Aircraft Based Concept Developments

Final ABCD Report

This document presents a synthesis of information aiming to support discussions concerning Aircraft Based Concept Developments. It does not represent the position of EUROCONTROL Agency.

DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION	DATE	DESCRIPTION OF EVOLUTION	MODIFICATIONS
0.1	June 30th 2009	First Draft	

SUMMARY

This deliverable (D7) presents the results for Work Package 7 “Final ABCD Report”, as part of the ABCD project aimed to define, prototype and validate an ABCD tool supporting the aircraft operator in flight planning management.

The objective of this Work Package is to summarize and gather the key findings of the whole ABCD project.

The present deliverable:

- Reminds how it was demonstrated through a CBA in WP3 that the ABCD tool is worth the investment at airline level;
- Recalls the operating principles of such a tool and evokes the requirements proposed in WP4.
- Shows how a prototype was designed and developed in WP5 in total compliance with the requirements defined in WP4.
- Reminds briefly how the prototype was tested in WP5 by a regional airline, through a process of verification and validation, and summarizes the feedback of the airline;
- Evokes possible upgrades of the tool proposed in WP6, which would enable to improve the use of the tool in the future, in particular in the context of CDM.

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GLOSSARY

ABCD	Aircraft Based Concept Developments
AOC	Airline Operation Centre
ATC	Air traffic Control
ATFCM	Air Traffic Flow and Capacity Management
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
CASA	Computer Assisted Slot Allocation
CBA	Cost Benefit Analysis
CDM	Collaborative Decision Making
CFMU	Central Flow Management Unit
CIA	CFMU Internet Application
CIAO	CFMU Interface for Aircraft Operators
CTOT	Calculated Take-off Time
DLA	Delay Message
ECAC	European civil aviation conference
EOBT	Estimated Off-Block Time
ETFMS	Enhanced Tactical Flow Management System
FMP	Flow Management Position
TACOT	TACT Automated Command Tool
WP	Work Package

REFERENCES

[1] ABCD: Aircraft Based Concept Developments D1, D2, D3, D4, D4, D6, D8 & D9

[2] Evaluating the true cost to airlines of one minute of airborne or ground delay (2003) (University of Westminster), report commissioned by the Performance Review Commission

1 INTRODUCTION

1.1 Project Context

Air transport punctuality is the "end product" of a complex interrelated chain of operational and strategic processes carried out by different stakeholders (aircraft operators, airports, air navigation service providers) during different time phases and at different levels up to the day of operations. Punctuality is affected by the lack of predictability of operations in the scheduling phases and by the variability of operational performance on the day of operations. Furthermore, part of the unpredictability of a given flight derives from the lack of information about the status of the previous flights using the same aircraft.

1.2 ABCD Concept

The ABCD project, which intends to improve flight predictability and optimise the airline flight planning process at the tactical level (day of operations), has developed a concept based on the linkage of individual flight plans executed by a same aircraft: this concept aims at monitoring the propagation of a delay all along a given aircraft journey, detecting as soon as possible potential reactionary delays (i.e. delays due to the late arrival of the previous flight) and proposing an update of the EOBT in case of conflict with the current flight schedule. Such a concept relies, in addition to the airline schedule, on the information flows (i.e. the messages) exchanged between the CFMU and the airlines, which provide information about flight planning and flight progress.

The objectives underlying the concept are manifold:

- Improve flight predictability and provide a better picture of operations in real time;
- Better anticipate reactionary delays, since they can be detected earlier on the basis of the information available for the previous flight, and consequently:
- Decrease the ATFM delay and optimize the efficiency of the ATFM slot allocation process, which enables to:
- Lessen the delay propagation, i.e. reduce reactionary delays for the subsequent flights, and therefore better control the knock-on effects due to an initial delay.

1.3 Project Background

The first part of the study (WP1 and WP2), carried out in 2007, was aimed at:

- Describing the ABCD concept;
- Defining the user needs and expectations regarding the ABCD concept, thanks to airlines interviews;
- Measuring the impact of delay anticipation on performance and identifying the possible benefits of ABCD, thanks to an analysis of CFMU and airlines' operational data;

Quantitative macroscopic analyses proved that, whatever the information media used for the notification of a delay, the earlier the notification of the delay the lower the ATFM delay. They have also shown that airlines do not generally notify delays more than 20 to 40 minutes in advance. Thanks to the linkage of flight plans, allowed by the aircraft registration number, the ABCD concept would permit to better anticipate delays than nowadays. Delays would be notified earlier to the CFMU, which would result for the delayed flights into a decrease of their ATFM delay. The reduction of ATFM delays would therefore provide aircraft operators with a financial gain related to the cost of delay. For the CFMU and ATM stakeholders, ATFM delay reduction would mean a better use of the available capacity.

Thus, the implementation of an ABCD related tool would bring airlines financial gains and allow the CFMU a better use of the available capacity.

Through the interviews, some airlines asserted their interest in the ABCD concept; especially regional and low-cost airlines because they are not equipped with the real-time operations scheduling tools used by some major carriers and sometimes get the impression that they are unfairly treated by ATFM. Those airlines therefore consider that ABCD would facilitate and optimise the management of delays. However, it was acknowledged that ABCD concept implementation should not be imposed to all aircraft operators since some of them, in particular major airlines, have already in operation some tools whose scopes encompass the ABCD functions and go far beyond the ABCD project objectives. Moreover, in the case of major disruptions, those airlines have the ability and the resources to swap aircraft for a given flight incurring too much delay. Thus, they are reluctant to use an ABCD tool when they have their own ABCD-like tool.

The airlines' interest in the ABCD concept led to the study of an implementation of the concept. Two possible strategies of ABCD implementation were proposed: either a centralised implementation by the CFMU, or a local implementation by airlines. Although the first solution enables to gather the information in a unique central point, it represents a real constraint for the CFMU since it requires that the CFMU database management processes are modified. Furthermore, this centralised solution raises juridical issues between the CFMU and airlines (liability for EOBT changes, etc.) which could not be resolved in the scope of the present project.

When the second phase of the project started in 2008, the local implementation solution was retained. In this strategy, the ABCD tool would be installed as a complementary system to the existing flight plan management system of the airline, providing the Airline Operations Centre with assistance to the management of delay messages (DLA).

The second phase of the ABCD project was structured as a set of seven work packages intended to define, prototype and validate with a local or low-cost airline an ABCD tool that would support the Aircraft Operator in the management of delay (DLA) messages:

- **WP3: Cost Benefits Analysis**. WP3 consists in assessing, through a Cost Benefit Analysis, the economic viability of the ABCD tool when implemented at airline level. The assessment of the benefits is based on fast-time simulations.
- **WP4: ABCD tool prototype definition**. The purpose of this Work Package is to refine the description of the ABCD concept and to define the requirements of the ABCD tool at airline level in order to develop a prototype in Work Package 5.
- **WP5: ABCD tool prototype development**. WP5 consists in developing and testing the functional prototype for the ABCD tool (at airline level) defined in the previous WP4, in cooperation with an airline.
- **WP6: ABCD Tool upgrade.** The aim of this Work Package is to propose upgrades to the ABCD prototype in order to improve the system performance regarding its

primary objective: to reconcile real time operations, flight planning and ATFCM measures.

- **WP7: Final ABCD Report**. WP7 consolidates the work done in the previous WPs and draw conclusions.
- **WP8 and WP9: Unused ATFM slots study.** Those Work Package intend to assess the impact of an earlier notification of DLA messages (thanks to an ABCD-like tool) on the efficiency of the slot allocation mechanism.

1.4 Purpose and scope of the document

The objective of this document is to summarize the WP findings.

1.5 Structure of the document

The present document is structured in four parts:

- Section 1 presents the context of the study and the purpose of the present document;
- Section 2 shows the interest of the ABCD concept at CFMU level and proves the economic viability of the tool when implemented by an airline (Findings of WP3, WP8, and WP9).
- Section 3 describes how the ABCD prototype was defined, developed and validated in cooperation with an airline (Findings of WP4, WP5 and WP6).

2 ABCD VALUE

In the first part of the project (WP1 and WP2), it was showed through qualitative (interviews and examples) and quantitative macroscopic analyses that ABCD could bring tangible benefits to the various ATM stakeholders. The study suggested indeed that the earlier the delay notification, the better the performance of the ATFM slot allocation system. Thus it was inferred that the use of the ABCD tool could result in a better use of the available ATC capacity (capacity improvement for CFMU) and as a consequence in a reduction of ATFM delays (efficiency improvement for airlines). The benefits would therefore be two-tiered: at CFMU level and at airline level.

The benefits were assessed at the two levels (at CFMU level in WP9 and at airline level in WP3), thanks to the support of fast-time simulations performed on real traffic with the TACOT facility which emulates the CFMU operational systems (ETFMS – CASA).

2.1 Overall impact at CFMU level

2.1.1 Rationale and objectives

On the one hand, IRAB pointed out that each year the number of unused ATFM slots is not negligible. On the other hand, studies such as the "Analysis of Unused ATFM Slots 2000" stressed that the ATFM slot allocation mechanism is more efficient when flight data is received as soon as possible by the CFMU.

In the wake of these observations, the ABCD WP8 and WP9 intended to perform an analysis of the impact of delay messages (DLA) anticipation on the ATFM system efficiency. More precisely, the objective of this study was to prove that if tactical flight delays were notified earlier to the CFMU, e.g. by means of an ABCD-like tool, it would have positive effects at network level, i.e.:

- Decrease the number of unused ATFM slots,
- Decrease the ATFM delay incurred by airlines,

while maintaining the same level of overloads.

As a consequence, the project focused on the assessment and the quantification of the **benefits** in terms of **reduction of ATFM delay** and **lost slots** that would be induced by the use of a distributed system like ABCD.

2.1.2 Simulations process

To prove those assumptions and measure the potential benefits, the study relied on fast-time simulations performed at ECAC level on six traffic days taken from the CFMU archives for 2007. The TACOT platform enabled to play different scenarios corresponding to possible changes in the airlines' operational behaviours.

The objective was to carry out a comparative assessment between the baseline situation (replaying the real situation) and several alternative situations where the anticipation of all the delay messages (DLA) was increased by a specific amount of time (-10, -20, -30, -45, -60, -90, -120 minutes).

2.1.3 Simulations Results Analysis

The analysis of results concluded that an earlier notification of delay messages by airlines would improve the ATFM slot allocation efficiency at central level (CFMU) since it would:

- Decrease up to 20% the number of lost slots, increasing the slot usage (cf. Figure 1), and reduce the number of end slots up to 30%, hence a reduction of the bunches at the end of the regulation periods (cf. Figure 2);

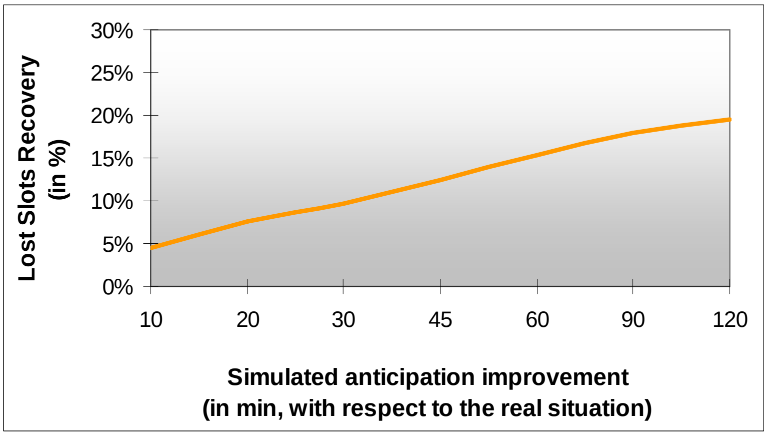

Figure 1: Lost slots recovery vs. DLA anticipation

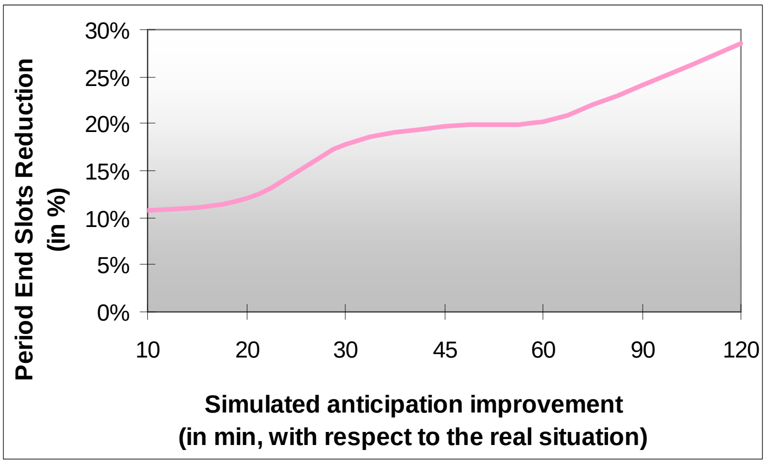

Figure 2: Period end slots recovery vs. DLA anticipation

- Decrease as a consequence the total daily ATFM delay by up to 30% (cf. Figure 3) and the number of delayed flights up to 15%;

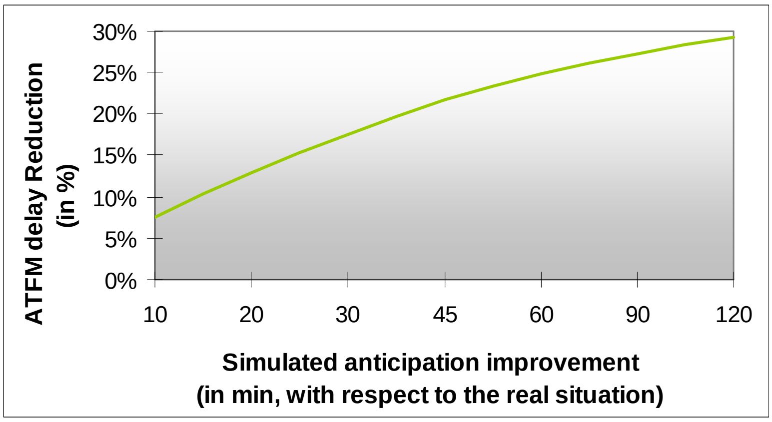

Figure 3: ATFM delay reduction vs. DLA anticipation

- While keeping stable the traffic load (cf. Figure 4), meaning that the performance of the slot allocation system will not decrease significantly.

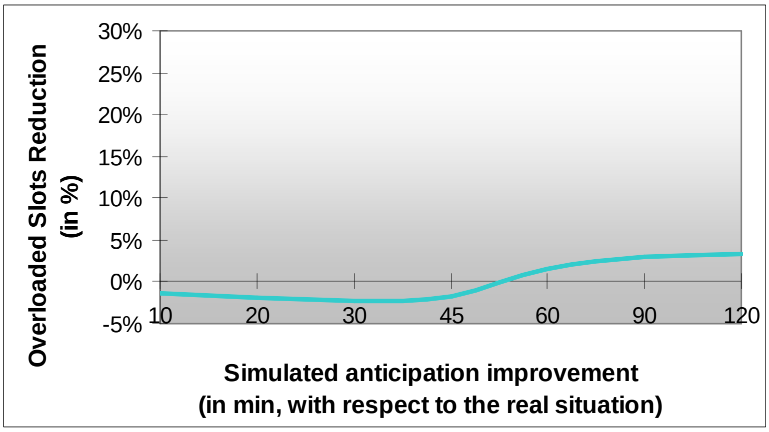

Figure 4: Overload variation vs. DLA anticipation

In addition, the gains stated at the central level (CFMU) were also observed at ATFM local level (FMP), even during the course of one event (i.e. one regulation): a congestion issue is solved much more efficiently by the system if the flight information is known as soon as possible.

The recommendations drawn from the Analysis of Unused ATFM Slots ("the sooner, the better") were therefore validated by the simulations: the earlier the notification of delay messages to the CFMU, the lower the number of unused ATFM slots, the lower the overall ATFM delay, the better the use of the available ATC capacity while maintaining the same level of overloads. Therefore, an ABCD-like tool would contribute to bring such benefits.

Lastly, simulation results confirmed what previous studies showed stating that there is no point in anticipating DLA messages more than two hours in advance, due to the high uncertainty of the information managed with such anticipation.

2.2 Cost Benefit Analysis at airline level

2.2.1 Rationale and objectives

The strategy retained to implement the ABCD concept in the frame of the present study was to develop an ABCD-like tool at airline level, focusing on small airlines. Since in that case, the development costs are borne by airlines, a Cost Benefit Analysis was conducted to assess if an ABCD tool would be worth the investment if the product was implemented by a low-cost airline. In particular, the purpose was to estimate on the one hand the benefits resulting from the use of ABCD – by performing simulations – and on the other hand the costs related to the tool in order to check that the benefits exceed the costs.

2.2.2 Approach to the quantification of the benefits

The benefits generated by the use of an ABCD tool result mainly from a decrease in the delay incurred by the flights operated by an airline using this tool.

The airline chosen for the benefits assessment has the particularity to be a low-cost carrier that tends to notify delays late, and is subject to high ATFM delay in case of very late notification, as shown by Figure 5. A better anticipation of delay messages was therefore likely to lead to a decrease in ATFM delay.

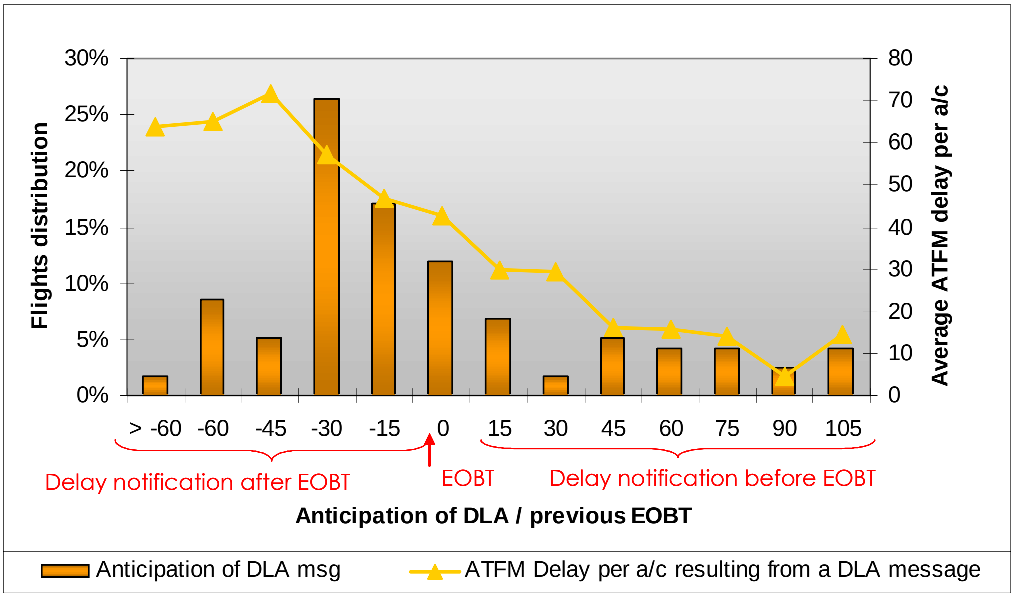

Figure 5 : Flights distribution and ATFM delay per flight according to DLA anticipation

The evaluation of the delay reduction was performed on 8 days of traffic representative of the breakdown of the yearly traffic in terms of ATFM delay and total traffic.

For each of the studied days, flight plans were linked thanks to aircraft schedule information provided by the airline, which allowed to identify reactionary delays and to determine how the use of ABCD would have improved delay anticipation.

To support this assessment, the TACOT facility was used as follows:

- In a first stage, the study only focused on the **direct impact of ABCD use on ATFM delay** for a given flight since an ATFM delay reduction should probably result from a better allocation of ATFM slots. The impact of a possible ATFM delay reduction on the next flights i.e. the reduction of reactionary delays was not taken into account. The modus operandi used to study the ABCD impact at CFMU level (cf. 2.1.2) was reused, but applied at the airline level, instead of ECAC level (i.e. only the DLA messages of the considered airline were assumed to be better anticipated).

- In a second stage, the study focused on **the indirect impact of ABCD use on reactionary delays** for the subsequent flights on the aircraft journey. Reactionary delays should indeed be reduced in the event of lower ATFM delays. To take into account these knock-on effects, the simulation scenarios were played step-by-step: the TACOT facility manager played the role of the AOC staff and exchanged dynamically ad-hoc messages.

It should be noted that the CBA only took into account the benefits due to the reduction of ATFM delays i.e. based on the results of the first simulations stage. This was conservative since lower ATFM delays contribute to lower reactionary delays thus bring additional benefits, as suggested by the results of simulations stage 2.

2.2.3 Simulations results

2.2.3.1 Impact on ATFM delay

i. Impact of anticipation on ATFM delay

Simulations were conducted to study how an earlier notification of DLA messages would impact on the ATFM delay incurred by the airline.

Almost all the simulation runs resulted in a lower ATFM delay, compared to the baseline situation: it proved that the ATFM delay incurred by the airline would decrease if DLA messages could be notified to the CFMU earlier than in today's situation. However at airline level, anticipation and ATFM delay could not be obviously correlated. In particular, the relation was not monotonous and the standard deviation was important. This is why a worst case (Fig. 4) was elaborated in addition to the average case (Fig. 4), each case being an input to the CBA: minimal gains were assessed, given that the real gains cannot be minutely evaluated since their magnitude depends on each operational situation.

For instance, situations were observed during which flights from the same airline tried to book the same slot because they were subject to the same ATFM regulation and took priority over one another, depending on the timeliness of the DLA notification.

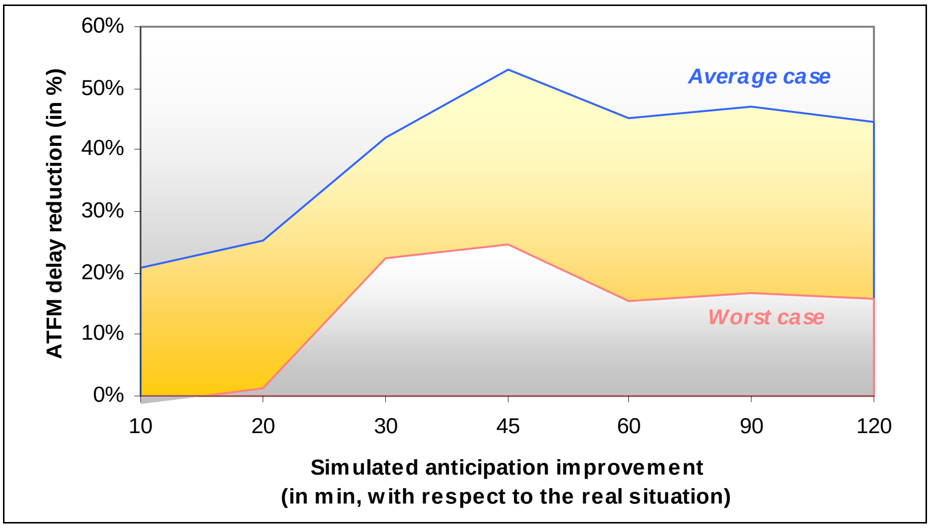

Figure 6: ATFM delay reduction vs. DLA anticipation (for one airline)

ii. Impact of ABCD use on ATFM delay

To evaluate the effective benefits generated by ABCD, the flights that could have used the tool were identified: depending on the day, between 10% and 30% of the flights could have sent their DLA messages earlier thanks to the tool.

Taking into account the statistical weight of each simulated day, the ATFM delay reduction related to ABCD was finally assessed over one year and varies between 1.7 minutes per flight (worst case) and 4.6 minutes per flight (average case), for each flight using the tool. Additional simulations were run to check the consistency of the approach – taking into account the flight plan linkage and the operating principles of the tool. They indicated that even the average case was likely to underestimate the actual gains.

2.2.3.2 Impact on reactionary delay

The second stage aimed to analyse the impact of ABCD on delay propagation and took the form of a case study focused on individual flights rather than on the complete airline fleet.

The repercussion of initial (primary) delays on subsequent flights was observed and simulated in two different ways: on the one hand, it was assumed that the reactionary delays were only known on arrival of the previous flight and were therefore notified to the CFMU at that time; on the other hand, it was assumed that reactionary delays were detected by the ABCD tool, i.e. that the flight plan linkage combined to the CFMU messages analysis enabled the airline to detect a reactionary delay earlier on.

The delay propagation for one aircraft journey is pictured on Figure 7 and Figure 8. The first flight of the journey was initially delayed by 20 minutes and in addition received an ATFM delay (50 minutes). Fig. 5 shows the impact of this initial delay on the subsequent flights: it indicates for each flight of the journey the incurred delay (primary delay and reactionary delay) on the one hand without ABCD use (right-hand bars), on the other hand with ABCD use (left-hand bars).

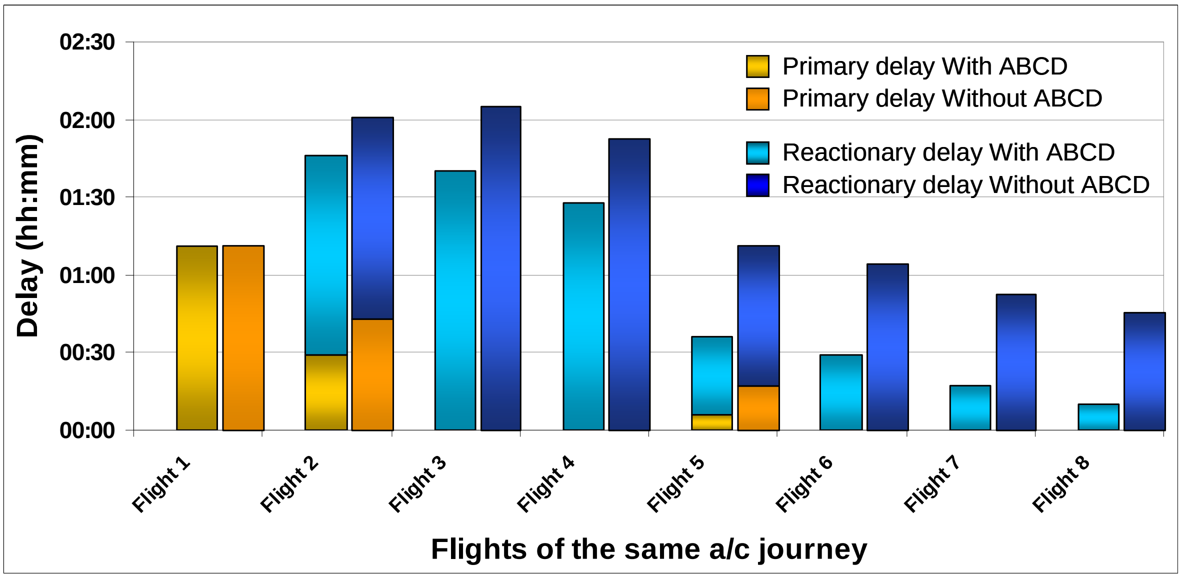

Figure 7: Delay (primary and reactionary) per flight with/without ABCD

This graph confirms that on that journey, ABCD would have allowed a reduction of the ATFM delay (in that case, the primary delay is only due to an ATFM delay, except for flight 1). In addition, it shows that the knock-on effect and the induced reactionary delay would be reduced. The delay reduction (primary and reactionary) is plotted on Fig. 6 for each flight, showing that with ABCD there is increased value to earn all along the flight chain.

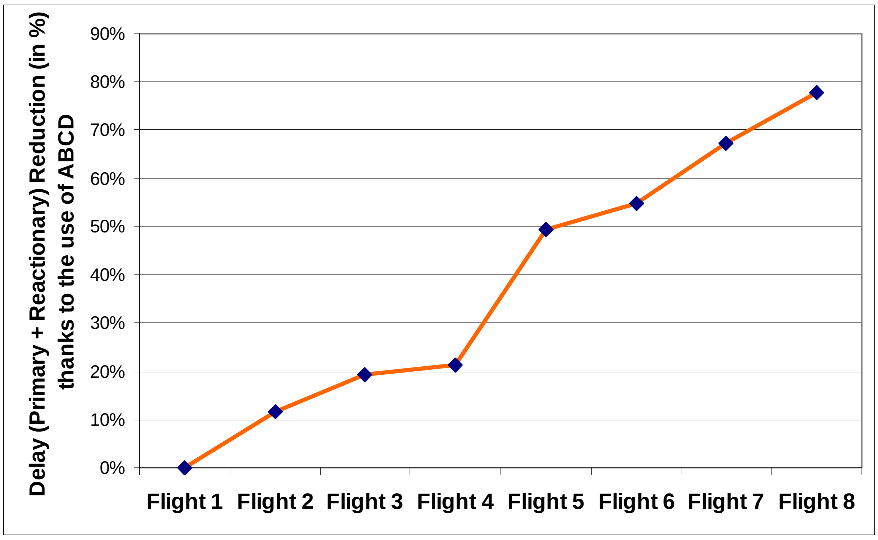

Figure 8: Delay reduction due to the use of ABCD (for a journey)

2.2.4 Cost Benefit Analysis

2.2.4.1 Financial benefits

To translate the benefits into financial gains, only the ATFM delays in excess of 15 minutes (on a per flight basis) were taken into account and cost. The total gain was evaluated thanks to an aircraft model cost based on the marginal cost of one minute of ground delay spent at gate (including crew, maintenance, fuel, aircraft and passenger costs) [2]. The cost of induced delays (reactionary delays and strategic delays i.e. buffers) was disregarded. Therefore not only the delay reduction assessment (cf. 2.2.2) but also the delay costing model of the CBA excluded the benefits related to the reduction of induced delays. With such conservative assumptions, mean cost savings vary between 100€ per flight (worst case) and 300€ per flight (average case) for each flight using the tool. The yearly benefits for the airline, taking into account the whole fleet, vary between 100k€ per annum (worst case) and 250k€ per annum (average case).

2.2.4.2 Costs

Investment costs are limited: ABCD is straightforward to develop, implement and operate. The tool is indeed a piece of software operated with a standard computer and potentially alleviates labour costs because of task automation. Furthermore the integration costs are light since ABCD is a standalone product that shall not impact on existing systems. ABCD implementation cost is therefore composed of a one-off cost corresponding to the development and installation of the tool, and a yearly operating cost corresponding to the maintenance of the product. The foreseen costs are given in Table 1:

Types of costs	Cost
One-off costs	80 000 €
Operating costs (per annum)	7 200 € pa

Table 1: ABCD foreseen costs

2.2.4.3 CBA

Usual economic indicators (net present value, internal rate of return, benefit cost ratio, payback period) were calculated:

- based on the financial results anticipated for ABCD (see previously);
- assuming that the product lifetime lies over ten years;
- assuming that the airline would support all the costs (and would receive all the benefits);

All the economic indicators were positive, even in the worst-case for which the payback period does not exceed two years.

The factors accounting for a positive CBA are:

- the limited investment costs;
- the cumulative effect resulting from a continuous use of the tool even if just a few flights are in a position to use it everyday;
- the size of the airline chosen to perform the CBA: the larger the airline, the higher the daily number of flights benefiting from the tool. The critical size to break even is close to one hundred flights a day. Given that the CBA is conservative, it should actually be even lower and include most of the regional/low-cost carriers.

Therefore it can be stated confidently that for such airlines the ABCD tool is worth the investment.

3 ABCD PROTOTYPING

3.1 ABCD Prototype Definition

The ABCD concept implementation phase was initiated in WP4 by the definition of the ABCD prototype to be developed and tested at real airline activity.

3.1.1 ABCD prototype operating principles

The envisaged ABCD tool will be installed within the airline environment as a complementary system to the current flight plan management system, providing the airline operations centre (AOC) with assistance to flight planning and DLA messages management. The principle of the tool relies on the detection of reactionary delays – i.e. delays due to the late arrival of the previous flight – thanks to the linkage of flight plans. The ABCD tool will not interact directly with the CFMU; any interchange of information will only be done with the airline systems, and without interfering with the normal operations of the airline.

Like any information management system, the ABCD tool will receive, process and provide information. As output, ABCD will provide the AOC with the information that allows the user to decide when to send a new DLA message together with the optimum EOBT proposal. The ABCD tool will require as input, to be provided by the airline systems, the set of messages interchanged by the airline with the CFMU and other systems to update the flight planning; and other planning information not included in the messages such as the aircraft allocation data to perform the linkage of the flight plans and minimum turn around times. The information will be managed by an internal database which continually checks that the flights can comply with their current EOBT (or CTOT if regulated) (cf. Figure 7).

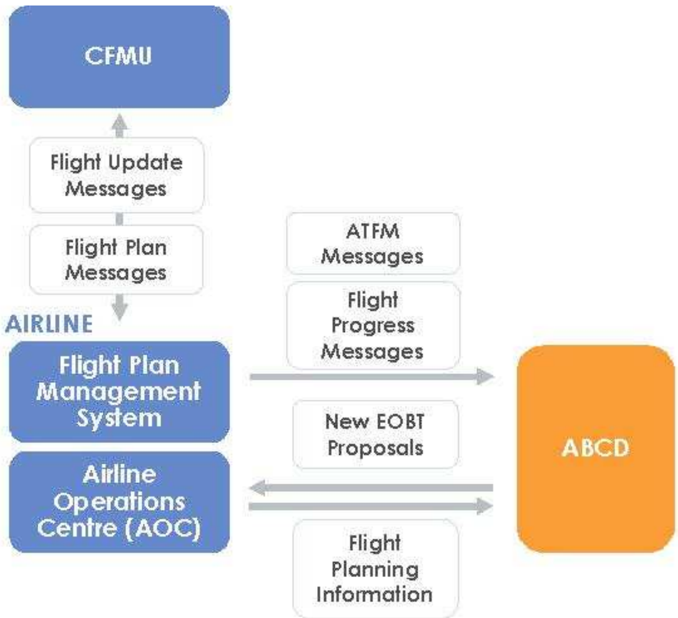

Figure 9: ABCD prototype environment

3.1.2 ABCD prototype operational services

ABCD prototype operational services were defined according to 5 levels, which provide the airline with the flexibility to choose the required service for each situation:

- Level 0 allows the user to monitor reactionary delays;
- Levels 1 and 2 detect reactionary delays and propose flight plan updates (new EOBT), taking into account (level 2) or not (level 1) stability criteria;
- Level 3 provides an automated DLA management service: preparation and proposal of DLA messages;
- Level 4 corresponds to a full automation of the DLA management function (not specified for the prototype development)1 that would allow the ABCD tool to send the DLA messages directly to the CFMU.

A set of functional requirements was defined to provide the user with those services: user interface requirements; airline system requirements; requirements internal to the ABCD system.

They are the minimum requirements required to allow the prototyping of a generic ABCD tool.

3.1.3 Additional functions

Upgrades to the tool were proposed in WP6 in order to improve the system performance regarding its primary objective: to reconcile real time operations, flight planning and ATFCM measures. The initial concept, based on the linkage of the individual flight plans executed by the same aircraft, aims to detect as soon as possible potential reactionary delays for successive flights and propose as a consequence departure time updates.

To enhance the concept, three types of options were investigated in this Work Package:

- **Interoperability of ABCD with CFMU applications**: ABCD could access some data provided by CFMU services, such as the NOP portal (which replaces the CFMU Internet Application – CIA) and the CFMU Interface for Aircraft Operators – CIAO. This would improve the accuracy of the ABCD database contents;
- **Compatibility between ABCD and Airport CDM**: to avoid any interference with CDM it is proposed to deactivate the EOBT proposal function for any flight departing from a CDM airport. This will not prevent ABCD from updating its database and proposing updates for the other flights;
- **What-if mode**: a new mode of operations is envisaged taking into account slot proposal / rerouting proposal / slot swapping opportunities. It will provide the user with an analysis of the impact of a potential new CTOT (or rerouting) on the next flights and therefore help him to choose such-and-such solution.

It has to be noted that those functions are not taken into account in the current prototype development.

[1] Level 4 is only proposed to exhaust all the possibilities opened up by the concept. The implementation of level 4 is currently not anticipated, due to legal impediments.

3.2 ABCD prototype development and validation

The requirements drafted in WP4 were used as input for the development of the ABCD tool prototype conducted in WP5. These initial requirements were revised and adapted by the ALG Software development team in order to align it to the specific requirements introduced by the development process and the envisaged verification and validation activities.

Additionally, the ABCD prototype was designed in line with the operational requirements of the chosen airline for the verification and validation processes, that is to say Air Nostrum.

Based on these refined requirements the tool architecture was initially designed. ABCD prototype was developed for Windows, using Visual Basic.Net as programming language and a SQL Server 2005 data base.

The prototype development approach proposed by the ALG Software development team implied a continuous verification and validation process of the tool:

- **Verification at virtual level**. The objective was to ensure that the tool prototype behaves as specified, aiming to answer the question: "are we building the tool right?". This verification consisted of the following activities:
    - Simulation of the ABCD software at a test environment using real data from the activity of an airline;
    - Calibration and preparation of the ABCD tool previous to the validation at airline level.

This verification, supported by the recording of videos of ABCD in operation, confirmed that the ABCD prototype software was correctly developed in full compliance with the initial requirements defined in WP4 as well as with the airline operating conditions.

- **Validation at airline level**. The objective was to ensure that the tool prototype responds to the operational needs, aiming to answer the question: "are we building the right tool?". This validation consisted of the following activities:
    - Implementation of the prototype tool at the AOC environment of the airline and on-site calibration of the tool;
    - Monitoring airline activity using ABCD;
    - Final acceptance of the ABCD prototype.

On-site validation was successfully performed by Air Nostrum operators from Flight Operations department, where HMI design and tool functionalities were validated: the tool is clear, intuitive, quick, and fulfils its main purpose, i.e. make EOBT proposals. Air Nostrum accepted therefore validation results and confirmed their interest in ABCD as flight planning support tool. The regional airline also suggested incorporating possible upgrades to the prototype in order to enhance data consistency and tool functionalities.

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