



## TWELFTH AIR NAVIGATION CONFERENCE

Montréal, 19 to 30 November 2012

### Agenda Item 6: Future directions

#### 6.1: Implementation plans and methodologies

### ICAO FUEL SAVINGS ESTIMATION TOOL

(Presented by the Secretariat)

#### 1. INTRODUCTION

1.1 Operational improvements are a key strategy that can be applied to deliver tangible reductions in aircraft fuel consumption. The *Global Air Navigation Plan* (Doc 9750, GANP) and several other documents provide guidance regarding operational improvements being implemented to improve efficiency of the air traffic management (ATM) system.

1.2 However, until recently a tool to assist those States without an automated means to estimate, model or report those benefits in a harmonized way, had not been available.

#### 2. DISCUSSION

2.1 The ICAO fuel savings estimation tool (IFSET) was developed for global application and has the ability to capture the difference in flight trajectory performance in terms of fuel consumption before and after implementation of operational improvements at a local or regional level.

2.2 The tool is to assist States and air navigation service providers (ANSPs) to estimate and report fuel savings consistently with the models approved by ICAO's Committee on Aviation Environmental Protection (CAEP) and aligned with GANP. IFSET can help States measure the benefits from:

- a) shortening/eliminating level segments on departure and arrival routes;
- b) shorter routes (either in time or distance);
- c) cruising at different altitudes; and
- d) reducing taxi times.

2.3 The tool is not intended to replace the use of detailed measurement or modelling of fuel savings, where those capabilities already exist today. Rather, it is provided to assist those States and ANSPs without such facilities to estimate the benefits from operational improvements.

2.4 Fuel savings can be enabled through the implementation of operational improvements in general categories such as reduced cruise time or distance, availability of optimal altitude, reduced taxi time and more efficient departure and approach/arrival procedures.

2.5 Simplifying assumptions are made regarding, inter alia, aircraft weight, aircraft centre of gravity (CG), engine thrust setting, meteorology, airframe/engine combinations, etc. As a result, the tool is not suitable for assessing the effects related to aircraft weight, thrust settings, or differences between aircraft/engine models.

2.6 The tool is intended to report differences in the fuel consumption based on the comparison of two scenarios and it is not appropriate to use the tool to compute the absolute fuel consumption for a specific procedure. It cannot be used for flight planning purposes or any other purpose that may affect safety of operations.

2.7 The tool will estimate the difference in fuel mass consumed by comparing a pre-implementation (i.e. “baseline”) case against a post-implementation case (i.e. “after operational improvements”), as detailed in the appendix to this paper.

2.8 The tool as well as the user’s guide can be downloaded from the ICAO website at: <http://www.icao.int/environmental-protection/Pages/Tools.aspx>.

### 3. CONCLUSION

3.1 IFSET, as an easy to use tool will allow States and ANSPs that do not currently have the capability to do so, to estimate the benefits that operational improvements will bring to environment in terms of fuel and emissions savings. The data collected will be used by ICAO to produce an annual global environmental report highlighting the operational improvements and benefits as an indication of positive environmental stewardship.

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## APPENDIX

### ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET)

#### 1. Fluxogram

The tool will estimate the difference in fuel mass consumed by comparing a pre-implementation (i.e. “baseline”) case against a post-implementation case (i.e. “after operational improvements”), as illustrated notionally in Figures 1 and 2.

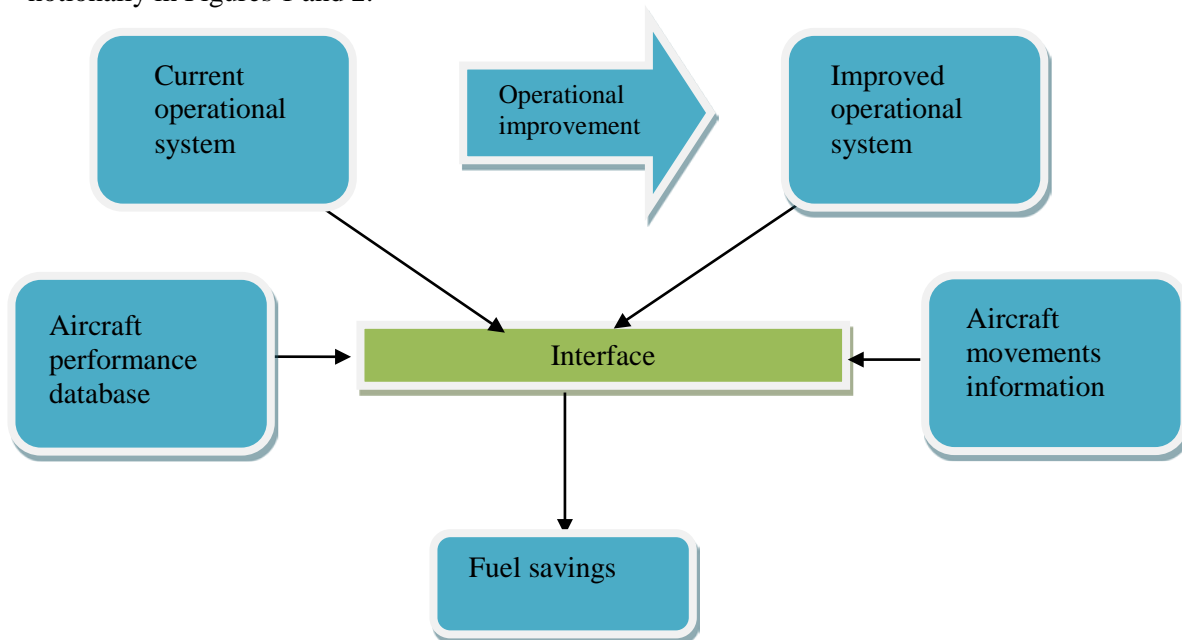


Figure 1. Notional fluxogram

The selection of the baseline case is an important step of the process. It will be defined by the user and could correspond to:

- a) the published or planned procedure (AIP, flight plan) scenarios;
- b) the daily practices;
- c) a combination of the two; and
- d) other criteria as appropriate.

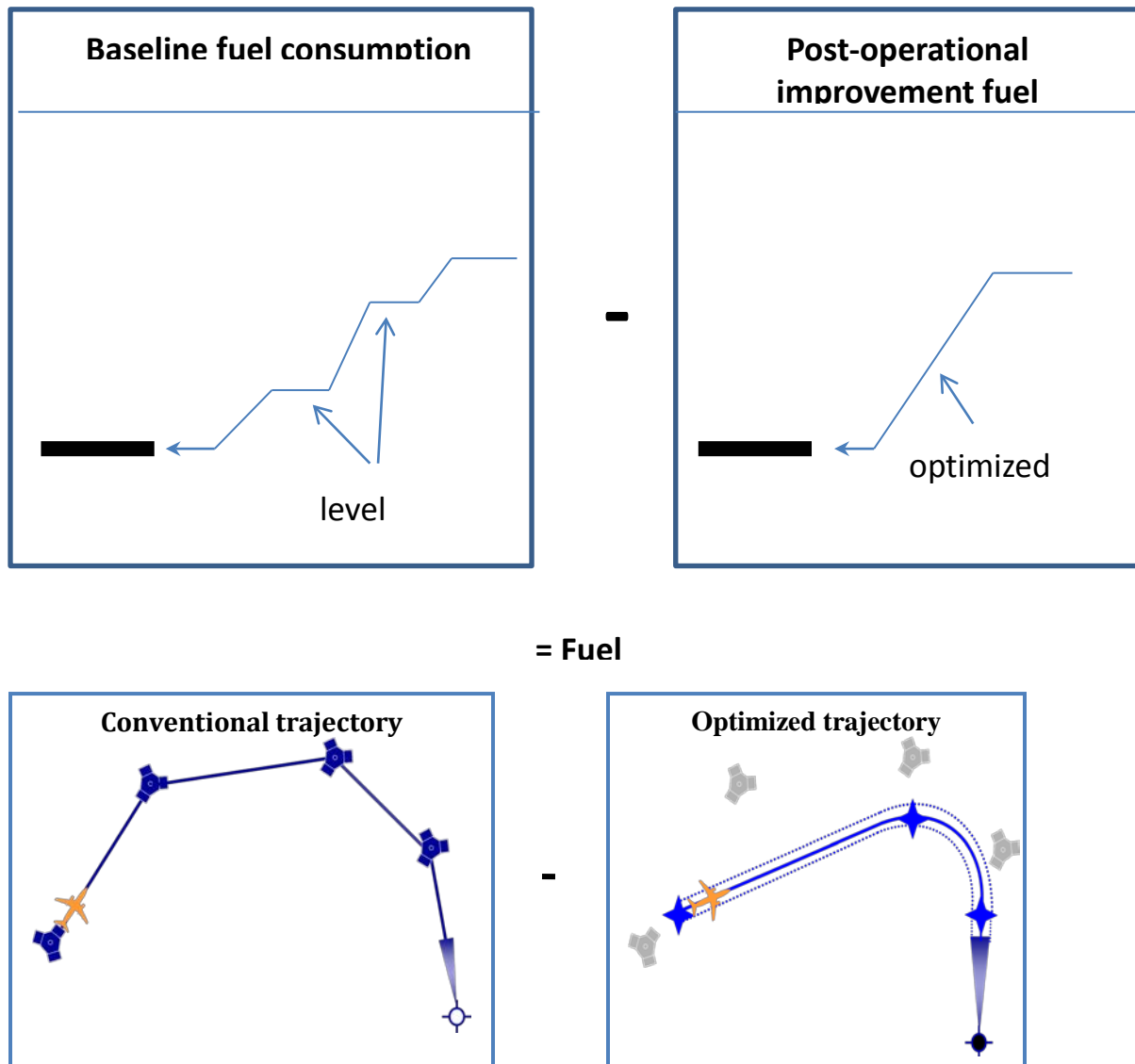


Figure 2. Notional illustration of fuel savings

In order to compute the fuel consumed in two different scenarios, the following information listed in Table 1 will be required for both scenarios.

- Number of operations by aircraft category

Also, a combination of the following elements that describes both scenarios:

- Average taxi time
- Time spent or distance flown at a specific altitude
- Top of descent altitude and bottom of descent altitude
- Base of climb altitude and top of climb altitude
- Distance flown in a climb or descend procedure

Table 1. Data required for computing fuel consumption changes

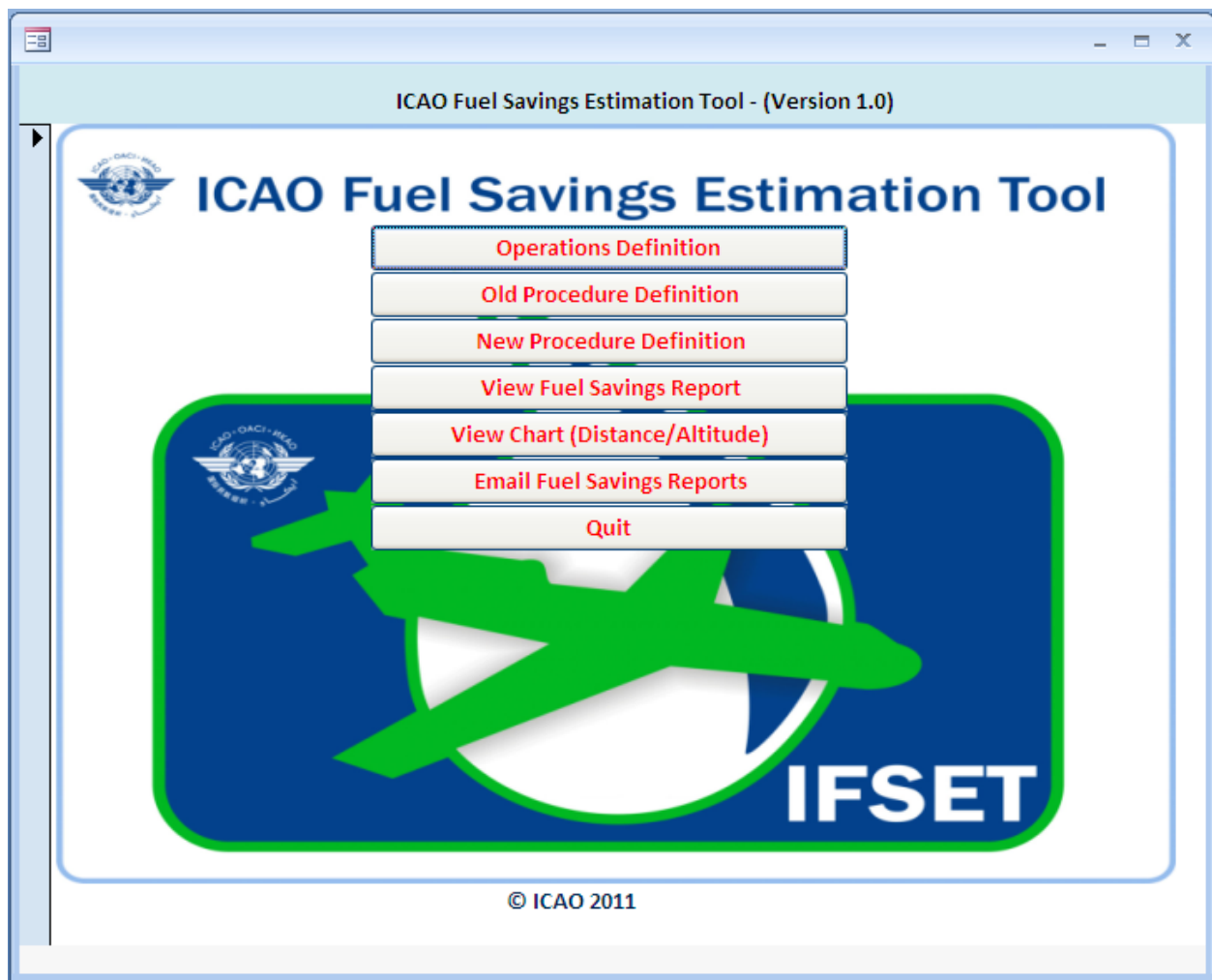
## 2. Requirements

The tool is a Microsoft Windows application that requires running an operating system of Windows XP or newer. The user interface is intended to be easy to use, requiring minimal input from the user. All analyses begin with describing the baseline and post-implementation cases. As defined in Table 2, the user begins by specifying the number of operations in both scenarios.

This is accomplished by selecting the aircraft categories from a dropdown list and then entering the number of operations. The number of operations entered can be hourly, daily, annually, etc. The resultant fuel savings will be reported on the same basis. The reason that the operations need to be defined in both cases is to permit the consideration of procedures that will only be available to properly equipped aircraft.

## 3. The tool step by step

### 3.1 Main screen



## INPUT

Start by selecting the **Operations Definition** tab, the following screen opens.

### 3.2 Operations definition

STEP 1 - OPERATIONS DEFINITION  
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Scenario Name

New Delete Return Find

Aircraft	Base Flights	New Flights	Continuing Old Flights	Remaining Trip (nm)

Save Delete Help

Record: 14 of 6 No Filter Search

#### Command buttons on this screen (top)

**New** – will open a blank screen allowing users to input new scenarios.

**Delete** – will delete the scenario, the aircraft mix and all associated operational definitions.

**Return** – will bring the user to the main screen.

**Find** – will enable the users to select an appropriate scenario among multiple scenarios saved in the database. After selection the scenario can be deleted or the aircraft mix on the second half of the screen can be edited.

#### Command buttons on this screen (bottom)

**Save** – will save this scenario and the related aircraft mix.

**Delete** – the user can select a row associated with an aircraft, the number of operations and remaining trip distance and delete that row.

**Help** – the user can see the various aircraft types and the associated aircraft categories so that he/she can make an appropriate input of the required aircraft type.

Clicking on **Return** will bring you to the main screen where the user will select **Old Procedure Definition**.

**INPUT**

**Scenario Name** – give a descriptive name for the operational scenario.

**Aircraft** – input the aircraft mix relating to the scenario under the aircraft category column from a drop down list. If required make use of the Help button indicated earlier to help in the selection of the appropriate aircraft category.

**Base Flights** – indicate the number of flights under the old operational scenario.

**New Flights** – indicate the number of flights under the new operational scenario. It means the number of operations benefiting from the operational improvement.

**Continuing Old Flights** – indicates those flights though being part of the new operational scenario continues to follow the old operational definitions. It means number of operations not benefiting from the operational improvement.

**Remaining Trip Distance** – is the average stage length in nautical miles (NM) appropriate for the aircraft category selected. If not known, the tool assumes a default value based on data already tested.

Click **Save** – it will save this scenario and the related aircraft category mix.

Click **Return** – it will bring the user back to the main screen.

### 3.3 Old procedure definition

**STEP 2 - OLD PROCEDURE DEFINITION**  
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Scenario Name

Action	From Alt(ft)	To Alt(ft)	Distance(nm)	Time(sec)
<input type="button" value="v"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Record: 6 of 6     No Filter

**Find the Scenario Name** which you have entered earlier under the Operations definition by clicking the **Find** Button. Select the Scenario Name and either add or edit appropriate actions associated to the operational procedures for the selected scenario. The scenario name on this screen is locked and no entry is allowed.

Navigate to the second half of the screen and enter the **Action** followed under the old operational procedures. The allowable actions are Level, Descend, Climb and Taxi selected from a drop down list.

For “Level” Action either the distance in nautical miles or time in seconds can be entered.

For “Taxi” Action only time in seconds can be entered.

For all actions except “Taxi” enter the “From” and “To” altitudes in feet. For the level action the “To” altitude will be automatically entered after entering the “From” altitude and clicking the “Tab” button.

For “Climb” or “Descend” actions, if there are variations in distance or time, the distances or time flown during climbing or descending shall be also entered.

#### Command buttons on this screen (top)

**Find** – as explained above, this allows the user to select the scenario name entered earlier under operations definition and either add or edit appropriate old operational procedures for the selected scenario.

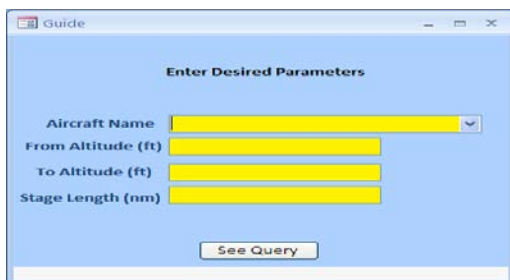
**Return** – will bring the user to the main screen.

#### Command buttons on this screen (bottom)

**Save** – will save the action associated to the procedure definitions for the selected scenario.

**Delete** – will enable the user to select a row of **Action** and delete it.

**Help** – The user can select an aircraft category and enter the altitudes associated with a climb or a descend phase and the stage length as shown below.

The image shows a screenshot of a software window titled "Guide". Inside the window, there is a section titled "Enter Desired Parameters". This section contains four input fields: "Aircraft Name" (a dropdown menu), "From Altitude (ft)" (a text box), "To Altitude (ft)" (a text box), and "Stage Length (nm)" (a text box). Below these fields is a button labeled "See Query". The entire form is set against a light blue background.

On generating the query the user can view the distance in nautical miles, time in seconds and speed (kt) for his/her selection criteria which is static in the database and inherent to the model.

The distance and time will act as a guide to the user to input meaningful distances or time especially when the savings in distance or time associated with a new procedure is known but where the overall distances or time involved under an old procedure are not known.

Clicking on **Return** will bring the user back to the main screen where the user selects **New Procedure Definition**.



## 3.4 New procedure definition

A screen identical to the **Old Procedure Definition** will open.

Enter the new operational procedures associated with the selected scenario as described under the **Old Procedure Definition**. All the command buttons in this screen are identical to the ones explained under the Old Procedure Definition.

Clicking on **Return** will bring you to the main screen where the user can select **View Full Burn Report**.

## 3.5 View chart (distance/altitude)

On clicking the **View Chart** tab a diagram indicating the phases of flight being analyzed will be shown.

## 3.6 Report generation

On clicking the **View Fuel Savings Report** tab, the consolidated report will be displayed as in the screen below.

Fuel Savings Report

Estimated Fuel Savings Report				
© ICAO 2011				
Scenario	Old Fuel Consumption (Kg)	New_Fuel_Consumption (Kg)	Savings (Kg)	Savings (%)
Ex1	412400	357400	-55000	-13.3
Export to Excel		Detailed Fuel Savings Report		

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The fuel consumption in kg under old and new operational definitions for each scenario will be displayed along with the estimated savings.

*RMK: The savings displayed in the report represents the benefits of reduced fuel consumption due to the adoption of new operational procedures and is restricted only to the phase of flight defined under each scenario.*

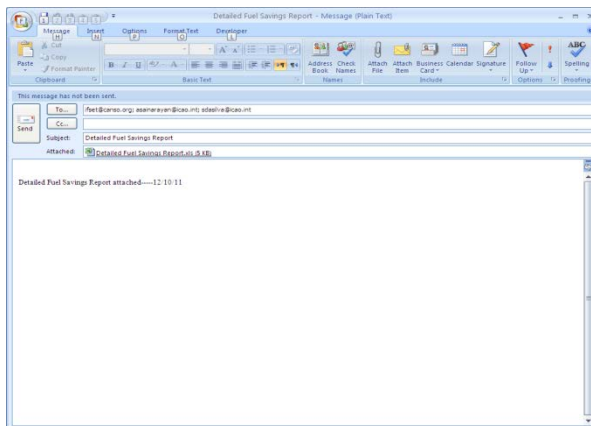
The user also has the option to generate the detailed report by action or phase of flight by just clicking the **Detailed Fuel Savings Report** key.

### 3.7 Report generation in Excel

To facilitate the exchange of messages or summation of results, the user can also export the results to an Excel file. For this, just click the **Export to Excel** key. An Excel file of the report will be generated for the user's information and can be stored by the user in a desired directory on his/her computer.

### 3.8 Sending the report via Email

The report can be sent automatically to the people in charge of generating the global report by just clicking the **Email Fuel Savings Report** key. A message will be automatically generated to the group in charge of generating the global report through Microsoft Outlook with the attachment of the Detailed Fuel Savings Report.



— END —