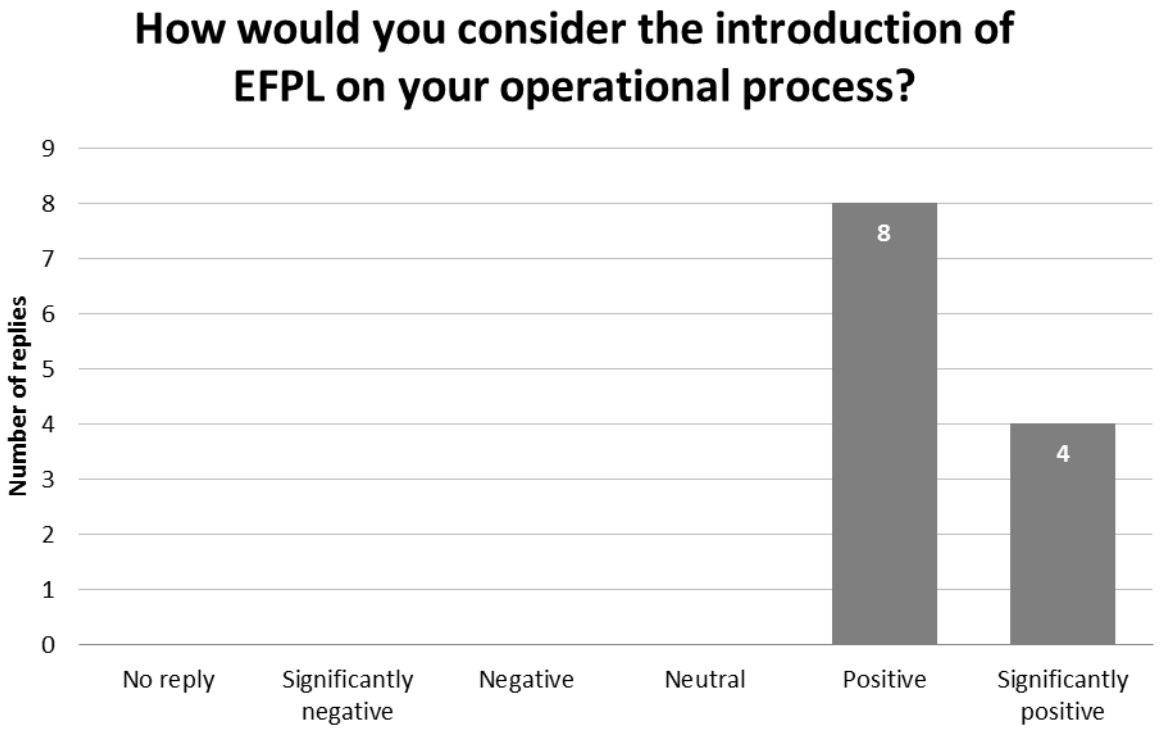


Figure 10: Questionnaire replies for question 1

This question has been answered by all 12 dispatchers joining trial. Figure 10 shows that the majority of participants assess the introduction of the EFPL as positive and 1/3 as significantly positive. Most of the comments related to this question were pointing out that the higher granularity of the EFPL data might lead to a decrease of workload and to a better fuel planning. Furthermore it has been pointed out that the – in case of reject – an error message should also include more accurate data. This is referring to the fact that the reply messages (format and content) remained the same compared to them provided in response to ICAO flight plans.

Question #2: How would you rate your workload considering the use of EFPL compared to the ICAO FPL operational process?

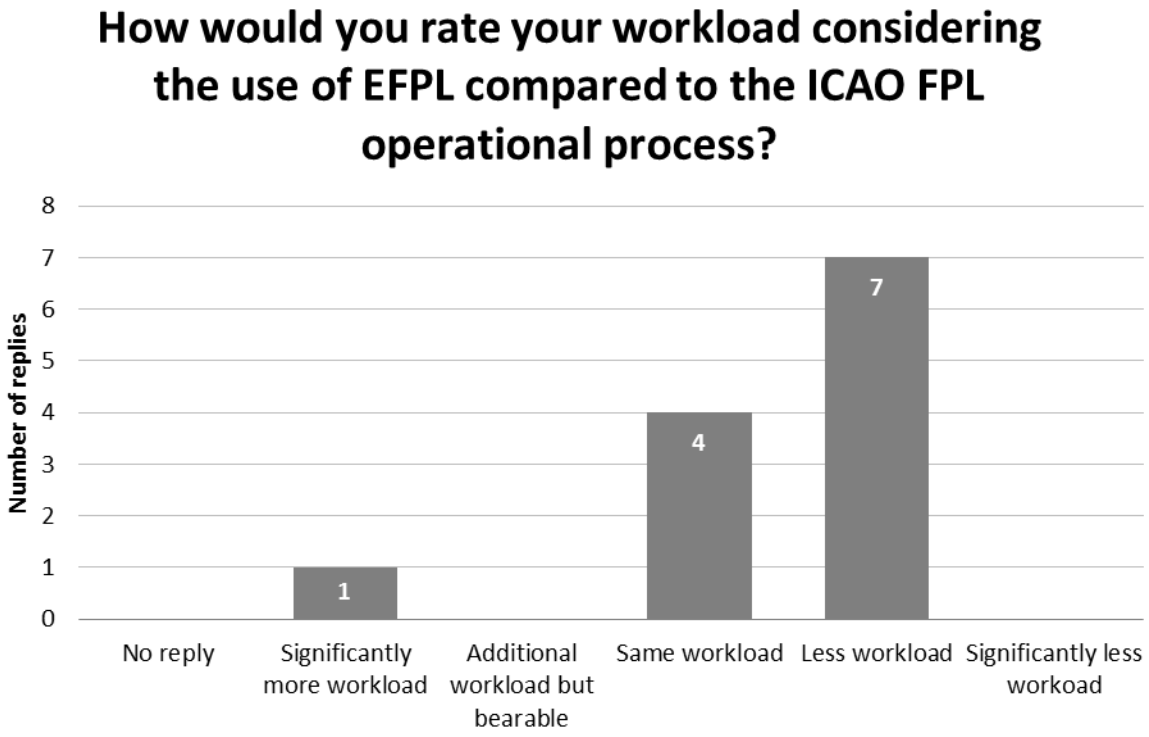


Figure 11 Questionnaire replies for question 2

This question has been answered by all participants of this trial. The majority of participants assumes, as Figure 11 indicates, that the workload in the flight dispatch process might be reduced a bit; respectively might remain almost the same. These replies are based on the conclusion of the flight dispatchers that the number of wrongly rejected ICAO flight plans might decrease with the EFPL and in case of any reject the relation between the reject reason and the trajectory planned by the flight dispatcher is always given. That would reduce the effort of analyzing the reject reason. In this context it has been pointed out that this also relates to the quality and granularity of information given in the reject message. It was requested to get more detailed information in such messages to simplify the identification and understanding of the reject issue.

Figure 11 also shows that one dispatcher assumes to have significant more workload with the EFPL. When looking onto the overall result for this question and the number of participants which is very low, it is hard to conclude on the significance of this reply. But when looking into the comment given with this reply, it becomes obvious why the respective flight dispatcher has concluded like this. The assumption made when answering this question was that a flight dispatcher is required to review the trajectory which is reported back by NM in the reply message and to compare it with the planned one. The reason is that it seems that this trajectory will differ from the planned one, which might have a negative effect on the trip fuel that has to be considered by the dispatcher. As such a procedure is not implemented for the ICAO FPL the assumption was made that the workload when using the EFPL will be increased significantly. But it must be pointed out that – even if it is true that the trajectory generated by IFPS/ ETFMS is not reviewed in case of an ICAO FPL acknowledge – that the procedure (to compare the AU planned with the NM replied trajectory) would be applicable for the ICAO FPL too, especially as it can be assumed that both trajectories might differ much more than for the EFPL. Nowadays this is rather compensated by the contingency fuel or special margins added to the trip fuel or added as additional fuel. The question here is whether the same approach as for the ICAO FPL could be used for the EFPL too and whether the procedure could be improved when using the EFPL which might reduce the deviations between the planned trajectory and the resulting trajectory in the NM systems.

Question #3: How would you rate your Situational Awareness considering the introduction of EFPL compared to ICAO FPL operational process?

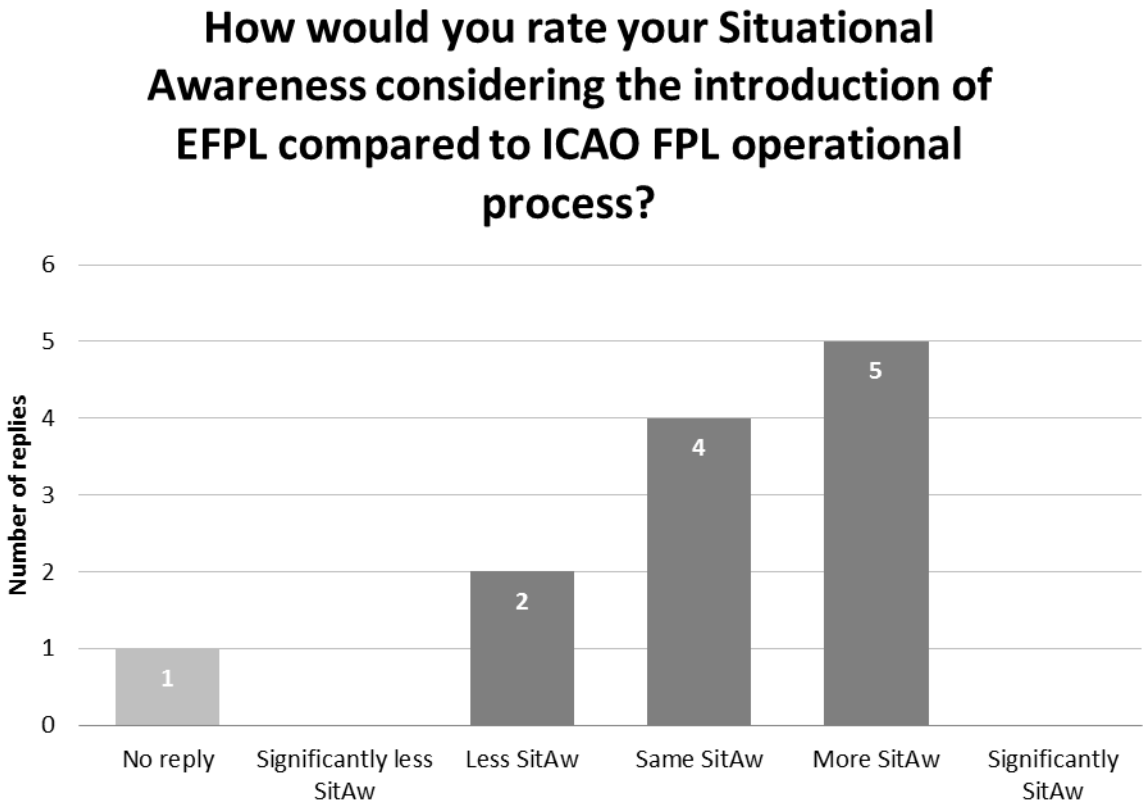


Figure 12 Questionnaire replies for question 3

This question has not been answered by all participants of this trial. One participant has not directly answered this question. That means the participants made a comment but has no ticked-in any of the available options. For that reason Figure 12 is considering that as “no reply” as it cannot be concluded on the degree of impact by only referring to the comment, which itself suggests that the situational awareness is improved. When reviewing Figure 12 it is directly visible that two participants selected “less situational awareness”. This was explained with the fact that the term “improvement” was still undefined, respectively that the concept is still new to the participants making it hard to conclude on the situational awareness. But both ended their statement with a positive outlook in regard to the concept and said that the situational awareness should increase if more experience has been gained and if the whole concept is well integrated into the flight operations.

The remaining participants see the situational awareness remaining on the same level or slightly increasing. None of these participants has given further explanation in regard to their decision. The only reply which might give some indication is the one of the participants who has not ticked-in any of the optional replies but made a comment. For this participant the improvement would be on the ability to more accurately plan the trip fuel. The conclusion here might only be that when using almost the same trajectory in all systems the need of buffers, e.g. in regard to fuel could be removed. In such case the situational awareness would be interpreted as having planned a trajectory that is most likely flown.

Question #4: Do you think that with the introduction of the EFPL your error propensity in trajectory planning increases comparing to today's ICAO FPL usage?

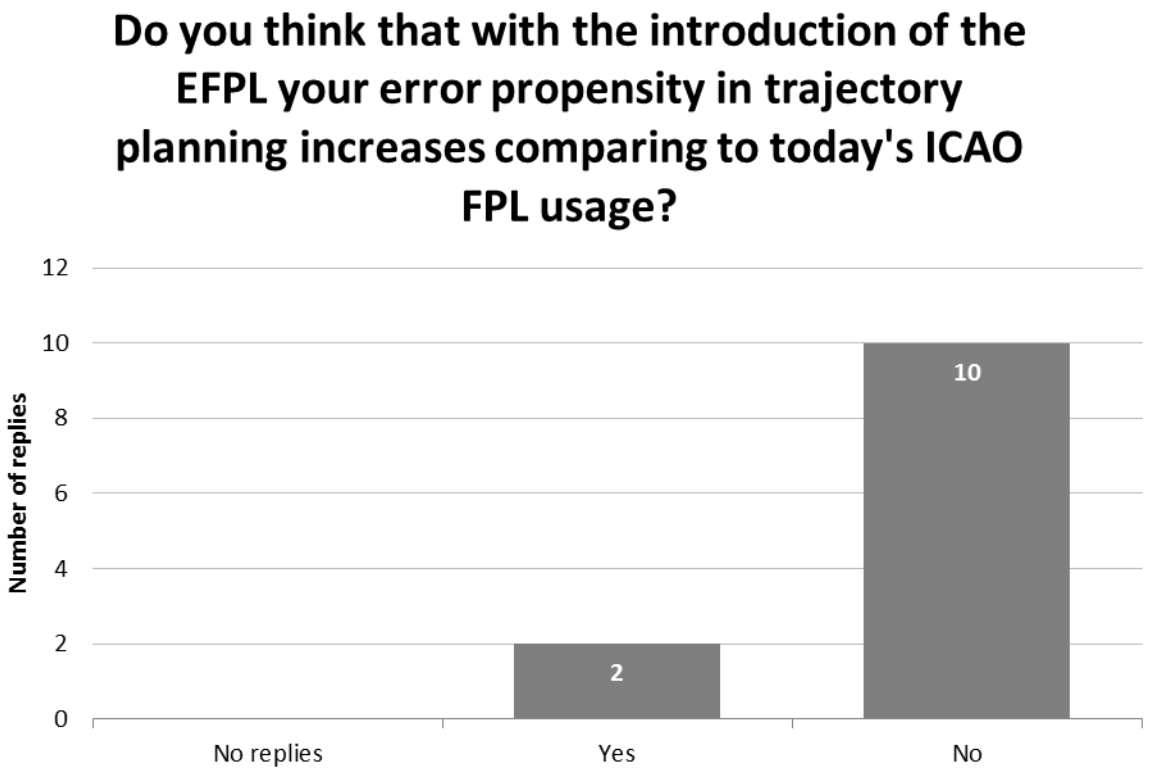


Figure 13 Questionnaire replies for question 4

This question has been answered by all participants of this trial. The majority of participants assumes, as Figure 13 indicates, that the error propensity will not increase with the introduction of the EFPL. Only two stated that the error propensity could increase. But at least in one case a comment made to this answer suggests that the question has been misunderstood. The comment explains that the “error data will be better explained/ displayed and therefore will be better than today”. This seems to be a different interpretation of the question, more referring to the handling and content of reject replies. The question itself refers to the problem of increasing or decreasing the tendency of making errors when operating the EFPL. The second participant answering the question above with “yes” added no further explanations. That makes it hard to conclude on this answer.

Anyhow for the majority of participants the introduction of the EFPL should bring a better alignment of any NM reply with the planned trajectory what should reduce the number of errors and should make it much easier to react effectively on any reject. Further aspects in regard to the error propensity were not discussed.

Question #5: Do you think that with the introduction of EFPL your operating methods change comparing to today's ICAO FPL usage?

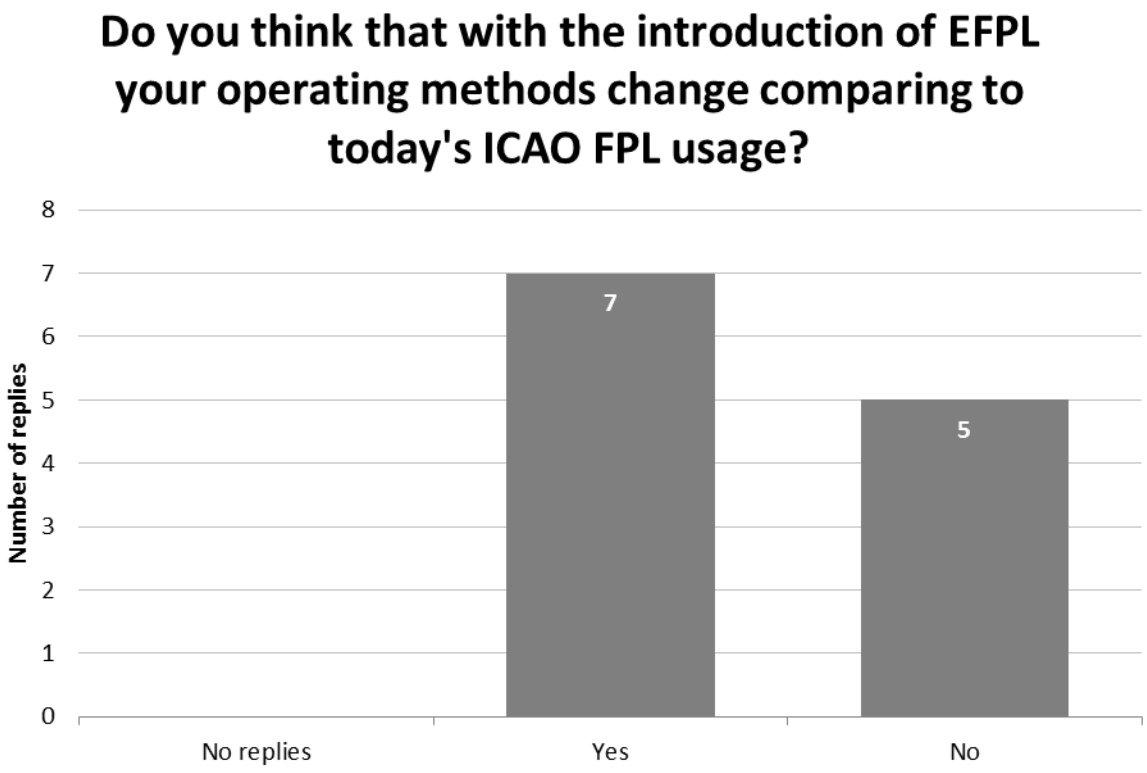


Figure 14 Questionnaire replies for question 5

This question has been answered by all participants of this trial. But as Figure 14 shows that the result is not very clear. Most of the comments made are rather referring to workload or to general procedures that are not necessarily related to the EFPL. In one case the statement “optional if FPL replace RPL”. In principle we could assume that this statement is already valid for the ICAO FPL, which, if filed on a per event basis, already requires different procedures compared to the handling of RPLs. Anyhow the question is whether the use of the EFPL means that the use of RPL cannot be facilitated anymore? If really focusing on the purpose of the EFPL, which is having a more accurate representation of the planned trajectory in all subsequent systems, the assumption can really be made that the EFPL concept is not applicable to the RPL procedures.

In one case a statement was made referring to the fact that with the EFPL an AU will still get rejects from NM. The conclusion was that as long as this is a fact the operational procedures will not change.

In two cases the question was rather interpreted in a more general way. It was assumed that the time required to handle a flight; especially in case of a reject, might be reduced. That could potentially release some capacity on AU side that can be used to focus on other tasks of flight operations. In the end this does not necessarily mean that the operating methods will change completely, but that the focus is put from one task to other tasks within the flight operations. That might lead to a change of the dispatch work organization.

Question #5.1: If yes, do the new operating methods support you in performing your tasks in an efficient way?

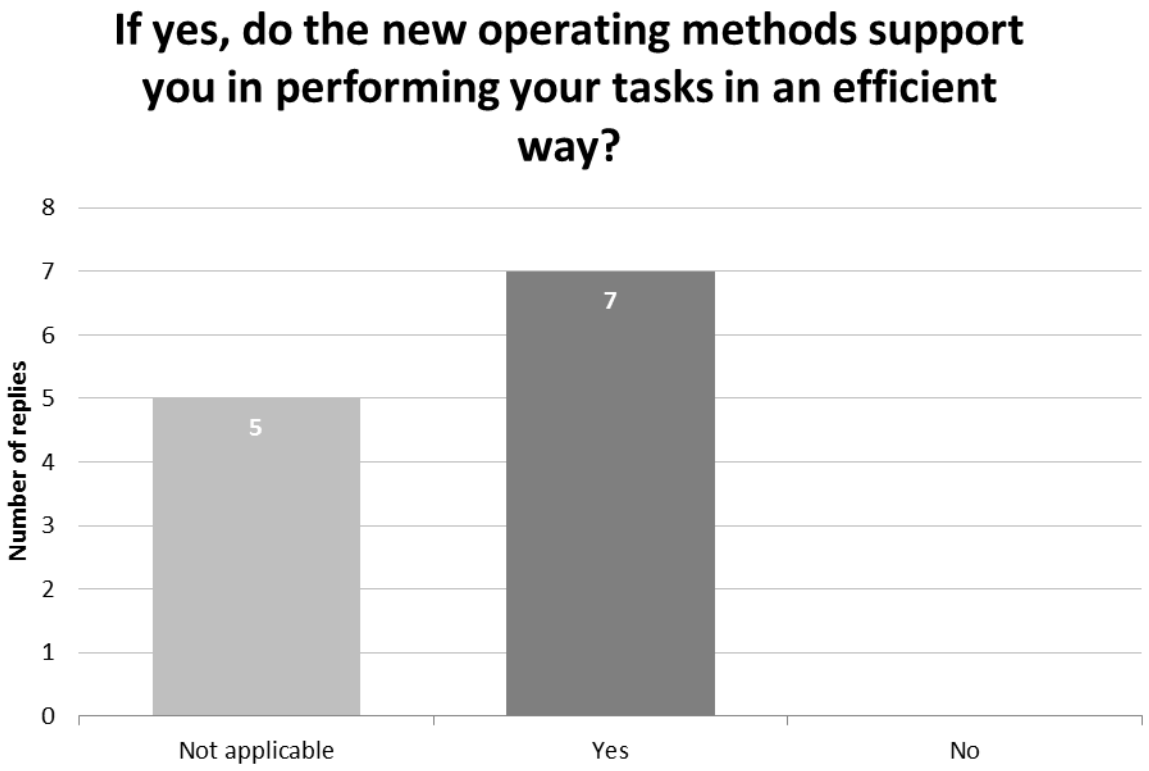


Figure 15 Questionnaire replies for question 5.1

This question is directly linked with question #5. Only in case that question #5 has been answered with yes the participants were invited to answer question #5.1. Figure 15 shows that all invited participants have answered this question; all answered with yes. Two of the participants added a comment to the reply.
In the first case a requirement was expressed that should be fulfilled to increase the efficiency. It was pointed out that it is expected that more information would be given with a reply message; especially in case of a reject, the reply message should be usable for analysis and re-planning. If this is given filing and re-filing might become more efficient.
The other statement was rather referring to the efficiency of filed trajectories. It was pointed out that the higher granularity of the EFPL should allow the filing of more efficient routes/ trajectories that are currently not plan able as respective ICAO flight plans are unjustifiably rejected.

Question #6: Do you think that the FPL negotiation process (communication) is acceptable when compared to current operations with ICAO FPL is used?

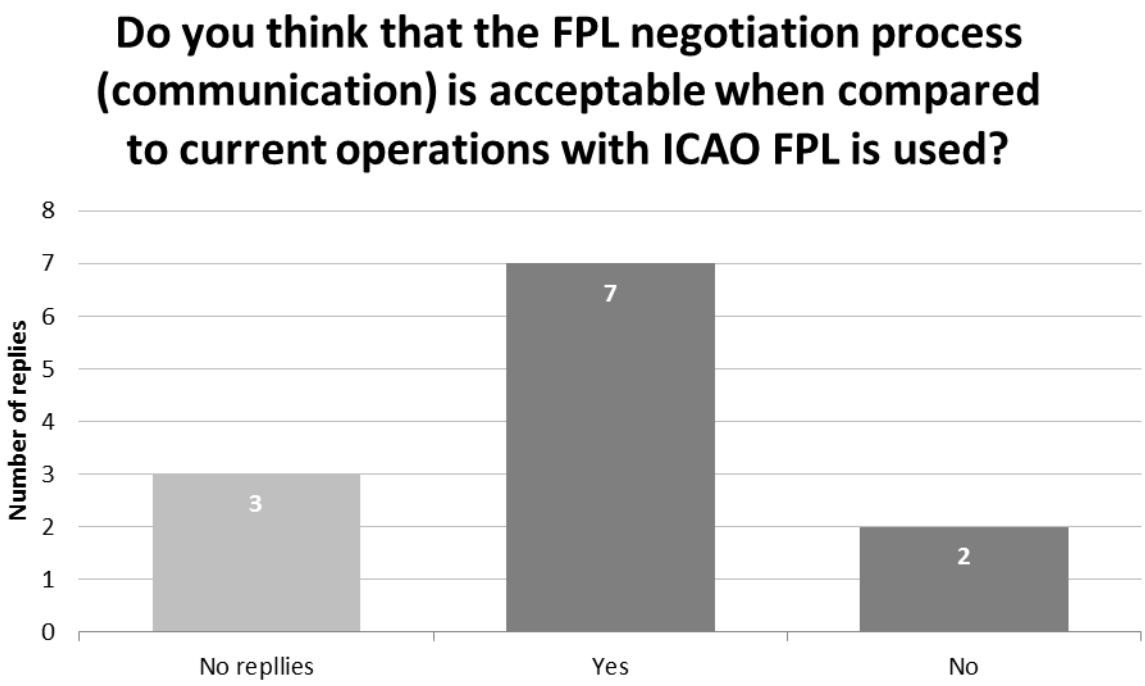


Figure 16 Questionnaire replies for question 6

This question has not been answered by 3 of the participants. The answers given are not very simple to interpret. This has several reasons. The first reason is that the term negotiation is used in a different way in SESAR compared to FF-ICE. It rather refers to an iterative process between the airspace user on the one hand and the NM, ANSPs and airports on the other hand to find a trajectory the airspace user agrees to fly and the ANSPs and airports agree to facilitate. Such procedures were not developed in the context of this validation exercise and, therefore, were not explored and validated. The only way of communication was established for the discussion of the different cases that were explored during the validation exercises. This procedure was not used to a maximal extend – at least not during the validation trials that were hosted by Lufthansa Systems. From this perspective it is very hard to really conclude on this question.
In the end the assumption can be made that the procedure of communication is the same when using the ICAO flight plan as when using the EFPL. In this case the replies could be interpreted as an indication whether the currently applied processes (used when exchange the ICAO FPL and related messages) are adequate for the EFPL filing or not.

However the majority of participants answering the question concluded that the communication is sufficient.
Only a low number of comments were made. One comment is very remarkable as it refers to the procedure of acknowledging the EFPL. During the validation exercise it became evident that in some cases changes to the trajectory, provided by the airspace user were done by NM. In this context a statement was made that such changes would have to be accepted by the airspace user as it is the originator of the flight plan as well as the one who is responsible for the safe conduction of the flight. An additional check of all these flight plans seems to be hard to imagine as the workload would be very high. Additionally it was pointed out that any change to the trajectory provided by the airspace user should be explained by the NM, particularly with a constraint that drives the change.
Another statement pointed out that such negotiation and communication procedure needs to be clarified and improved.

Question #7: Do you think that for a good integration of the EFPL you would need more or less coordination with the NM compared to current operations?

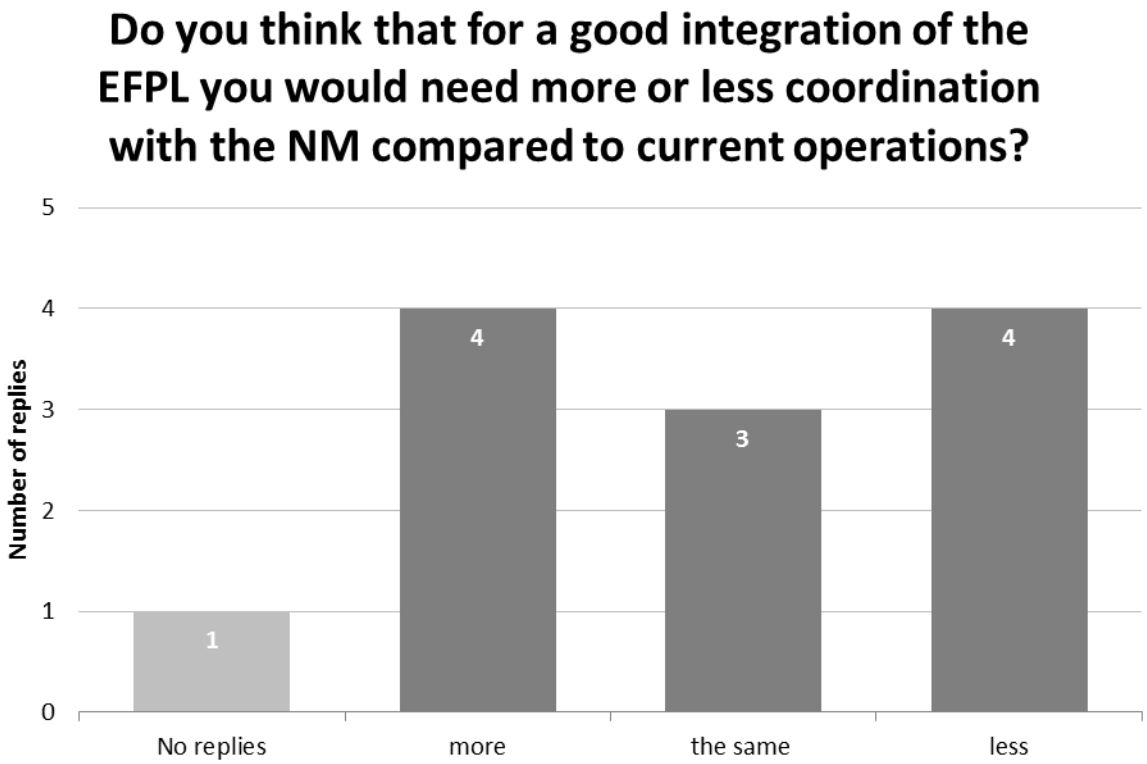


Figure 17 Questionnaire replies for question 7

This question was not answered by one participant. The answers given by the remaining participants are not really leading to an explicit result as the results are homogeneous distributed among the possible options as Figure 17 shows. From the authors perspective that could be a result of the way the question is asked as it is not clear what is meant by it. It seems that two aspects are mixed in the question. The first aspect seems to refer to the question whether designing a possible process or technical solution requires more or less coordination with the NM. The second aspect might refer to the way the EFPL data exchange is implemented in operations in the end and the question whether this implementation and the related processes will require more or less coordination with NM. These are two completely different aspects. Generally it could be assumed that every additional workload that is required to coordinate during flight operations should be reduced to an absolute minimum.

When reviewing the comments made by the participants the expectation is clearly that the need of coordination with the NM should decrease once the EFPL is operational. It is pointed out that clear processes have to be defined how issues are reported and processed. During the implementation phase the coordination effort is seen as being increased. Further comments have not been made; only three comments have been received.

Question #8: Was the coordination with NM clear to you?

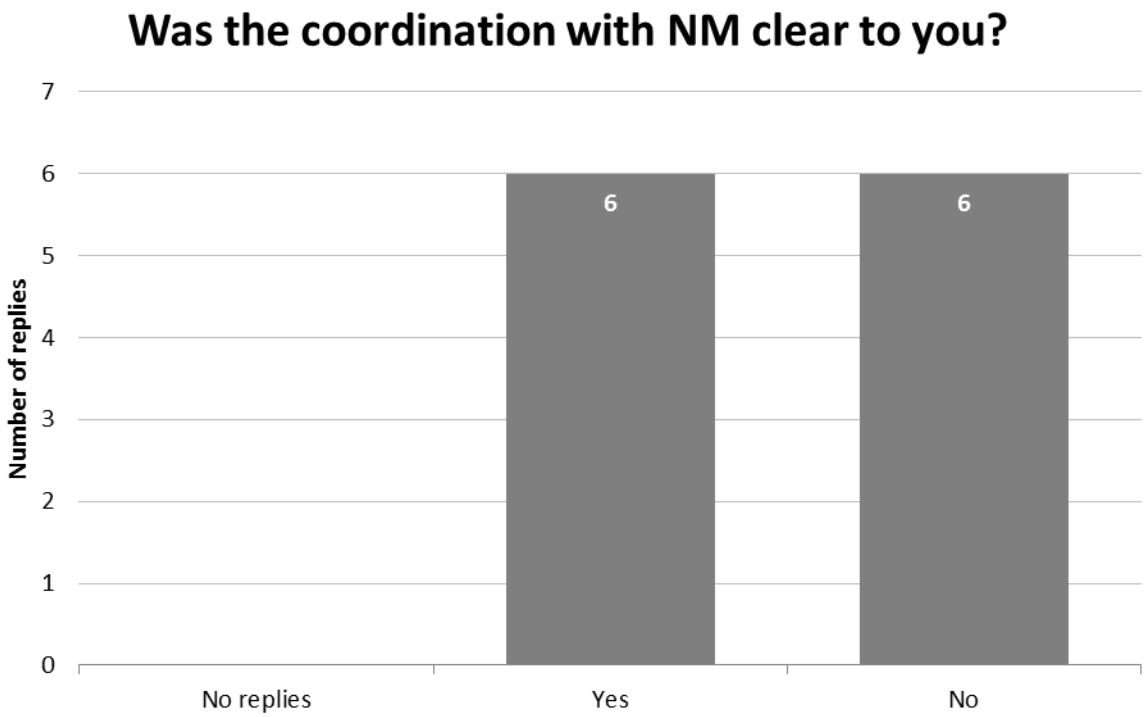


Figure 18 Questionnaire replies for question 8

This question has been answered by all participants. But as the coordination was more related to the conduction of the trial, by having an ongoing voice communication between the participants and EUROCONTROL, it was not clear how to answer this question. It can be assumed that the communication during the validation exercise should not be used to validate the EFPL concept as this does not relate to the operational communication that might relate to the EFPL handling. In this context the result as displayed in Figure 18 becomes understandable. From the numbers itself it is impossible to conclude on this question as 50% of the participants answered with “no” and the other 50% answered with “yes”.
This seems to be a result of the vagueness of the question.
Anyhow two participants pointed out that it is still unclear how they would report any issue to EUROCONTROL during real operational conditions and the communication and information exchange process should be defined in more detail first.

Question #9: Were you able to perform all the modifications in the EFPL (Update, Delay and Cancel)?

This was not part of the gaming session performed at Lufthansa Systems as the prototype had not the required capabilities in time. This capability was only available for the “shadow mode” trials where it worked without any technical issue.

Question #10: Do you think the current HMI efficiently supports you during the EFPL negotiation process?

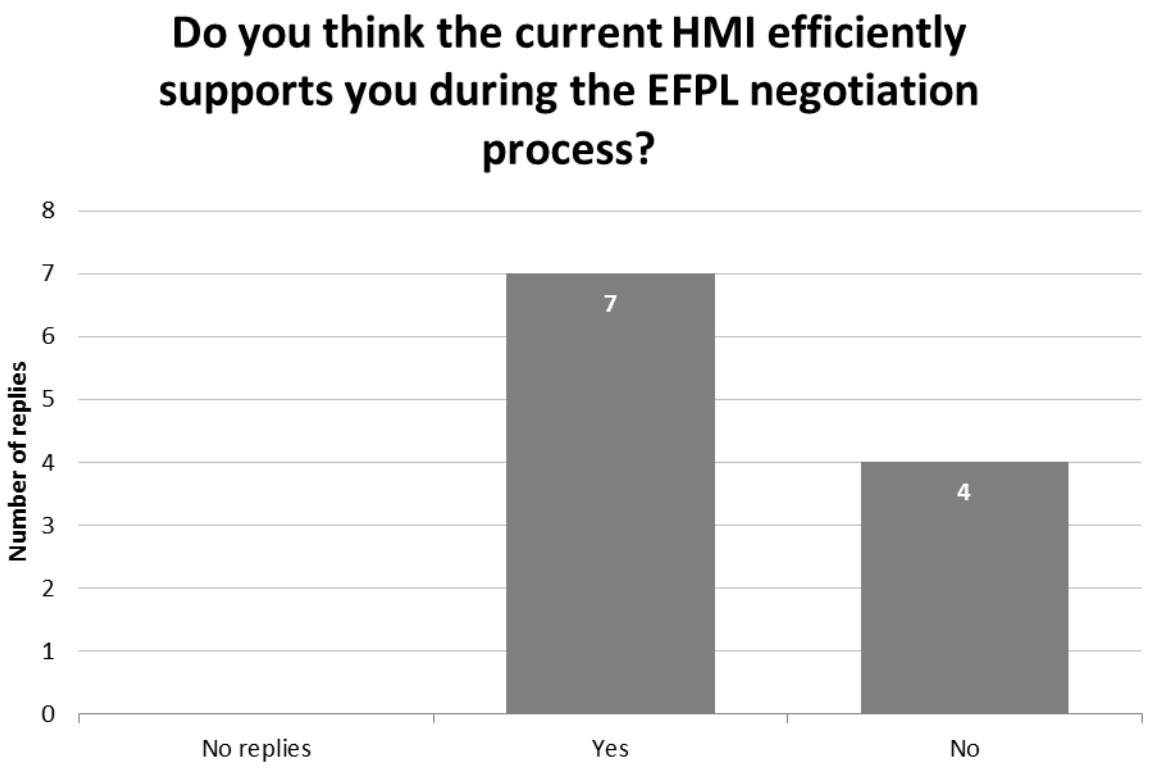


Figure 19 Questionnaire replies for question 10

This question was answered by all the participants. Most of the participants concluded that the current HMI supports them during the EFPL negotiation as Figure 19 shows. However there are again some aspects that have to be considered when reviewing this question. The first thing is that the "EFPL negotiation" is still not clearly defined as a process. Therefore the assumption could be made that the process for the ICAO FPL filing and the EFPL filing is equal. The second thing is that the prototype was not changed significantly in regard to the HMI under the following assumptions.

1. As the EFPL is based on the trajectory calculated in the flight planning system an additional graphical representation of the EFPL 4D trajectory has not been implemented yet;
2. The validation replies – especially in case of a reject – are structured in the same way as for the ICAO FPL. That means that a reject reason is only given in a text format.

For these two reasons no further adaptations have been done to the prototype.

However for more than 50% of the participating flight dispatchers this seems to be sufficient in a first step. But it was pointed out that the information exchange and communication processes have to be defined in particular. Such processes might require adaptations to the HMI.

Question #11: In your opinion, what are the main benefits of the EFPL introduction on your work?

Only one participant has not answered to this question. Table 13 lists all received answers given for this question. It is quite obvious that for most of the flight dispatchers the higher accuracy of the 4D trajectory is the main benefit. This is linked to the hope that this reduces the number of Wrongly rejected ICAO flight plans what would reduce the workload on airspace user side and with the hope to being able to plan more efficient trajectories what would increase the overall flight efficiency of an airspace user.

Question #11 - Received answers
"Reduction of unjustified rejections."
"To introduce real performance of the aircraft and restriction areas."
"It is a more realistic approach to the filed FPL."
"A more precise vertical profile to avoid "false" reject, and the reduction of SLOT thanks to a better airspace management."
"Very precise trajectory that avoids rejects due to inaccurate climb/ descent profiles and times --> less rejects. *More accurate information provided with rejects (reject message more precisely.)"*
"Hopefully less errors/ rejections."
"Reduction in unnecessary Rej's -> finally have potential for 100% *ACK: Reduction in processing time; increase in efficiency; reduction in ATFM delay; Improvement resiliency - reduction in reliance in outdated AFTM technology."*
"Reduced workload, most efficient flight plans being accepted."
"More accurate FPL/ fewer rejections."
"Reduce workload for OCC staff and optimize the flight profile."
"Less workload due to less rejection."

Table 13 Answers to question #11

Question #12: In your opinion, what are the possible drawbacks of the EFPL introduction on your work?

Only one participant has not answered to this question. Table 13 lists all received answers given for this question. Two flight dispatchers replied that they fear of being required to invest in an upgrade of the flight planning system or into a new flight planning system. Both flight dispatchers are not Lido/Flight users. They were invited to the trial as they are working in SESAR. From this perspective the answer is not directly related to Lido/Flight, but is a general comment that has to be taken into consideration. It is based on the fact that the high granularity of the EFPL requires a flight planning system that is able to plan a trajectory with a very high accuracy. This is not given for all airspace users. Those might continue using the ICAO flight plan until they will conclude that the benefits of the EFPL justify the investment into an upgraded flight planning system.

The main concern seen for the EFPL is the workload that might not decrease if the number of rejects is not reduced or that might increase if in every case the airspace user has to assess the trajectory replied by NM. In this context it was pointed out that NM should use the trajectory as given by the airspace user and that the granularity of data in any reject message might be enriched.

One participant does not see a drawback except an issue that was observed with the taxi out times coded in the EFPL. But it can be assumed that the hint with the taxi time was rather referring to an issue with the prototype. In the particular case the taxi time, given in minutes, was considered by NM as given in seconds. The respective issue has been solved already in the NM system, as the use of minutes is specified.

Apart from that it was pointed out that the EFPL concept could be confusing to some dispatchers. This should be addressed in the introduction phase of the EFPL as adequate training for the respective flight dispatchers seems to be required.

Question #12 - Received answers
"Need to update the software."
"A new system."
"The possibility to have an accepted FPL that's far from the filed FPL."
"Checking all the ACK in order to update the OFP if needed. *Moreover, we file our ATC FPL around three hours before departure. So at departure time, teh weight and performance may not be the same (more fuel taken by pilots, payload change, etc.). So we will have to update our EFPL few minutes before departure in order to have last data? Or the buffer taken into account by IFPS would be sufficient?"*
"EUROCONTROL trajectory; it is essential and important to take over the AU's trajectory since it is more accurate and already implemented in the AU's planning tools"
"If EFPL will create more rejections, or errors will continue to be unclear, then the EFPL will have no benefit."
"Lack in clarity in reject reason"
"Remains to see"
"Could be confusing for dispatcher to understand the EFPL concept"
"As seen currently should be no drawbacks apart from taxi times."

Table 14 Answers to question #12

Question #13: As a user, were there any major operability or socio-technical issues related to the EFPL use (HMI, human-human etc.) you would like to outline in order to improve your efficiency?

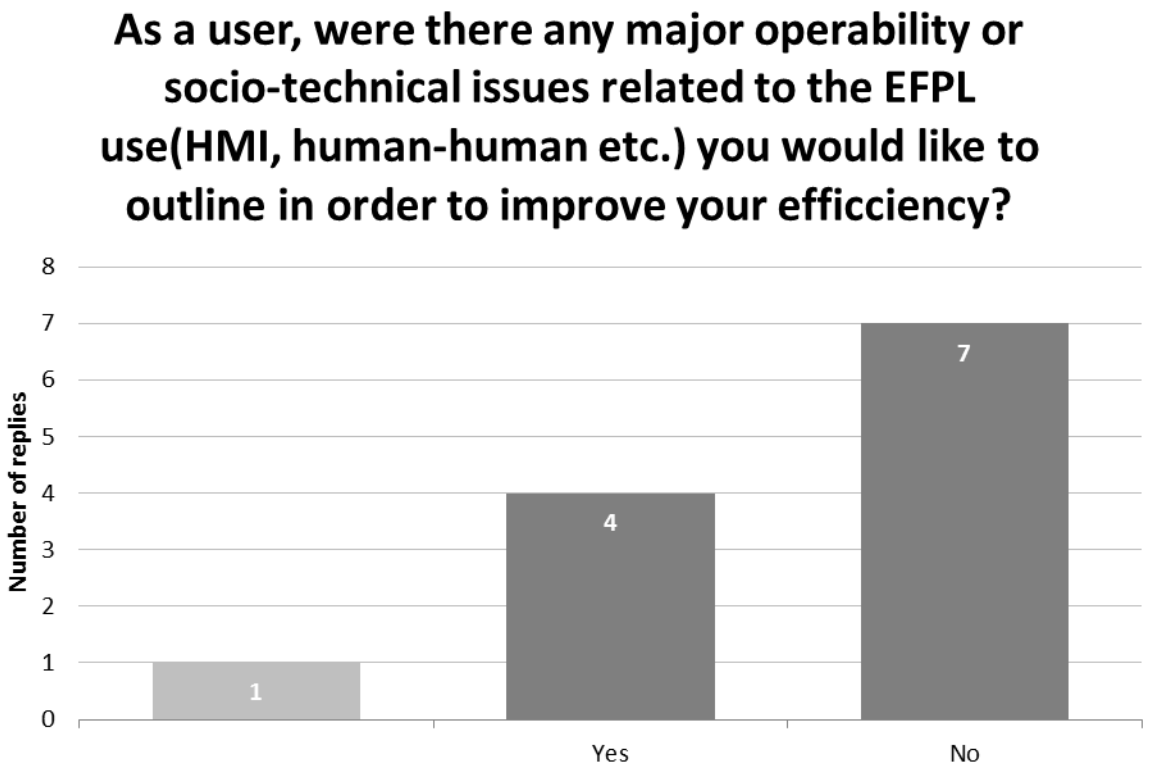


Figure 20 Questionnaire replies for question 13

Only one participant has not answered to this question. The remaining participants answered this questions and the result can be found in Figure 20. In one case “yes” was ticked-in without giving any further explanation. In the other cases the issue was rather related to the replies given by NM. For the IFPUV it was pointed out that it should already inform about cases that would be manually accepted by IFPS operators. This has already been implemented in the IFPUV. From this perspective this must not be discussed further. For the other two participants the replies given by NM upon a reject could be more detailed and should allow the planning of another trajectory on AU side. Apart from that it was pointed out by one of the flight dispatchers that the focus should be on the provision of very granular information on a reject reason and not on the provision of an alternative trajectory by NM.

Question #14: Do you have any proposals on how to improve the HMI to better support the EFPL negotiation process?

Two participants have not answered to this question. Four of the participants replied with some proposals. These are summarized in Table 15. The main concern of the airspace users seems to be the differences between the trajectory that is planned by the airspace user and the one used by NM. The airspace user would rather than request an additional indication if both are differing too much to be able to initiate adequate actions to take them in consideration. Another proposal was the provision of more adequate information in regard to the traffic situation and constraints to give a flight dispatcher better information to make an assessment of the situation and to be able to more efficiently react on any issue.

Question #14 - Received answers
"To have an indication on the CHMI[9] to alert the dispatchers on those FPLs that were accepted but are significantly different from the filed FPLs."
"It would help us to have a REJECT if there's a difference between the EFPL we've sent and the routing accepted by IFPS. Then we could file it again in accordance with EUROCONTROL acceptance. *The workload would still be important for dispatchers, but less than if we'll have to check the ACK of all our flights.* *Furthermore, it would be great if the EFPL will take into account the PTR in order to have a more realistic profile and fuel on board."*
"If HMI will be able to display more info on rejected item/ area (i.e. traffic data, different solution suggestion etc.) it will be a great improvement for airline operations."
"Taxi times"

Table 15 Answers to question #14

[9] The CHMI was not used at all during this validation exercise on Lufthansa Systems side. Anyhow the respective comment indicates that the dispatcher would like to get some warning in case of trajectory deviations on its HMI. This HMI must not be the CHMI.

Question #15: What information would you consider important to be able to visualize to improve EFPL operations?

This question was answered by 7 of the 12 participants. Table 16 summarizes all received answers that have been received for this question. It was pointed out the differences in the trajectories should be indicated as these seem to be an important issue for the airspace users. This relates to the fact that a different trajectory might lead to a different fuel required for the trip. As these differences seem to be a fact (but should be avoided by using the trajectory planned by the airspace user) the impact of these deviations on the safe operations has to be minimized.

Most other replies were rather referring to the granularity and standardization of data. This has several reasons. The granularity of data is seen as being required to be able to plan another optimal trajectory if a trajectory has been rejected. Standardization of data formats is required to implement efficient processes to deal with all possible situations where rejects or trajectory deviations are reported.

Question #15 - Received answers
"To have an indication on the CHMI[10] to alert the dispatchers on those FPLs that were accepted but are significantly different from the filed FPLs."
"Giving us the delta fuel between what we file and what is accepted by IFPS may be interesting, in order to evaluate quickly the difference between the fuel we've planned and what he really going to burn with the acceptance."
"The reply must be very precise and maybe even graphically available to give the AU more options to find the optimum trajectory."
"rejection/ error text"
"Standardization of information -> Ability to invest into statistical data base for trend analysis -> Prioritisation of resolution efforts locally"
"Manual messages from IFPS shown in IFPUV."
"Before and after calculations"

Table 16 Answers to question #15

[10] The CHMI was not used at all during this validation exercise on Lufthansa Systems side. Anyhow the respective comment indicates that the dispatcher would like to get some warning in case of trajectory deviations on its HMI. This HMI must not be the CHMI.

Question #16: How would you prefer to have the validation reply displayed to you in case you need to modify the FPL (text format, visually displayed in the trajectory generated by you, visually displayed in the trajectory of the IFPS operator, other format)?

Only one participant has not answered to this question. The remaining participants answered this question. Table 17 lists all received answers. In principle two possibilities seem to be accepted, graphical and textual representation of the validation reply. But there is also a tendency to show the reply in the trajectory to have a direct link between any reply and the planned trajectory. This is especially applicable for flight level related issues. Further ideas have not been proposed. This might be related to the fact that it is still hard to imagine for some flight dispatchers what can be displayed/ done based on the new data and data formats.

Question #16 - Received answers
"Text format"
"Text initially"
"Visually displayed"
"I would actually prefer to have it visually displayed in the trajectory generated by us in a very detailed way and maybe a text format at first sight to recognize familiar issues right away."
"Visually display is better than text. If possible to have suggestions to solve problem or error it will be helpful."
"Standardised coded + deconstructed including complete RAD reference as necessary + resolution suggestion"
"Text and visual, specifically for flight level rejects"
"Visually displayed in the trajectory generated by the AU + text"
"Don't know, need example of formats"
"Visually including restrictions"

Table 17 Answers to question #16

Question #17: Which ones or which combination from these three (4D trajectory, TOW and performance data) do you consider more important to improve predictability in various operational contexts?

Only one participant has not answered to this question. The remaining participants answered this question. Table 18 lists all received answers. One participant has replied with the statement "I do not know/ can't assess". Most stated that the 4D trajectory is the most important data. But it must also be mentioned that it seems that the question was not clear to many of the participants as answer "Difficult to answer without TOW and correct performance we can't provide with a 4D trajectory" suggests. The statement is valid as this data is necessary to provide an accurate 4D trajectory, but this does not refer to the question if this should be included in the EFPL. Furthermore it has to be said that the use of the TOW and the Flight Specific Performance Data was not discussed/ explored in the EXE-07.06.02-VP-713-A "Gaming Session". Therefore it is questionable whether the replies of to this question are representative.

Question #17 - Received answers
"4D trajectory"
"4D trajectory"
"Performance data and 4D trajectory"
"TOW and performance data"
"In my opinion the 4D trajectory is most important, but with taking over the AU's trajectory all data would be "included" and the trajectory would be very accurate (it includes performance, weight etc.)"
"I don't know, can't assess"
"4D trajectory"
"4D trajectory. TOW and performance could vary too much between aircrafts."
"all together"
"Difficult to answer without TOW and correct performance we can't provide with a 4D trajectory."
"all + taxi times"

Table 18 Answers to question #17

6.1.3.2.3 Verification of the FIXM EFPL flight plan exchange

The following results are based on the trials that have been conducted in the context of EXE-07.06.02-VP-713-B. Considering the setup of this part of the validation exercise it becomes obvious that it is rather verification than validation. The purpose of this part of the exercise is the verification of the use of the FIXM EFPL format. That is a FIXM v3.0 format that includes an EFPL extension defined/ developed by EUROCONTROL. This part of the validation exercise had the purpose to compare the request and reply messages (content wise) when sending EFPLs in the NM EFPL XML format on the one hand and in the FIXM EFPL format on the other hand. It has been agreed with EUROCONTROL that Lufthansa Systems is only analyzing the reply messages received from NMVP when sending an EFPL to NMVP. In both cases the respective flight plan was based on the same trajectory.

6.1.3.2.3.1 NM EFPL XML and FIXM EFPL flight plan acceptance rates

The acceptance rates for both types of flight plan formats are compared. In principle both acceptance rates should be the same as the same trajectories were exchanged in the FIXM EFPL flight plan and the NM EFPL XML format. That means that for both flight plan formats the share of flights accepted by the NMVP is calculated. However, Figure 21 shows that the FIXM EFPL flight plan acceptance rate is above the NM EFPL XML flight plan acceptance rate.

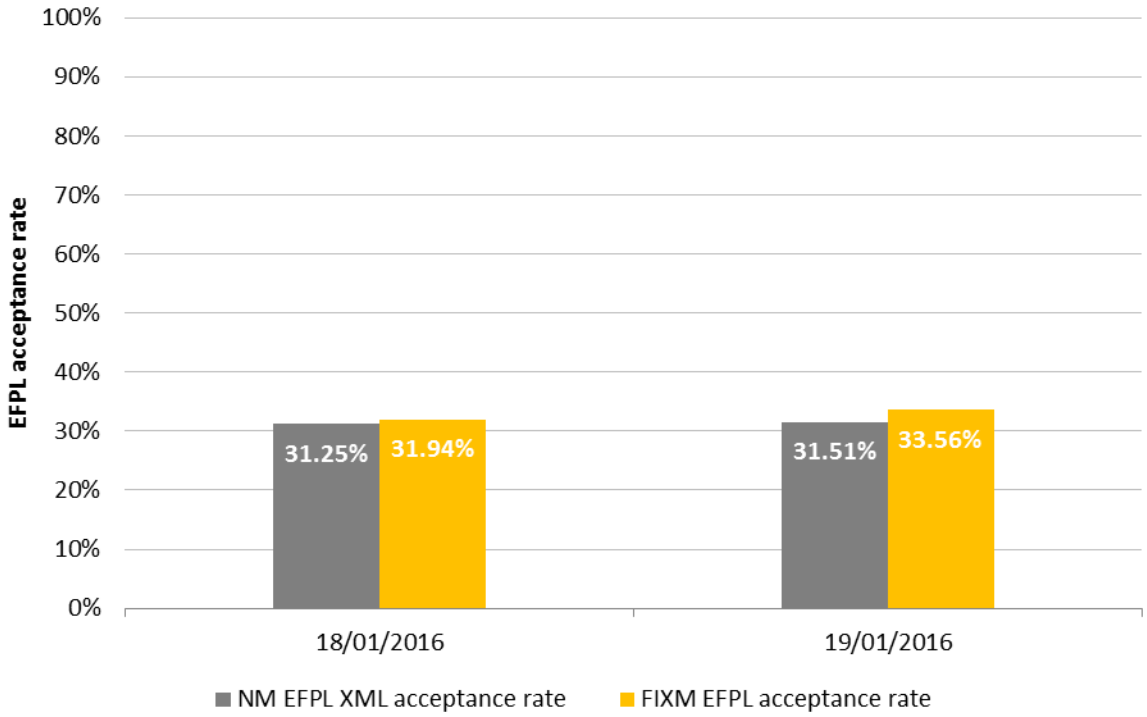


Figure 21 FIXM EFPL and NM EFPL XML acceptance rates

In both cases the relative low acceptance rates was caused by the setup that was chosen for this trial, where only a part of the trajectories were considering all constraints. The setup was designed to have a good range of different NMVP reply messages. As only the reject messages are differing, a setup was choses that led to a high number of rejects. In consequence the EFPL acceptances rates are very low.

It is remarkable that the FIXM EFPL flight plan acceptance rates and the NM EFPL XML flight plan acceptance rates on both days differ from each other. On the first day the difference was a little more that 0.5% points. On the second day the difference was about 2% points. In both cases the FIXM EFPL flight plan showed better flight plan acceptance rates. The values indicate that the FIXM EFPL flight plan and the NM EFPL XML flight plan deliver different flight plan acceptance rates. But Figure 21 is not giving an indication on the share of flight plans that have different validation results.

6.1.3.2.3.2 Differences of flight plan validity results for NM EFPL XML and FIXM EFPL flight plan creation

It has been analysed for how many flights the same validity result (valid or invalid) has been received. Figure 22 shows that on the first trial day 97.92% of the flight plans showed the same validation results for the FIXM EFPL and the NM EFPL XML flight plan messages, on the second trial day the value was 97.26%. Both values correspond to cases were the FIXM EFPL and the NM EFPL XML messages were either both “valid”; or both “invalid”. The fact that on both trial days the value is below 100% suggests that the validity result of the NM EFPL XML message and the FIXM EFPL message were not equal. These values correspond to two flight plans with different validation results on the 18th January and four flight plans on the 19th January. Table 19 lists all flights which lead to different validation results as described above. Two of all these occurrences are caused due to a negative value for an airport elevation. In both cases it was the same city pair that caused the error as the flight was planned to fly to the airport of Amsterdam. This airport has a negative elevation raising this error on EUROCONTROL side. A detailed description with regard to this issue can be found in section 6.1.2.1.2 on page 62. This error has been solved meanwhile, but the solution was not available for this part of the validation exercise.

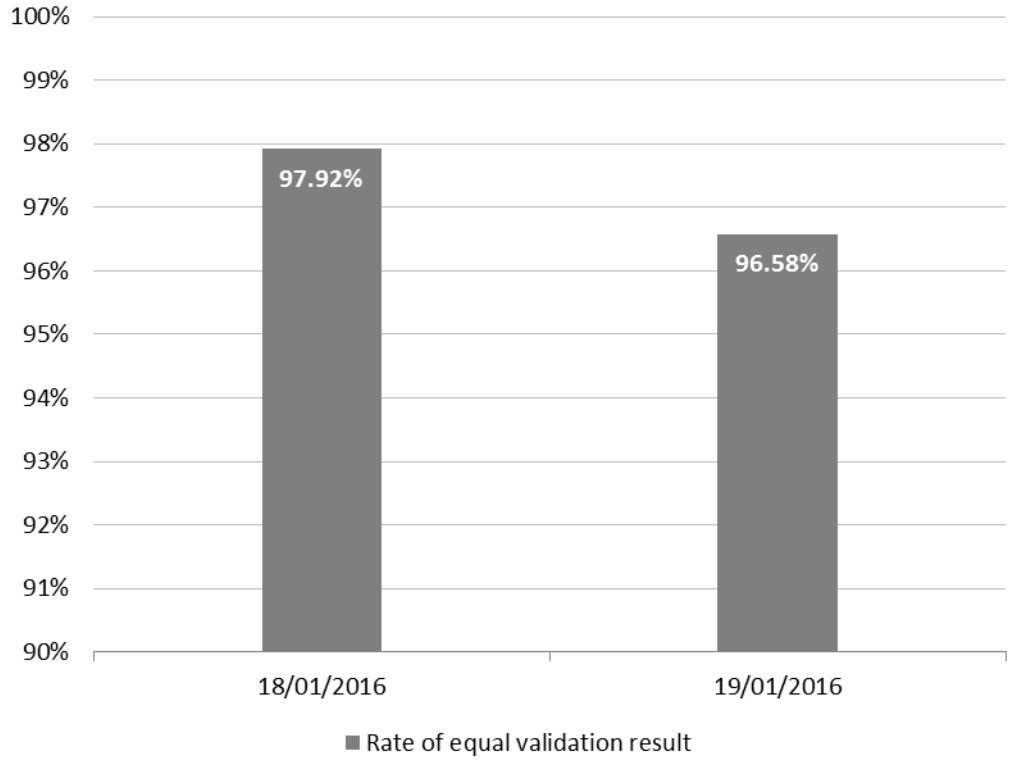


Figure 22 Rate of equal validation result between FIXM EFPL and NM EFPL XML

Day of trial	Flight number	NM EFPL XML		FIXM EFPL	
		Creation validation result	Error description	Creation validation result	Error description
18/01/ 2016	LH016	INVALID	value must be greater or equal to: '0'	VALID	
18/01/ 2016	LH023	VALID		INVALID	PROF50 CLIMBING/DESCENDING OUTSIDE THE VERTICAL LIMITS OF SEGMENT CIV UN872 KOVIN; PROF204 RS: TRAFFIC VIA LFFFTL:F000..F255 IS ON FORBIDDEN ROUTE REF:[LF2914A] VIA KOVIN
19/01/ 2016	LH016	INVALID	value must be greater or equal to: '0	VALID	
19/01/ 2016	LH023	VALID		INVALID	PROF50 CLIMBING/DESCENDING OUTSIDE THE VERTICAL LIMITS OF SEGMENT CIV UN872 KOVIN; PROF204 RS: TRAFFIC VIA LFFFTL:F000..F255 IS ON FORBIDDEN ROUTE REF:[LF2914A] VIA KOVIN
19/01/ 2016	LH062	INVALID	PROF204 RS: TRAFFIC VIA ARDOD:F195..F999 IS ON FORBIDDEN ROUTE REF:[LF2492A] UZ15 DIDAK ARDOD	VALID	
19/01/ 2016	LH097	INVALID	PROF204 RS: TRAFFIC VIA LUGEN TUPAR:F255..F999 IS ON FORBIDDEN ROUTE REF:[LF2884A] UM616 LUGEN TUPAR	VALID	

Table 19 List of flight plans with differing validation results (NM EFPL XML vs. FIXM EFPL)[11]

[11] More information with regard to the flights; like ADEP and ADES; can be found in **Fehler! Verweisquelle konnte nicht gefunden werden.** in Appendix B.3.

The other errors are referring to profile issues. In case of flight LH023 the FIXM EFPL is rejected as the segment CIV UN872 KOVIN; respectively the point KOVIN is used below FL255.
When checking the data in each EFPL flight plan message the following can be found (see Table 20 below).

	CIV		KOVIN	
	<level>	<unit>	<level>	<unit>
FIXM EFPL request	569	S	984	S
NM EFPL XML request	569	M	984	M
FIXM EFPL reply[12]	*none*	*none*	*none*	*none*
NM EFPL XML reply	5699	SM	9845	SM

Table 20 Level and level unit information for waypoints CIV and KOVIN (flight LH023)

In the FIXM EFPL request the <unit> *S* is used for the <level> while in the NM EFPL XML message the <unit> *M* is used. The NM EFPL XML message uses the <unit> *SM*. In the NM 19.5.0 NOP/ B2B Reference Manuals – Release Notes [16] the following is defined:

(1) "The following unit of measures are supported for FlightLevel

FlightLevelUnit A (altitude in hundreds of feet)

a. FlightLevelUnit F (standard flight level)

b. FlightLevelUnit M (altitude in tens of meters)

c. FlightLevelUnit MM (altitude in meters)

d. FlightLevelUnit S (Standard metric level in tens of meters)

e. FlightLevelUnit SM (Standard metric level in meters)

Only FlightLevelUnit F (standard flight level) is handled properly. The other UOM are not converted."

As visible in Table 20 the values for <level> at the point CIV and the point KOVIN are equal in the FIXM EFPL request message as well as in the NM EFPL XML request message. The difference is the <unit>. While the prototype used the "standard metric level in tens of meters" in the FIXM EFPL request message, "altitude in tens of meters" has been used in the NM EFPL XML. In the reply message that has been received from the NMVP the <level> is given in "standard metric level in meters". For the FIXM EFPL a reject has been received in the reply message. "Altitude" in this context means that the <level> indicated refers to the geographic height above the MSL, while "standard" refers to a pressure altitude that is referring to a height above the MSL measured with a pressure altimeter with the standard pressure (1013,25 hPa) set up as reference. As the FIXM EFPL reply message does not include the trajectory that has been used by the NMVP for the validation, neither <level> nor <unit> are available. The reject is raised due to two reasons:

1. The ATS-Route CIV UN872 KOVIN is used outside its vertical levels; and
2. The RAD restriction "LF2914A" is offended as the point KOVIN is used below FL255.

The first reject reason seems to refer to the use of UN872 below its vertical limit. As published in the AIP of Belgium [18] and the AIP of France [17]; where the respective portion of this ATS Route is located; the lower limit is FL195. Usually it is allowed that a transition from outside the vertical limits into the vertical limits of an ATS Route is allowed. From this perspective the last point mentioned in the reject message, KOVIN, is relevant for this analysis. The value in the FIXM EFPL message is

[12] EUROCONTROL is not returning a trajectory in case of a reject in its reply message. Therefore no value is available in this case.

about FL330. If the minimum level at KOVIN, according to the definition of the ATS-Route UN872 is FL195, it needs to be explained why this error is raised. An assumption could be that EUROCONTROL is using altitudes instead of standard pressure altitudes and that the conversion led to this error. But in such case it would be surprising that such a conversion leads to a difference of about 13500ft, which corresponds to about 4115m.
The second reject reason is caused by a restriction from the Route Availability Document. This restriction, the LF2914 is published in the following way:

Point or Airspace	Utilization	Restriction Apllicability	ID Number	Operational Goal
KOVIN	Not available for traffic DEP Brussels Group, Lille Group below FL255 except with RFL below FL255	H24	LF2914	Traffic departing Brussels/Lille Group with RFL above FL255 shall be FL260 at KOVIN to avoid LFFFTL sector

Table 21 Extract from the Route Availability Document - restriction LF1914

The issue seems to be caused by the fact that the flight level that is assumed to be flown at KOVIN is below FL255. In the FIXM EFPL the <level> is indicated as being about 984 in the <unit> 's' which means "standard metric level in tens of meters". This value corresponds with a flight level of about FL323. This is clearly above FL255. FL255 corresponds with about 7772m. That means that the difference between the filed <level> and the level leading to the reject is about 2000m. To have some more indication on what is used in the NMVP when the FIXM EFPL is processed it makes sense to check what is replied by NMVP in case that the FIXM EFPL is reported as being valid. In such a case the NM trajectory is provided in the reply message.

	LOKRU		LAPAB		NORRY	
			<level>	<unit>	<level>	<unit>
FIXM EFPL request	460	S	360	F	768	S
NM EFPL XML request	460	M	1097	M	768	M
FIXM EFPL reply[13]	4450	MM	10972	MM	6797	MM
NM EFPL XML reply	4450	SM	10972	SM	6797	SM

Table 22 Level and level unit information flight LH001 - Examples

Table 22 lists the <unit> and <level> information as included in the respective FIXM EFPL and Nm EFPL XML request and reply messages. The data refers to only to the three waypoints LOKRU, LAPAB and NORRY that have been used in the trajectory generated for flight LH001. The first observation relates to the two request messages. Besides the fact that in the NM EFPL XML the <unit> *M* and in the FIXM EFPL the unit *S* have been used, it can be seen that the FIXM EFPL uses the <unit> *F* at waypoint LAPAB. LAPAB is used in cruise and from that perspective the use of <unit> *F* should not be a problem at all. As *F* is "standard flight level" it also corresponds to *S*, which is "standard metric level in tens of meters". What is more interesting is the fact that the FIXM EFPL reply shows the same <level> information as the NM EFPL XML reply but that in both cases different <unit> information is present. While in the FIXM EFPL reply the <unit> MM is used; the *MM* EFPL XML uses <unit> *SM*. In this case the assumption is that two different trajectories are used for the assessment of the flight plan validity. While in case of the FIXM EFPL "altitude in meters" seems to be used; in case of the NM EFPL XML the NMVP seems to use "standard metric level in meters"[14]. This seems to be a

[13] EUROCONTROL is not returning a trajectory in case of a reject in its reply message. Therefore no value is available in this case.
[14] This is still an assumption based on the reply messages as it could be that NMVP processes trajectories using another <unit> and converts it before creating the reply messages.

technical issue that has to be sorted out as that seems to lead to different flight plan validities in some cases.

As a conclusion the following questions have to be raised.

1. How is the conversion of different <units> working in the EUROCONTROL flight plan processing system?
2. What are the consequences of such conversions?
3. Which <unit> and which combination of <unit> are appropriate for the use in a 4D flight plan message?
4. Which <unit> is the reference for the definition of any altitude/ level used in a constraint or restriction?

The other cases referring to profile issues (LH062 and LH097) are not discussed further in this document. The reason is that the conclusions would be similar to the conclusion made for the event referring to flight LH023. Again the same value of <level> is used in the NM EFPL XML and the FIXM XML, but the <unit> differs. The response of NMVP, in both cases states that the NM EFPL XML is rejected, while the FIXM EFPL is accepted. When looking into the cases the result should be that all the flight plans should be rejected in principle. These different results might be caused by the use of the different <units> in the flight plans, raising the same questions as above.

Besides the cases where the validation result is differing there are some cases where the error message differs. That means that the trajectory is rejected when a FIXM EFPL is send to NMVP as well as in the cases where a NM EFPL XML message is send to the NMVP, but the reasons of this reject are differing. Figure 23 shows the share of flights were the same validation results as well as the same reject reason in case of a reject was provided.

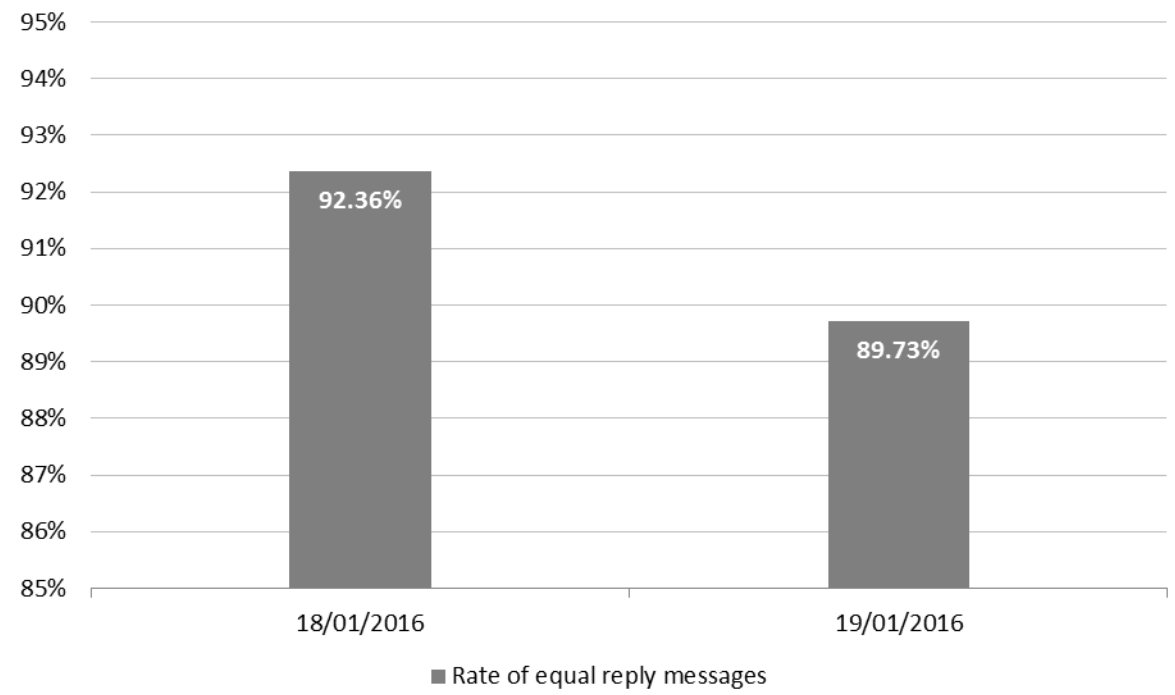


Figure 23 Share of flights where the reply message was equal.

It can be seen that about 10% of the flights showed a different validation result when sending an NM EFPL XML message and a FIXM EFPL message for the same trajectory. Table 23 lists all flights for which a different reject reasons were reported in the NM EFPL XML creation reply and in the FIXM EFPL creation reply. Again some of the discrepancies are caused by NM EFPL XML messages that are rejected because of a negative value for the <level> at the airport. If such reject occurs the message seems to be directly rejected and the NMVP is not checking the validity of 4D trajectory. For that reason it is not possible to compare the reply messages of the NM EFPL XML and FIXM EFPL in

those cases, as it is not possible to analyse whether the NM EFPL XML would have been rejected due to the same issues if the negative elevation at the airport would have been accepted. These flights are written in grey letters (Table 23)

Besides that Table 23 indicates where different reject reasons have been received from NMVP for the respective flight. These differences are written in red colour to indicate the differences. All differences are related to profile issues as the respective error codes (PROF~) suggest. In most cases an additional reject reason has been received for either the NM EFPL XML or the FIXM EFPL. In three of the cases a different reject reason has been received for the same segment of the trajectory. When comparing the respective NM EFPL XML and the FIXM EFPL creation request messages the same things can be pointed our as described before for flight LH023. The <level> information is the same in both request messages while the <unit> differs. Unfortunately it is not possible to compare this data with the resulting <level> information as used by NMVP for the flight plan validation, as all reply messages that indicate a reject do not include a trajectory.

After some deeper analysis made by EUROCONTROL the following results were reported. EUROCONTROL identified a software issue in their prototype system that led to these differences in the respective reply messages. The issue is caused by the use of different unit of measures in the FIXM EFPLs provided by the flight planning prototype. As illustrated in first row of Table 22 the FIXM EFPL requests provided by Lufthansa Systems used to different units of measure. In the climb and descend phases the <unit> *S* was used, corresponding to *standard metric level in tens of meters*, while for cruise <unit> *F* was used, corresponding to *standard flight levels*. EUROCONTROL found out that the switch of <unit> was not accepted by the NMVP FIXM prototype causing the differences in the reply messages. Assuming that a correction of the NMVP FIXM prototype with regard to this issue would solve all the cases where the EFPL reply messages for the NM EFPL XML and FIXM EFPL it can be assumed that both, FIXM EFPL and NM EFPL XML would lead to the same content in the respective reply messages.

DOT	Flight number	Error description	Error description
18/01/2016	LH019	PROF201 CANNOT CLIMB OR DESCEND ON LANON UL18 BADSI BECAUSE OF UNAVAILABLE LEVELS F205..F360 ON L18 UL18; PROF204 RS: TRAFFIC VIA EGMTANWSL:F195..F305 [201601180845..201601181945] IS ON FORBIDDEN ROUTE REF:[EGMTANWSLR] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM; PROF204 RS: TRAFFIC VIA EGD201:F000..F205 [201601180945..201601181645] IS ON FORBIDDEN ROUTE REF:[EGD201R] NOT AVAILABLE FOR TRAFFIC; PROF204 RS: TRAFFIC VIA LIPGO:F055..F195 IS ON FORBIDDEN ROUTE REF:[EGMTANWSLX] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM	PROF201 CANNOT CLIMB OR DESCEND ON LANON UL18 BADSI BECAUSE OF UNAVAILABLE LEVELS F205..F360 ON L18 UL18; PROF204 RS: TRAFFIC VIA EGMTANWSL:F195..F305 [201601180845..201601181945] IS ON FORBIDDEN ROUTE REF:[EGMTANWSLR] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM; PROF204 RS: TRAFFIC VIA EGD201:F000..F205 [201601180945..201601181645] IS ON FORBIDDEN ROUTE REF:[EGD201R] NOT AVAILABLE FOR TRAFFIC
18/01/2016	LH033	PROF201 CANNOT CLIMB OR DESCEND ON LANON UL18 BADSI BECAUSE OF UNAVAILABLE LEVELS F205..F360 ON L18 UL18; PROF204 RS: TRAFFIC VIA EGMTANWSL:F195..F305 [201601180845..201601181945] IS ON FORBIDDEN ROUTE REF:[EGMTANWSLR] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM; PROF204 RS: TRAFFIC VIA EGMTANWSL:F195..F305 [201601180845..201601181945] IS ON FORBIDDEN ROUTE REF:[EGMTANWSLR] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM; PROF204 RS: TRAFFIC VIA EGD201:F000..F205 [201601180945..201601181645] IS ON FORBIDDEN ROUTE REF:[EGD201R] NOT AVAILABLE FOR TRAFFIC	PROF201 CANNOT CLIMB OR DESCEND ON LANON UL18 BADSI BECAUSE OF UNAVAILABLE LEVELS F205..F360 ON L18 UL18; PROF204 RS: TRAFFIC VIA EGMTANWSL:F195..F305 [201601180845..201601181945] IS ON FORBIDDEN ROUTE REF:[EGMTANWSLR] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM; PROF204 RS: TRAFFIC VIA EGD201:F000..F205 [201601180945..201601181645] IS ON FORBIDDEN ROUTE REF:[EGD201R] NOT AVAILABLE FOR TRAFFIC
18/01/2016	LH058	PROF204 RS: TRAFFIC VIA PIXIS:F275..F999 IS ON FORBIDDEN ROUTE REF:[LF2719C] UM975 PILUL PIXIS; PROF204 RS: TRAFFIC VIA LUSAR:F235..F999 IS ON FORBIDDEN ROUTE REF:[LSLF1114B] LUSAR	PROF50 CLIMBING/DESCENDING OUTSIDE THE VERTICAL LIMITS OF SEGMENT UTUXA UN859 HON; PROF204 RS: TRAFFIC VIA PIXIS:F275..F999 IS ON FORBIDDEN ROUTE REF:[LF2719C] UM975 PILUL PIXIS; PROF204 RS: TRAFFIC VIA LUSAR:F235..F999 IS ON FORBIDDEN ROUTE REF:[LSLF1114B] LUSAR
18/01/2016	LH073	PROF204 RS: TRAFFIC VIA BOKNO IS ON FORBIDDEN ROUTE REF:[LF3012D] BOKNO; PROF204 RS: TRAFFIC VIA VADOM:F345..F999 IS ON FORBIDDEN ROUTE REF:[LF2273B] UN874 VANAD BAMES; PROF205 RS: TRAFFIC VIA BAMES UN874 KOPOR IS OFF MANDATORY ROUTE REF:[LF2342A] BAMES UN874 KOPOR;	PROF204 RS: TRAFFIC VIA BOKNO IS ON FORBIDDEN ROUTE REF:[LF3012D] BOKNO; PROF204 RS: TRAFFIC VIA VADOM:F345..F999 IS ON FORBIDDEN ROUTE REF:[LF2273B] UN874 VANAD BAMES; PROF205 RS: TRAFFIC VIA BAMES UN874 KOPOR IS OFF MANDATORY ROUTE REF:[LF2342A] BAMES UN874 KOPOR;

DOT	Flight number	Error description	Error description
		PROF204 RS: TRAFFIC VIA CMB IS ON FORBIDDEN ROUTE REF:[LFEB1002A] M617 CMB ROBAL; PROF205 RS: TRAFFIC VIA EB:F065..F999 IS OFF MANDATORY ROUTE REF:[EB5503B] APPENDIX 5 EB	PROF204 RS: TRAFFIC VIA CMB IS ON FORBIDDEN ROUTE REF:[LFEB1002A] M617 CMB ROBAL
18/01/2016	LH075	value must be greater or equal to: '0'	PROF205 RS: TRAFFIC VIA FERDI IS OFF MANDATORY ROUTE REF:[EBYX1001B] Y/UY18 FERDI DENUT
18/01/2016	LH106	PROF195 MEDIL UQ237 DISAK DOES NOT EXIST IN FL RANGE; PROF201 CANNOT CLIMB OR DESCEND ON MEDIL UQ237 DISAK BECAUSE OF UNAVAILABLE LEVELS ON UQ237; PROF204 RS: TRAFFIC VIA ARKIP FOUCO:F345..F500 IS ON FORBIDDEN ROUTE REF:[LF5167B] ARKIP DCT FOUCO; PROF204 RS: TRAFFIC VIA FOUCO BEGUY:F345..F500 IS ON FORBIDDEN ROUTE REF:[LF5168B] FOUCO DCT BEGUY	PROF201 CANNOT CLIMB OR DESCEND ON MEDIL UQ237 DISAK BECAUSE OF UNAVAILABLE LEVELS ON UQ237; PROF204 RS: TRAFFIC VIA ARKIP FOUCO:F345..F500 IS ON FORBIDDEN ROUTE REF:[LF5167B] ARKIP DCT FOUCO; PROF204 RS: TRAFFIC VIA FOUCO BEGUY:F345..F500 IS ON FORBIDDEN ROUTE REF:[LF5168B] FOUCO DCT BEGUY
18/01/2016	LH110	value must be greater or equal to: '0'	PROF50 CLIMBING/DESCENDING OUTSIDE THE VERTICAL LIMITS OF SEGMENT LUMIL UY873 DENUT; PROF198 ABRIX UN858 CNA IS A CDR 3 IN FL RANGE F195..F500; PROF201 CANNOT CLIMB OR DESCEND ON LUMIL UY873 DENUT BECAUSE OF UNAVAILABLE LEVELS ON UY873; PROF204 RS: TRAFFIC VIA CNA BOKNO:F345..F500 IS ON FORBIDDEN ROUTE REF:[LF5178B] CNA DCT BOKNO; PROF204 RS: TRAFFIC VIA BOKNO PON:F305..F500 IS ON FORBIDDEN ROUTE REF:[LF5305B] RAD APP4 BOKNO DCT PON; PROF204 RS: TRAFFIC VIA PON LUMIL:F295..F500 IS ON FORBIDDEN ROUTE REF:[LF5306B] RAD APP4 PON DCT LUMIL; PROF204 RS: TRAFFIC VIA LFEEUN IS ON FORBIDDEN ROUTE REF:[LF3233A] LFEEUN NOT AVAILABLE FOR TRAFFIC; ROUTE165 THE DCT SEGMENT PON..LUMIL (87 NM) IS TOO LONG FOR LFEEDCT:195:999. MAXIMUM IS 0 NM [LFEE2A]; ROUTE165 THE DCT SEGMENT PON..LUMIL (87 NM) IS TOO LONG FOR LFFFDCT:195:500. MAXIMUM IS 0 NM [LFFF2A]; ROUTE168 INVALID DCT COA..HSD. DCT ARE NOT ALLOWED TO CROSS THE BORDER BETWEEN EHDCT:000:065 AND EBDCT:000:065. [EHEB400A]
18/01/2016	LH128	value must be greater or equal to: '0'	ROUTE130 UNKNOWN DESIGNATOR MAASV

DOT	Flight number	Error description	Error description
19/01/2016	LH019	PROF201 CANNOT CLIMB OR DESCEND ON LANON UL18 BADSI BECAUSE OF UNAVAILABLE LEVELS F205..F354 ON L18 UL18; PROF204 RS: TRAFFIC VIA EGMTANWSL:F195..F305 [201601190745..201601191945] IS ON FORBIDDEN ROUTE REF:[EGMTANWSLR] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM; PROF204 RS: TRAFFIC VIA EGD201:F000..F205 [201601190945..201601191645] IS ON FORBIDDEN ROUTE REF:[EGD201R] NOT AVAILABLE FOR TRAFFIC; PROF204 RS: TRAFFIC VIA LIPGO:F055..F195 IS ON FORBIDDEN ROUTE REF:[EGMTANWSLX] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM	PROF201 CANNOT CLIMB OR DESCEND ON LANON UL18 BADSI BECAUSE OF UNAVAILABLE LEVELS F205..F354 ON L18 UL18; PROF204 RS: TRAFFIC VIA EGMTANWSL:F195..F305 [201601190745..201601191945] IS ON FORBIDDEN ROUTE REF:[EGMTANWSLR] EG MTANW TRAINING AREA SEE AUP/UUP/NOTAM; PROF204 RS: TRAFFIC VIA EGD201:F000..F205 [201601190945..201601191645] IS ON FORBIDDEN ROUTE REF:[EGD201R] NOT AVAILABLE FOR TRAFFIC
19/01/2016	LH058	PROF204 RS: TRAFFIC VIA PIXIS:F275..F999 IS ON FORBIDDEN ROUTE REF:[LF2719C] UM975 PILUL PIXIS; PROF204 RS: TRAFFIC VIA LUSAR:F235..F999 IS ON FORBIDDEN ROUTE REF:[LSLF1114B] LUSAR	PROF50 CLIMBING/DESCENDING OUTSIDE THE VERTICAL LIMITS OF SEGMENT UTUXA UN859 HON; PROF204 RS: TRAFFIC VIA PIXIS:F275..F999 IS ON FORBIDDEN ROUTE REF:[LF2719C] UM975 PILUL PIXIS; PROF204 RS: TRAFFIC VIA LUSAR:F235..F999 IS ON FORBIDDEN ROUTE REF:[LSLF1114B] LUSAR
19/01/2016	LH073	PROF204 RS: TRAFFIC VIA BOKNO IS ON FORBIDDEN ROUTE REF:[LF3012D] BOKNO; PROF204 RS: TRAFFIC VIA VADOM:F345..F999 IS ON FORBIDDEN ROUTE REF:[LF2273B] UN874 VANAD BAMES; PROF205 RS: TRAFFIC VIA BAMES UN874 KOPOR IS OFF MANDATORY ROUTE REF:[LF2342A] BAMES UN874 KOPOR; PROF204 RS: TRAFFIC VIA CMB IS ON FORBIDDEN ROUTE REF:[LFEB1002A] M617 CMB ROBAL; PROF205 RS: TRAFFIC VIA EB:F065..F999 IS OFF MANDATORY ROUTE REF:[EB5503B] APPENDIX 5 EB	PROF204 RS: TRAFFIC VIA BOKNO IS ON FORBIDDEN ROUTE REF:[LF3012D] BOKNO; PROF204 RS: TRAFFIC VIA VADOM:F345..F999 IS ON FORBIDDEN ROUTE REF:[LF2273B] UN874 VANAD BAMES; PROF205 RS: TRAFFIC VIA BAMES UN874 KOPOR IS OFF MANDATORY ROUTE REF:[LF2342A] BAMES UN874 KOPOR; PROF204 RS: TRAFFIC VIA CMB IS ON FORBIDDEN ROUTE REF:[LFEB1002A] M617 CMB ROBAL
19/01/2016	LH075	value must be greater or equal to: '0'	PROF205 RS: TRAFFIC VIA FERDI IS OFF MANDATORY ROUTE REF:[EBYX1001B] Y/UY18 FERDI DENUT
19/01/2016	LH080	PROF205 RS: TRAFFIC VIA WSN L23 HAM IS OFF MANDATORY ROUTE REF:[ED2565A] L23 WSR HAM; PROF204 RS: TRAFFIC VIA HAM IS ON FORBIDDEN ROUTE REF:[ED5502A] HAM APP5; PROF205 RS: TRAFFIC VIA EDDH EDHI EDHL IS OFF MANDATORY ROUTE REF:[ED2705A] N/UN125 REVLA LBV	PROF205 RS: TRAFFIC VIA ESTAD L23 HAM STADE L23 ESTAD WSN L23 STADE IS OFF MANDATORY ROUTE REF:[ED2565A] L23 WSR HAM; PROF204 RS: TRAFFIC VIA HAM IS ON FORBIDDEN ROUTE REF:[ED5502A] HAM APP5; PROF205 RS: TRAFFIC VIA EDDH EDHI EDHL IS OFF MANDATORY

DOT	Flight number	Error description	Error description
			ROUTE REF:[ED2705A] N/UN125 REVLA LBV
19/01/2016	LH110	value must be greater or equal to: '0'	PROF50 CLIMBING/DESCENDING OUTSIDE THE VERTICAL LIMITS OF SEGMENT LUMIL UY873 DENUT; PROF198 ABRIX UN858 CNA IS A CDR 3 IN FL RANGE F195..F500; PROF201 CANNOT CLIMB OR DESCEND ON LUMIL UY873 DENUT BECAUSE OF UNAVAILABLE LEVELS ON UY873; PROF204 RS: TRAFFIC VIA CNA BOKNO:F345..F500 IS ON FORBIDDEN ROUTE REF:[LF5178B] CNA DCT BOKNO; PROF204 RS: TRAFFIC VIA BOKNO PON:F305..F500 IS ON FORBIDDEN ROUTE REF:[LF5305B] RAD APP4 BOKNO DCT PON; PROF204 RS: TRAFFIC VIA PON LUMIL:F295..F500 IS ON FORBIDDEN ROUTE REF:[LF5306B] RAD APP4 PON DCT LUMIL; PROF204 RS: TRAFFIC VIA LFEEUN IS ON FORBIDDEN ROUTE REF:[LF3233A] LFEEUN NOT AVAILABLE FOR TRAFFIC; ROUTE165 THE DCT SEGMENT PON..LUMIL (87 NM) IS TOO LONG FOR LFEEDCT:195:999. MAXIMUM IS 0 NM [LFEE2A]; ROUTE165 THE DCT SEGMENT PON..LUMIL (87 NM) IS TOO LONG FOR LFFFDCT:195:500. MAXIMUM IS 0 NM [LFFF2A]; ROUTE168 INVALID DCT COA..HSD. DCT ARE NOT ALLOWED TO CROSS THE BORDER BETWEEN EHDCT:000:065 AND EBDCT:000:065. [EHEB400A]
19/01/2016	LH113	PROF201 CANNOT CLIMB OR DESCEND ON SANTA UM744 ROSAL BECAUSE OF UNAVAILABLE LEVELS F194..F306 ON A44 UM744; PROF205 RS: TRAFFIC VIA EGGXOCA|EISNCTA IS OFF MANDATORY ROUTE REF:[EI2039A] EMPER; PROF204 RS: TRAFFIC VIA EGCC IS ON FORBIDDEN ROUTE REF:[EG5530A] APP5 WAL DCT EGCC ONLY AVAILABLE; ROUTE165 THE DCT SEGMENT LIFFY..MALUD (68 NM) IS TOO LONG FOR EGDCT:245:999. MAXIMUM IS 0 NM [EG3A]; ROUTE165 THE DCT SEGMENT LIFFY..MALUD (68 NM) IS TOO LONG FOR EGDCT:105:245. MAXIMUM IS 50 NM [EG2A]	PROF50 CLIMBING/DESCENDING OUTSIDE THE VERTICAL LIMITS OF SEGMENT SANTA UM744 LASIB; PROF205 RS: TRAFFIC VIA EGGXOCA|EISNCTA IS OFF MANDATORY ROUTE REF:[EI2039A] EMPER; PROF204 RS: TRAFFIC VIA EGCC IS ON FORBIDDEN ROUTE REF:[EG5530A] APP5 WAL DCT EGCC ONLY AVAILABLE; ROUTE165 THE DCT SEGMENT LIFFY..MALUD (68 NM) IS TOO LONG FOR EGDCT:245:999. MAXIMUM IS 0 NM [EG3A]; ROUTE165 THE DCT SEGMENT LIFFY..MALUD (68 NM) IS TOO LONG FOR EGDCT:105:245. MAXIMUM IS 50 NM [EG2A]
19/01/2016	LH128	value must be greater or equal to: '0'	PROF50 CLIMBING/DESCENDING OUTSIDE THE VERTICAL LIMITS OF SEGMENT LUMIL UY873 DENUT; PROF198 ABRIX UN858 CNA IS A CDR 3 IN FL RANGE F195..F500; PROF201 CANNOT CLIMB OR DESCEND ON LUMIL UY873 DENUT BECAUSE OF UNAVAILABLE LEVELS ON UY873; PROF204 RS: TRAFFIC VIA CNA BOKNO:F345..F500 IS ON

DOT	Flight number	Error description	Error description
			FORBIDDEN ROUTE REF:[LF5178B] CNA DCT BOKNO; PROF204 RS: TRAFFIC VIA BOKNO PON:F305..F500 IS ON FORBIDDEN ROUTE REF:[LF5305B] RAD APP4 BOKNO DCT PON; PROF204 RS: TRAFFIC VIA PON LUMIL:F295..F500 IS ON FORBIDDEN ROUTE REF:[LF5306B] RAD APP4 PON DCT LUMIL; PROF204 RS: TRAFFIC VIA LFEEUN IS ON FORBIDDEN ROUTE REF:[LF3233A] LFEEUN NOT AVAILABLE FOR TRAFFIC; ROUTE165 THE DCT SEGMENT PON..LUMIL (87 NM) IS TOO LONG FOR LFEEDCT:195:999. MAXIMUM IS 0 NM [LFEE2A]; ROUTE165 THE DCT SEGMENT PON..LUMIL (87 NM) IS TOO LONG FOR LFFFDCT:195:500. MAXIMUM IS 0 NM [LFFF2A]; ROUTE168 INVALID DCT COA..HSD. DCT ARE NOT ALLOWED TO CROSS THE BORDER BETWEEN EHDCT:000:065 AND EBDCT:000:065. [EHEB400A]
19/01/2016	LH144	PROF202 LUXAL P31 XERBI IS NOT AVAILABLE IN FL RANGE F245..F425; PROF201 CANNOT CLIMB OR DESCEND ON LUXAL P31 XERBI BECAUSE OF UNAVAILABLE LEVELS F307..F360 ON P31; PROF204 RS: TRAFFIC VIA DENKO LATAG:F245..F660 IS ON FORBIDDEN ROUTE REF:[EP5073A] APP4 DENKO DCT LATAG; PROF204 RS: TRAFFIC VIA TEDGO TITIX:F325..F660 IS ON FORBIDDEN ROUTE REF:[EDLS5000C] TEDGO DCT TITIX; PROF204 RS: TRAFFIC VIA TITIX BENOT:F365..F660 IS ON FORBIDDEN ROUTE REF:[LSED5000B] APP4 TITIX DCT BENOT; PROF204 RS: TRAFFIC VIA ADIMO GAI PMR TOU IS ON FORBIDDEN ROUTE REF:[LF5525A] ADIMO/GAI/PMR/TOU DCT LFBO APP5; ROUTE165 THE DCT SEGMENT OLRAK..GAI (66 NM) IS TOO LONG FOR LFBBDCT:195:500. MAXIMUM IS 0 NM [LFBB2A]; ROUTE165 THE DCT SEGMENT OLRAK..GAI (66 NM) IS TOO LONG FOR LFBBDCT:000:195. MAXIMUM IS 50 NM [LFBB1A]	PROF201 CANNOT CLIMB OR DESCEND ON LUXAL P31 XERBI BECAUSE OF UNAVAILABLE LEVELS F275..F360 ON P31; PROF204 RS: TRAFFIC VIA DENKO LATAG:F245..F660 IS ON FORBIDDEN ROUTE REF:[EP5073A] APP4 DENKO DCT LATAG; PROF204 RS: TRAFFIC VIA TEDGO TITIX:F325..F660 IS ON FORBIDDEN ROUTE REF:[EDLS5000C] TEDGO DCT TITIX; PROF204 RS: TRAFFIC VIA TITIX BENOT:F365..F660 IS ON FORBIDDEN ROUTE REF:[LSED5000B] APP4 TITIX DCT BENOT; PROF204 RS: TRAFFIC VIA ADIMO GAI PMR TOU IS ON FORBIDDEN ROUTE REF:[LF5525A] ADIMO/GAI/PMR/TOU DCT LFBO APP5; ROUTE165 THE DCT SEGMENT OLRAK..GAI (66 NM) IS TOO LONG FOR LFBBDCT:195:500. MAXIMUM IS 0 NM [LFBB2A]; ROUTE165 THE DCT SEGMENT OLRAK..GAI (66 NM) IS TOO LONG FOR LFBBDCT:000:195. MAXIMUM IS 50 NM [LFBB1A]

Table 23 List of flights with differing reject reasons

6.1.3.2.4 Unexpected Behaviours/Results

As described in section 6.1.3.2.3.2 the validation results when sending a NM EFPL XML creation request and those for the corresponding FIXM EFPL were different in some cases. This behavior was not expected and seems to be caused by the used <unit> for the <level> indication at any 4D trajectory point in the 4D trajectory. The issue seems to relate to the different use of the reference for the <level> information. While in the FIXM EFPL "*Standard metric level in tens of meters"* was used, the NM EFPL XML used *"altitude in tens of meters".* Even if not directly obvious the difference between both seems to be significant enough to force different flight plan validation results. The main difference between both units is the fact that "standard metric level" is a level that is measured (using the air pressure/ temperature) when the standard atmospheric conditions are selected in the altimeter. The altitude is the geographical altitude. Standard levels are usually used above the transition altitude MSL (e.g. 5000ft MSL/ Germany) when climbing and above the transition layer when descending. Altitudes are used near the ground; respectively below the transition altitude and transition layer.

This behavior raises the question on how to represent levels at every waypoint. For the ICAO FPL that was never an issue as only a low number of levels were given (Requested Flight Levels).

6.1.3.3 Confidence in Results of Validation Exercise

6.1.3.3.1 Quality of Validation Exercise Results

6.1.3.3.1.1 V3 EFPL validation exercise – gaming session

This validation trial was performed together with 12 flight dispatchers from the airlines that are listed in chapter 6.1.2.2.1. The dispatchers had a long years' experience in flight planning. Hence 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.

The number of participants was relative small. That has a high 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.

6.1.3.3.1.2 V3 EFPL validation exercise – shadow mode session

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. A factor slightly limiting especially the EFPL validation results is the fact that the flight dispatchers of the respective airline were 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 (shadow mode).

6.1.3.3.1.3 V2 FIXM EFPL validation exercise – analytical modeling

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.

6.1.3.3.2 Significance of Validation Exercise Results

6.1.3.3.2.1 V3 EFPL validation exercise – gaming session

This part of the validation exercise has been performed together with representatives of 9 airlines. In sum 12 experienced flight dispatchers were present in this part of the validation exercise. Except three dispatchers all were already familiar with the flight planning system Lido/Flight. That means that for the nine flight dispatchers, already using Lido/Flight, 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 dispatchers 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.

6.1.3.3.2.2 V3 EFPL validation exercise – shadow mode session

This part of the validation exercise was supported by 6 airlines[15]. All these airlines use Lufthansa Systems' flight planning system Lido/Flight. 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, Thomas Cook) were joining this validation exercise. All these airlines provided more than 15,000 flights from which about 14,000 were used for the analysis.

6.1.3.3.2.3 V2 FIXM EFPL validation exercise – FIXM analytical modeling

This part of the validation exercise was rather a verification of the FIXM EFPL related format and services. 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 EFPL 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 increased the significance of the results as variety of observed cases was very high.

[15] Some of these airlines are organized in individual sub-airlines. This organizational separation has not been considered here.

6.1.4 Conclusions and recommendations

6.1.4.1 Conclusions

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 93% 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 5% points lower) was mainly driven by the setup of the shadow mode exercise For more details on that please read the explanations on the ICAO flight plan scenarios in chapter 6.1.3.2.1.1.. 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 procedures is that a set of predefined routes is built for a 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. Hence the reduced number of accepted EFPL flights discloses rather the rate and number of flights with a wrongly accepted ICAO flight plan when filed with an ICAO FPL. In those cases the pilot will be briefed with a different trajectory compared to that one that is used by the NM. An analysis of the cases were the ICAO FPL has been accepted while the EFPL was rejected showed that most cases can be solved when enabling the corresponding functionalities in Lido/Flight that consider respective restrictions during the trajectory calculation process. In some cases the Lido/Flight system failed to recalculate respective restrictions (if all restrictions are considered) confirming that the Lido/Flight system is able to correctly consider respective restrictions. In such cases the airspace user would have to find another trajectory replacing the wrong trajectory.

On the other hand the validation exercise showed that in case that an ICAO flight plan is wrongfully rejected the EFPL will most likely be accepted. In the particular shadow mode exercise the rate of EFPL accepted while the ICAO flight plan was rejected was about 19% in average. In these cases the EFPL would directly lead to gains in cost efficiency on airspace user side in two senses. 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. It has to be pointed out that the number of those cases could be higher if EFPL is implemented in operations. This is due to the fact that the setup of this validation exercise was avoiding cases were flight plans with ICAO FPL reject are filed. For more details on that please read the explanations on the ICAO flight plan scenarios in chapter 6.1.3.2.1.1.

All this indicates that the acceptance rate for EFPLs can be equal or higher as for the ICAO flight plan in general. If the trajectory is correctly planned the EFPL will be accepted what could allow EFPL acceptance rates close to 100%.

During the gaming sessions the potential of the EFPL to decrease the workload by reducing the number of wrongly rejected ICAO flight plans 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 built 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 the ICAO flight plan were a deviation between the 4D trajectory in the flight planning system and the 4D trajectory in the NM system should be more significant. In this context it was also pointed out that any 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 be clearly defined from the airspace user perspective. Such definitions would have direct impact onto required tools or – if applicable – specific training of airspace users.

The analysis on the use of the FIXM EFPL showed that there are still some things that have to be sorted out before the EFPL concept can be used in operations. This has two aspects. On the one hand some technical issues have to be sorted out, like the different use of the <unit> information in the NM EFPL XML request/ reply and the FIXM EFPL request/ reply. That caused different flight plan validity results due to the different trajectories that are a consequence of the different unit of measures used for the same <level> value. In this context a focus should also be laid on the effects of converting <level> information from one <unit> to another. It has to be ensured that this is not causing any differences and errors. This is purely a technical issue that should be further analyzed and solved in the flight planning system as well as in the NM flight plan processing system.

On the other hand it has to be analyzed which granularity is 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.

This result cannot be seen as an isolated issue with the FIXM EFPL. The analysis shows that in some cases the NM EFPL XML lead to further reject reasons and in some cases the FIXM EFPL. From this perspective it is not simply a matter of the one or the other 4D flight plan format. It rather raises the question about some of the rejects that have been raised for the NM EFPL XML messages that have been sent from the operational flight planning systems during the EXE-07.06.02-VP-713-A “shadow mode” trial. It has to be 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 accuracy 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.

6.1.4.2 Recommendations

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. This validation exercise, especially the validation exercise parts related to the FIXM EFPL, showed that the use of certain units of measure impacts the validity of a flight plan significantly. Therefore the topic units of measure and the related granularity of data should be addressed again to agree on the appropriate units and related procedures of use.

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 flights 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.

7 References

7.1 Applicable Documents

[1] Template Toolbox 03.01.00
https://extranet.sesarju.eu/Programme%20Library/SESAR%20Template%20Toolbox.dot

[2] Requirements and V&V Guidelines 03.00.00
https://extranet.sesarju.eu/Programme%20Library/Requirements%20and%20VV%20Guidelines.doc

[3] Templates and Toolbox User Manual 03.01.01
https://extranet.sesarju.eu/Programme%20Library/Templates%20and%20Toolbox%20User%20Manual.doc

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

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

7.2 Reference Documents

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

[6] Step 1 Business trajectory OSED 2015 update; Edition V00.04.00;
https://extranet.sesarju.eu/WP_07/Project_07.06.02/Project%20Plan/Trajectory-Step%201/BT%20OSED/Edition%204.0%20-%20D45/07%2006%2002%20-D45-Step%201%20Business%20trajectory%20OSED%202015%20update.docx

[7] FOC operational and performance requirements for Step 1 (Quick Wins) including the traceability of the AU comments; Edition V00.01.04;
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[8] Step 1 Business Trajectory VALR 2014; 2013; Edition V00.01.01;
https://extranet.sesarju.eu/WP_07/Project_07.06.02/Project%20Plan/Trajectory-Step%201/BT%20Validation%20Report/07.06.02%20-%20D05%20-%20S1%20BT%20VALR%202013%202014.doc

[9] Step 1 Business Trajectory Validation Plan for VP-713; Edition V00.01.01
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[10] D16 Contribution to EXE-07.06.02-VP-713-EFPL Step 1 V3 Validation Plan
https://extranet.sesarju.eu/WP_11FW/Project_11.01.05/Project%20Plan/EFPL/D16-D11.1.5-1ca-EFPL%20-%20Edition%2000.01.00.doc

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http://www.ead.EUROCONTROL.int/eadbasic/pamslight-91A1BB2B57730639E9A7E4F6E20777CE/B6EM2JLBGI7ZU/EN/Charts/AD/NON_AIRAC/EH-AD-2.EHAM-AOC-04-22_2015-11-12.pdf (EAD)

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

[13] D55 Step 1 EFPL Validation Report for EXE-07.06.02-VP-713 (currently prepared by EUROCONTROL); Edition 00.00.01

[14] D29-D11.1.5-3c-AFUA Contribution to Validation Report, Edition 00.01.00
https://extranet.sesarju.eu/WP_11FW/Project_11.01.05/Project%20Plan/AFUA/D29-D11.1.5-3c-AFUA%20Edition%2000.01.00%20Contribution%20to%20Validation%20Report.doc

[15] Doc 4444 Procedures for Air Navigation Services – Air Traffic Management; Fifteenth Edition – 2007; ICAO

[16] NM 19.5.0 – NOP/B2B Reference Manuals – Release Notes; Edition 19.5.0.4.87; Issue date 12/11/2015; https://ost.eurocontrol.int/sites/B2BWS/Shared%20Documents/1%20-%20Technical%20Resource%20%28OPS%20-%20NM19.5%29/00%20-%20NM19.5.0.4.87%20-%20ReleaseNotes.pdf

[17]AIP FRANCE ENR 3.2 ROUTES ATS SUPERIEURS/ UPPER ATS ROUTES; ENR 3.2-1 http://www.ead.eurocontrol.int/eadbasic/pamslight-67489614C66E7AA2C26E43C293D620EE/SVR2UEKJIUOIC/EN/AIP/ENR/LF_ENR_3_2_en_2016-05-26.pdf

[18]AIP Belgium and Luxembourg ENR 3.3. Area Navigation (RNAV) Routes/ ENR 3.3-1 ; http://www.ead.eurocontrol.int/eadbasic/pamslight-67489614C66E7AA2C26E43C293D620EE/UW2XZDUJH55X2/EN/AIP/ENR/EB_ENR_3_3_en_2016-04-28.pdf

Appendix A KPA Templates

Not applicable.

Appendix B List of Flight Samples

B.1 EXE-07.06.02-VP-713-A “Gaming Session”

The flight list for this part of the exercise can be found in section 6.1.2.1.1.

B.2 EXE-07.06.02-VP-713-A “Shadow Mode”

For this part of the validation exercise no specific flight list has been maintained. All flights used for this part of the validation are operational flights of the respective participating airspace users.

B.3 EXE-07.06.02-VP-713-B “FIXM Analytical Modeling”

001	LDDU	EGGD	11:35	15:44	A319
002	EGGP	LFML	13:39	15:46	B738
003	LEBB	EDDH	13:37	15:28	A319
004	LPPT	EDDF	14:16	16:31	B738
005	LEMD	EDDS	12:12	14:51	B738
006	LFBO	EDDF	12:18	14:37	B738
007	EGLL	LSZH	12:51	15:21	B738
008	LSGG	EGCC	13:32	15:46	B738
009	EPWA	LPPR	12:06	13:42	A319
010	EDDM	KJFK	12:07	15:05	A319
011	EDDF	SBGL	12:09	13:18	A319
012	LFRS	EDDF	12:41	14:22	B738
013	LDZA	EGGD	12:53	15:41	B738
014	EPGD	LPPT	14:04	15:51	A319
015	ENGM	LEPA	13:07	15:06	A320
016	LEBL	EHAM	13:23	16:12	A321
017	ESSA	LEMD	13:16	15:37	A320
018	LEVC	EDDV	13:31	16:34	A320
019	LIRF	EIDW	13:31	15:21	B738
020	LSGG	EBBR	14:12	16:25	B738
021	LSZH	EGLL	13:50	16:03	B738
022	EGLL	LSGG	12:04	13:27	A319
023	EBBR	LFBD	12:58	14:29	A320
024	LFBD	EDDF	11:01	13:33	B738
025	EDDF	LFBD	14:33	17:03	B738
026	LTBA	EGLL	13:54	15:13	A319
027	EDDM	EGGD	12:05	13:31	A320
028	BIKF	LSGG	13:04	13:57	A319
029	LFLS	EGCC	12:23	13:37	A320
030	EDDH	LFBD	14:08	15:07	A320
031	ENGM	LEVC	12:52	14:41	A319
032	EHAM	LSGG	13:22	14:37	A319
033	EDDF	EIDW	13:14	14:32	A319
034	EBBR	LIRF	13:01	14:32	A319
035	LEST	EDDS	13:25	15:20	A320
036	EDDF	KJFK	13:30	14:53	A319

037	EDDF	KMIA	14:35	15:54	A320
038	EPWA	LFRS	13:18	15:09	A320
039	LDDU	EIDW	13:39	15:00	A319
040	EDDV	LPPT	14:09	16:23	A319
041	EPGD	LFST	13:31	15:04	A319
042	LFRN	LDZA	13:44	15:11	A320
043	EPKK	LFRS	13:56	15:20	A320
044	LSZH	BIKF	13:42	15:20	A320
045	LEVC	EBBR	14:05	15:30	A319
046	EIDW	LIRF	14:16	15:44	A319
047	LEPA	LFRS	14:01	15:14	A319
048	ENGM	LPPR	13:53	15:42	A319
049	LGAV	EGGD	14:01	16:02	A320
050	LHBP	EGGD	14:02	15:34	A319
051	EGGD	LDDU	14:03	16:50	B738
052	LFML	EGGP	14:05	15:48	A319
053	EDDH	LEBB	14:09	15:13	A319
054	EDDF	LPPT	14:20	15:51	A319
055	EDDS	LEMD	14:23	16:15	A320
056	EDDF	LFBO	14:24	16:09	A319
057	LSZH	EIDW	14:14	16:21	A319
058	EGCC	LSGG	14:43	16:39	A319
059	LPPR	EPWA	14:21	15:49	A320
060	KJFK	EDDM	14:40	15:58	A320
061	SBGL	EDDF	14:37	16:28	A319
062	EDDF	LFRS	13:53	15:22	A320
063	EGGD	LDZA	13:09	15:33	A320
064	LPPT	EPGD	11:35	14:10	A320
065	LEPA	ENGM	14:08	16:09	B738
066	EHAM	LEBL	11:48	13:18	A319
067	LEMD	ESSA	12:03	13:51	A320
068	EDDV	LEVC	14:24	15:50	A319
069	EIDW	LIRF	12:20	13:44	A320
070	EBBR	LSGG	12:27	14:18	A320
071	EGLL	LFLS	11:51	13:28	A320
072	LSGG	EGLL	14:25	16:24	A320
073	LFBD	EBBR	14:21	16:15	A333
074	EDDF	EBBR	13:43	15:46	B738
075	LFBO	EHAM	13:47	15:17	A319
076	EIDW	LTBA	13:35	15:31	B738
077	EGGD	EDDM	14:40	16:30	B738
078	LSGG	BIKF	14:41	16:46	B738
079	EGCC	LFLS	14:53	16:58	A320
080	LFBD	EDDH	12:10	13:31	A319
081	LEVC	ENGM	13:50	16:03	A320
082	LSGG	EHAM	13:07	14:39	A319
083	EIDW	EDDF	11:33	13:35	B738
084	LIRF	EBBR	12:18	13:58	A320

085	EDDS	LEST	11:26	17:09	B738
086	KJFK	EDDF	11:42	14:19	B738
087	KMIA	EDDF	11:29	12:58	B738
088	LFRS	EPWA	13:54	15:29	B738
089	EIDW	LDDU	12:44	14:16	A319
090	LPPT	EDDV	12:52	14:43	B738
091	LFST	EPGD	14:07	15:22	B738
092	LDZA	LFRN	12:13	13:47	B738
093	LFRS	EPKK	14:55	16:11	A319
094	BIKF	LSGG	14:43	15:50	A319
095	EHAM	LEVC	12:31	14:21	B738
096	LIRF	EGCC	12:33	15:45	A319
097	LFRS	LEPA	12:10	13:35	B738
098	LPPR	ENGM	15:28	16:36	A320
099	EGGD	LGAV	14:16	15:35	B738
100	EGGD	LHBP	13:17	14:50	B738
101	EGLL	LEMD	15:15	16:42	A320
102	EHAM	LEMD	14:49	16:54	B738
103	EDDF	LEMD	13:45	15:33	A319
104	EGCC	LEMD	13:34	15:06	B738
105	EDDV	LEMD	12:51	16:04	B738
106	EBBR	LEMD	13:55	15:39	A319
107	LEMD	LFRS	11:56	14:04	B738
108	LEMD	EGLL	13:50	15:29	B738
109	LEMD	EIDW	13:55	15:03	A319
110	LEMD	EHAM	15:15	16:07	A320
111	LEMD	EDDT	14:53	16:33	A319
112	LFBO	EGCC	15:17	16:51	A319
113	LEZL	EGCC	12:41	15:05	B738
114	LPPT	EGCC	12:40	15:22	A320
115	LSGG	EGCC	14:43	15:59	A319
116	LDDU	EGCC	12:17	13:49	A319
117	EDDS	EGCC	15:08	16:39	A319
118	EGCC	LPPR	12:54	14:54	B738
119	EGCC	LFBO	14:57	16:18	A319
120	EGCC	LFML	13:42	15:28	B738
121	EGCC	LSGG	12:18	13:34	A319
122	EGCC	LIRF	14:56	16:28	A319
123	EGCC	EDDM	12:14	13:42	A319
124	EGCC	LDZA	14:24	16:21	A319
125	EDDM	EGGD	12:28	13:59	A319
126	LSGG	EGLL	15:05	16:29	B738
127	LFML	EBBR	14:37	15:59	B738
128	LEMD	EHAM	14:42	16:24	B738
129	KMIA	EDDF	12:44	13:44	A319
130	EIDW	LFSB	12:53	15:14	A319
131	ENGM	LFBO	13:07	15:01	A319
132	LEST	EDDF	13:59	16:14	A320

133	EHAM	LFBO	13:49	15:46	A319
134	EBBR	LEBL	11:30	15:56	A319
135	EGLL	LFML	13:38	14:55	A319
136	EGGD	LIRF	13:58	16:19	A319
137	EGGD	EDDM	14:26	16:11	A319
138	LFBO	ESSA	14:34	16:33	A320
139	LFML	EGLL	13:41	14:38	B744
140	EIDW	LFBO	14:55	19:02	B738
141	EHAM	LFBO	14:43	18:53	A319
142	EDDH	LFBO	12:31	16:45	B738
143	EDDT	LFBO	12:33	16:48	A320
144	EPGD	LFBO	12:10	17:00	B738
145	LFBO	EDDC	15:28	18:00	B738
146	LFBO	ENGM	14:16	18:25	A320
147	EDDF	EPGD	13:17	14:59	B738
148	LFBO	EGLL	15:15	17:43	A319
149	EBBR	EDDF	14:49	15:55	B738
150	EGLL	EDDF	13:45	15:15	B738

Table 24: Flight list used in the EXE-07.06.02-VP-713

Appendix C Questionnaire of EXE-0706.02-VP-713 "gaming session"

This is the questionnaire that was prepared by the innovate consortium and used for the human aspects assessment during the EXE-07.06.02-VP-713-A "gaming session".

AU Questionnaire

Your feedback will help us in assessing the Human Performance aspects impacted by the introduction of the EFPL in the Airspace User dispatch operations. Therefore, we would appreciate if you could read carefully the questions below and provide us with as detailed answers as possible.

Thank you in advance for your time and effort!

Name:

Company:

E-mail contact:

1. How would you consider the introduction of EFPL on your operational process?

   □ Significantly Negative □Negative □Neutral □ Positive □ Significantly Positive

   Comment:_____
   _____

2. How would rate your workload considering the introduction of EFPL compared to ICAO FPL operational process?

   □ Significantly more workload □Additional workload but bearable□ Same workload □ Less Workload □ Significantly less Workload

   Comment:_____
   _____

3. How would rate your Situation Awareness (SA) considering the introduction of EFPL compared to ICAO FPL operational process?

   □ Significantly less SA □Less SA □ Same SA □ More SA □ Significantly more SA

   Comment:_____
   _____

4. Do you think that with the introduction of EFPL your error propensity in trajectory planning increases comparing to today's ICAO FPL usage?
   □yes □no

   Comments:_____
   _____

5. Do you think that with the introduction of EFPL your operating methods change comparing to today's ICAO FPL usage?
□yes □no

Comments:_____
_____

5.1 If yes, do the new operating methods support IFPS operators in performing their tasks in an efficient way?
□yes □no

Comments:_____
_____

6. Do you think that the FPL negotiation process (communication) is acceptable when compared to current operations with ICAO FPL is used?
□yes □no

Comments:_____
_____

7. Do you think that for a good integration of EFPL you would need more or less coordination with the NM compared to current operations?
□more □the same □less

Comment:_____
_____

8. Was the coordination with NM clear to you?
□yes □no

Comments:_____
_____

9. Were you able to perform all the modifications in the EFPL (Update, Delay and Cancel)?
□yes □no

Comments:_____
_____

10. Do you think the current HMI efficiently supports you during the EFPL negotiation process?
□yes □no

If no, please explain why:

_____
_____

11. In your opinion, what are the main benefits of the EFPL introduction on your work?

_____
_____
_____

12. In your opinion, what are the possible drawbacks of the EFPL introduction on your work?

_____
_____
_____

13. As a user, are there any major operability or socio-technical issues related to the EFPL use (human-machine interface, human-human, etc) you would like to outline in order to improve your efficiency?
□yes □no

Comment:

_____
_____

14. Do you have any proposals on how to improve the HMI to better support the EFPL negotiation process?
□yes □no

Comment:

_____
_____

15. What information would you consider important to be able to visualize to EFPL operations?

_____
_____
_____

16. How would you prefer to have the validation reply displayed to you in case you need to modify the FPL (text format, visually displayed in the trajectory generated by you, visually displayed in the trajectory of the IFPS operator, other format)?

_____
_____
_____

17. Which ones or which combination from these three (4D trajectory, ToW and performance data) do you consider more important to improve predictability in various operational contexts?

_____
_____
_____

Appendix D Reject reasons leading to the exclusion of a flight from the flight sample.

This appendix lists reject reasons that led to a remove of the related flight from the flight sample. The list is not completely covering the reasons that were used to filter flights but those were an error descriptions is available. Other reasons that were used to filter out flights are

OBJECT_EXCISTS – corresponding to flights via the initial EFPL creation directly led to a reject with this reason. This was mainly caused during the enabling phase of the EFPL filing, during which the data feed from the NM OPS and NMVP was still engaged. During this time FPLs have been copied by EUROCONTROL from the NM OPS to the NMVP. In case the EFPL was filed to NMVP after the ICAO FPL of the corresponding flight was copied from the NM OPS to NMVP, this error was raised for the EFPL to indicate that a flight plan has already been filed;

No reply – corresponding to cases were a format error in the EFPL message or any other technical error led to a situation in which the NMVP was not responding with an XML message. In such cases no reply message was stored on the flight planning system;

INVALID_INPUT without further explanation – corresponding to cases; during the setup phase of the validation exercise; where the reject reason was not completely recorded by the validation prototype.

D.1 INVALID INPUT

D.1.1 Coding of the ICAO aircraft identifier

INVALID_INPUT: INVALID_ATTRIBUTE_VALUE RECEIVED: 763D CONSTRAINT: value does not respect the expected format: ' once the character sequence of one lower or upper case letter A to Z followed by one to three times either one lower or upper case letter A to Z or one digit 0 to 9'

In this case an artificial aircraft identifier was maintained in the flight planning system to cover a special operational case. This identifier is not used in the ICAO FPL, but is used in corresponding EFPLs making them invalid in the flight plan validation. This error is not related to the trajectory that has been planned by the flight dispatcher. A validation of the flight trajectory was not performed by NM. For that reason flights rejected with that error have not been considered in the flight sample as the validation was focusing on the validation of the trajectory. In sum 76 flights were removed from the sample due to this issue.

The issue itself is a matter of data maintenance. That means a change of the software is not required to solve this issue. The only thing that has to be done in this case is a change of the data stored in the system for the respective aircraft type.

D.1.2 Negative airport elevation

INVALID_INPUT INVALID_ATTRIBUTE_VALUE RECEIVED: -3 CONSTRAINT: value must be greater or equal to: '0'

This reject was caused by the implementation of the flight plan validator on NM side. It was built in a way that it is not allowing any negative elevation reported in the EFPL. In most cases this is not an issue, but for a handful of airports the runway reference point has a negative elevation as the airport is located below the mean sea level (MSL). An example is the airport Amsterdam Schiphol, which has an elevation of -3 and -4m below the MSL. All EFPLs to and from this airport have been rejected. The trajectory has not been validated and therefore flights with such a reject have been removed from the flight sample. 602 flights have been removed from the flight sample due to this issue.

This error only occurred during the EXE-07.06.02-VP-713-A “shadow mode” trials that were performed in January 2016. During the trials performed in March this case was not observed

regardless the fact that flights from and to Amsterdam Schiphol have been performed in this time. Therefore it is concluded that this issue has been solved already.

D.2 INVALID REJECTED

D.2.1 Passed of block time

INVALID_REJECTED: (R)EFPM234 - ESTIMATED OFF BLOCK DATE AND TIME IS NOT WITHIN ACCEPTABLE RANGE, AFTER FILING TIME. (EOBD)

In this case the EFPL creation (filing) was done outside of the accepted time range that is defined by IFPS. In such case the ICAO FPL might be rejected too, except a DOF has not been given in the item 18 field of the ICAO flight plan. In the particular case – and this has to be further investigated – such rejects might be related to the implementation of the prototype where the EFPL filing is triggered by the ICAO FPL filing. However, this type of error does not allow any analysis of the trajectory validation result and was therefore removed from the flight sample.

Only a single occurrence of this issue was recorded. The respective flight has been removed from the sample.

D.2.2 Aircraft equipment error

INVALID_REJECTED EFPM167 - FILED PBN REQUIRES CEQPT G

In this case the performance based navigation capabilities of the aircraft were wrongly coded in the EFPL. This only happened for a series of a single aircraft type. In the respective case only a single PBN code was used instead of adding all PBN codes that are representing the full range of capabilities of the respective aircraft. This issue has to be fixed in the flight planning software, which has already been initiated.

This error occurred on 437 flights that have been removed from the flight sample.

-END OF DOCUMENT-