International Civil Aviation Organization

MIDANPIRG CNS/ATM/IC Sub-Group (CNS/ATM/IC SG)

Sixth Meeting
(Cairo, Egypt, 31 January – 02 February 2012)

Agenda Item 4: MID Region Air navigation performance based approach

ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET), AND MEASUREMENT OF ENVIRONMENT BENEFITS FROM OPERATION IMPROVEMENTS

(Presented by the Secretariat)

SUMMARY

Different initiatives are in place to improve the efficiency of the ATM system and one of the results of the ongoing improvements is the reduction in fuel consumption by aircraft capable of using the new procedures, concepts of operations or technologies. This paper addresses the need to measure the benefits accrued from operational improvements and proposes the terms of reference to a dedicated group for this task as well as a form to report the benefits.

Action by the meeting is at paragraph 4.

This working paper relates to Strategic Objective Environmental Protection and Sustainable Development of Air transport

1. BACKGROUND

1.1 The *Global Air Traffic Management Operational Concept* (Doc 9854), endorsed by the 11th Air navigation Conference (2003) describes the expectations of the ATM community in 11 key performance areas. One of them is environment, and the endorsed vision is that the ATM system should be environmentally sustainable.

1.2 At the 37th Assembly (2010), resolution A37-19 calls upon the States to develop and implement procedures to reduce aviation emissions.

1.3 Several operational improvements are being planned and implemented at global, regional or local levels and to effectively manage the implementation, measurement mechanisms should be put in place.

1.4 The purpose of this paper is to propose a mechanism to estimate and report the environment benefits accrued from operational improvements aligned with the Assembly Resolutions in force and also to propose an annual environmental report outlining the operational improvement benefits as an indication of positive environmental stewardship.

2. INTRODUCTION

2.1 It is generally an accepted fact that climate change can pose threats to life on our planet. The aviation world has long recognized this reality as well as the benefits that air transportation brings to world development.

2.2 The aviation industry's wish to grow in a sustainable manner coupled with the global desire to reduce the impact of aviation on climate change has triggered several actions by the ATM community such as investing in new technologies and applying new concepts of operations to reduce emissions from aviation.

2.3 The experience of the ATM community in applying Standards and Recommended Practices as well as Procedures for Air Navigation Services has already set in motion several plans to respond to the aviation impact on climate change.

2.4 Bearing in mind that the aviation sector is responsible for the movement of billions of people and million tonnes of goods per year while providing employment for millions of people, it is evident that flight operations today are much more efficient than they were 40 years ago. However, the improvements have not stopped the ATM community from continuing to study and apply new concepts and procedures to reduce the impact of aviation green house gas emissions on the global climate. Clear progress is being achieved in the provisions of well-structured services that improve efficiency and impact directly on the reduction of fuel consumption and gas emissions.

2.5 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) and the Operational Opportunities to Minimize Fuel Use and Reduce Emissions (Circular 303) are among several documents providing guidance regarding operational improvements being implemented to improve efficiency of the ATM System.

3. DISCUSSION

3.1 Against a background of increasing concern regarding the impact of aircraft engine emissions on the environment, ICAO has been considering what steps could be taken by the international aviation community to control and measure emissions.

3.2 Implementation of operational improvements will generally have benefits in areas such as improved airport and airspace capacity, shorter cruise, climb and descend times through the use of more optimized routes, and an increase of unimpeded taxi times. These improvements have the potential to reduce fuel burn and lower levels of pollutants.

3.3 Calculation of aviation emissions is dependent on several different factors including the number and type of aircraft operations, the type and efficiency of the aircraft engines, the type of fuel used, the length of flight, the power setting, the time spent at each stage of flight, and the location (altitude) at which exhaust gases are emitted.

3.4 Specifically for operational improvements benefit analyses, it is necessary to have data that can reflect the operational changes and depending on the need, there are different levels of analysis possible: order of magnitude, simple consideration of CO2 based on fuel burn, detailed modelling of all emissions parameters, and variations in between. However, to-date, a tool to assist those States without an automated means to estimate, model or report those benefits in a harmonized way, has not been available.

3.5 The main purpose of this paper is to request the estimation and reporting of fuel savings resulting from national or regional operational improvements through the use of a simple tool (ICAO Fuel Savings Estimation Tool - IFSET) specifically designed for this purpose and that do not require any specific skills from the user.

3.6 The tool is to assist the States to estimate and report fuel savings consistently with the models approved by ICAO's Committee on Aviation Environmental Protection (CAEP) and aligned with the Global Air Navigation Plan. IFSET can help States measure benefits from:

- shortening/eliminating level segments on departure and arrival route;
- shorter ATS – Routes (either in time or distance)
- cruising at different altitudes/levels
- reduction in taxi times.

3.7 The tool is not intended to replace the use of detailed measurement or modelling of fuel savings, where those capabilities exist. Rather, it is provided to assist those States or ANSPs without such facilities to estimate the benefits from operational improvements. Details on the tool are provided at **Appendix A** to this working paper.

3.8 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.

3.9 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 affects safety of operations.

3.10 To have all the necessary data to generate an annual report, it is proposed that any operational improvement being planned or implemented by a State/ANSP or the region should use IFSET or a more advanced model / measurement capability and report, at least, the data proposed using the table to report environmental benefits of operational improvements as at **Appendix B** to this working paper.

3.11 It is proposed that the benefits be sent to ICAO as soon as the State/Region has the definition of the improvements to be made, considering that this information will be used for the generation of the ATM environment report to be issued by the end of 2012.

3.12 For the purpose of estimation and reporting of fuel savings from operational improvements; it is proposed to establish an Air Traffic Management Measurement Task Force (ATM – M TF) dedicated to the measurement process, with proposed terms of reference as at **Appendix C** to this working paper. Accordingly the meeting may wish to agree to the following Draft Decision;

Why	To measure ATM performance
What	Establish ATM measurement TF
Who	States and CNS/ATM/IC SG
When	MIDANPIRG/13 Meeting

DRAFT DECISION 6/X: ***ESTABLISHMENT OF THE AIR TRAFFIC MANAGEMENT MEASUREMENT TASK FORCE (ATM M TF)***

That, the ATM M TF be established with Terms of Reference (TOR) as at ***Appendix*** **C** to this working paper.

3.13 It is also proposed that all States/ANSPs in the region start reporting the benefits as they plan or implement any type of operational improvement. it is proposed that the results are sent to ICAO as soon the analysis is done or on quarterly basis using the form proposed in **Appendix B** to this working paper.

3.14 Considering the need to have a clearly defined regional approach for using IFSET as a tool for estimating environment benefits, the meeting is invited to agree to the following Draft Conclusion;

Why	measure the benefits from ATM operations
What	reduce CO2 emission from International CAA
Who	States, ATM/M TF and CNS/ATM/IC SG
When	MIDANPIRG/13 Meeting

DRAFT CONCLUSION 6/X: ***ESTIMATING ENVIRONMENT BENEFITS***

That,

a) *MID States be urged to use IFSET or a more advanced model/measurement capability available to estimate environment benefits accrued from operational improvements the benefits should be reported as soon as the analysis is finished or on a quarterly basis to ICAO; and*

b) *agree that all plans to implement operational improvements shall encompass an environmental benefits analysis.*

4. ACTION BY THE MEETING

4.1 The meeting is invited to:

a) review and agree with the proposed form at **Appendix B** to this working paper for reporting benefits

b) agree to the establishment of an Air Traffic Management Measurement Task Force (ATM – M TF) per the Draft Decision in para 3.12; and

c) agree to Draft Conclusion in para 3.14

CNS/ATM/IC SG/6-WP/8
APPENDIX A

2011

ICAO FUEL SAVINGS ESTIMATION TOOL (IFSET) USER'S GUIDE

V3

13/10/2011

TABLE OF CONTENTS

1-Introduction

Against a background of increasing concern regarding the impact of aircraft engine emissions on the environment, the ability to adequately estimate fuel burn and emissions savings accrued from operational improvements being put in place by all members of the ATM community on a system wide scale is of high importance.

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) and the Operational Opportunities to Minimize Fuel Use and Reduce Emissions (Circular 303) are among several documents providing guidance regarding operational improvements being implemented to improve efficiency of the ATM System.

However, to-date, a tool to assist those States without an automated means to estimate, model or report those benefits in a harmonized way, has not been available.

This *User's Guide* will detail the steps that the user of this application follows to generate the estimated fuel savings from the implementation of operational improvements.

2-Objective

This document describes the ICAO Fuel Savings Estimation Tool (IFSET) developed to be applicable globally with the ability to capture the difference in flight trajectory performance in terms of fuel consumption before and after implementation of operational improvements at local, regional or global level.

The tool is to assist the States to estimate and report fuel savings consistently with the models approved by ICAO's Committee on Aviation Environmental Protection (CAEP) and aligned with the Global Air Navigation Plan.

3-Description

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

Fuel savings can be enabled through the implementation of operational improvements in the general categories listed in Table 1.

Table 1. Operational improvements to be evaluated by IFSET.

• Reduced cruise distance or time • Availability of optimal (preferred) altitude • Reduced taxi time • More efficient departure and approach/arrival procedures

4-Assumptions

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.

The tool is intended to report differences in fuel consumption based on the comparison of two scenarios and therefore 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.

5-Methodology

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.

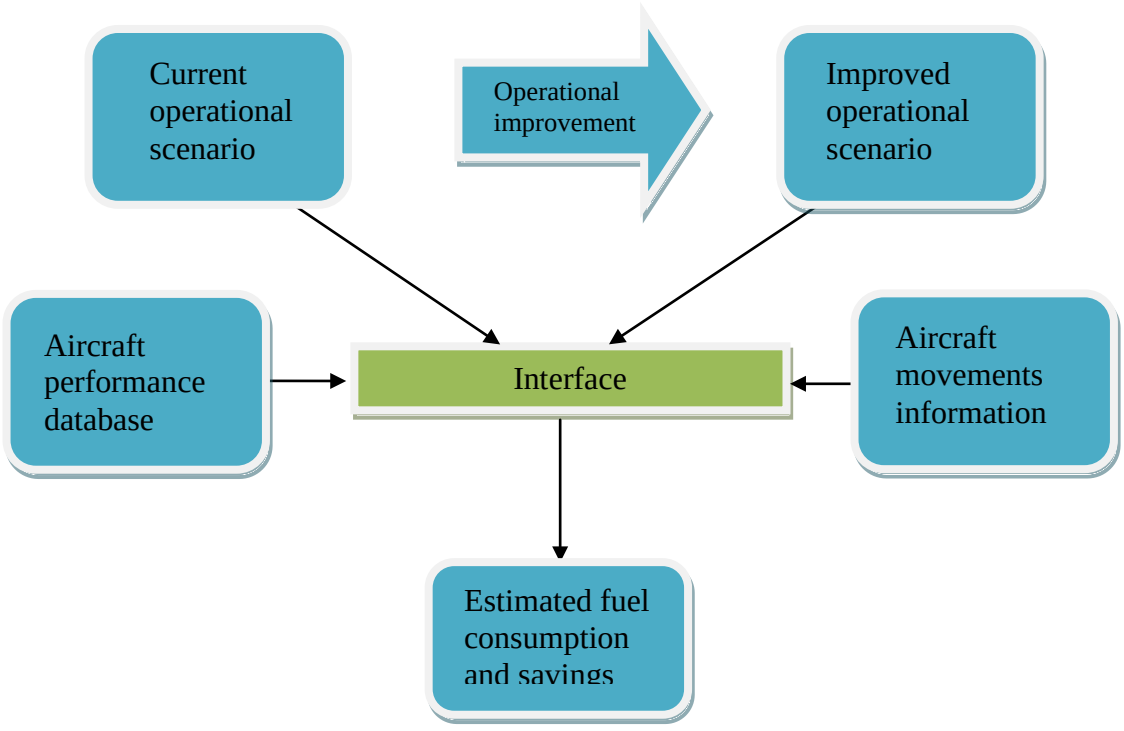


Figure 1. Notional fluxogram.

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

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

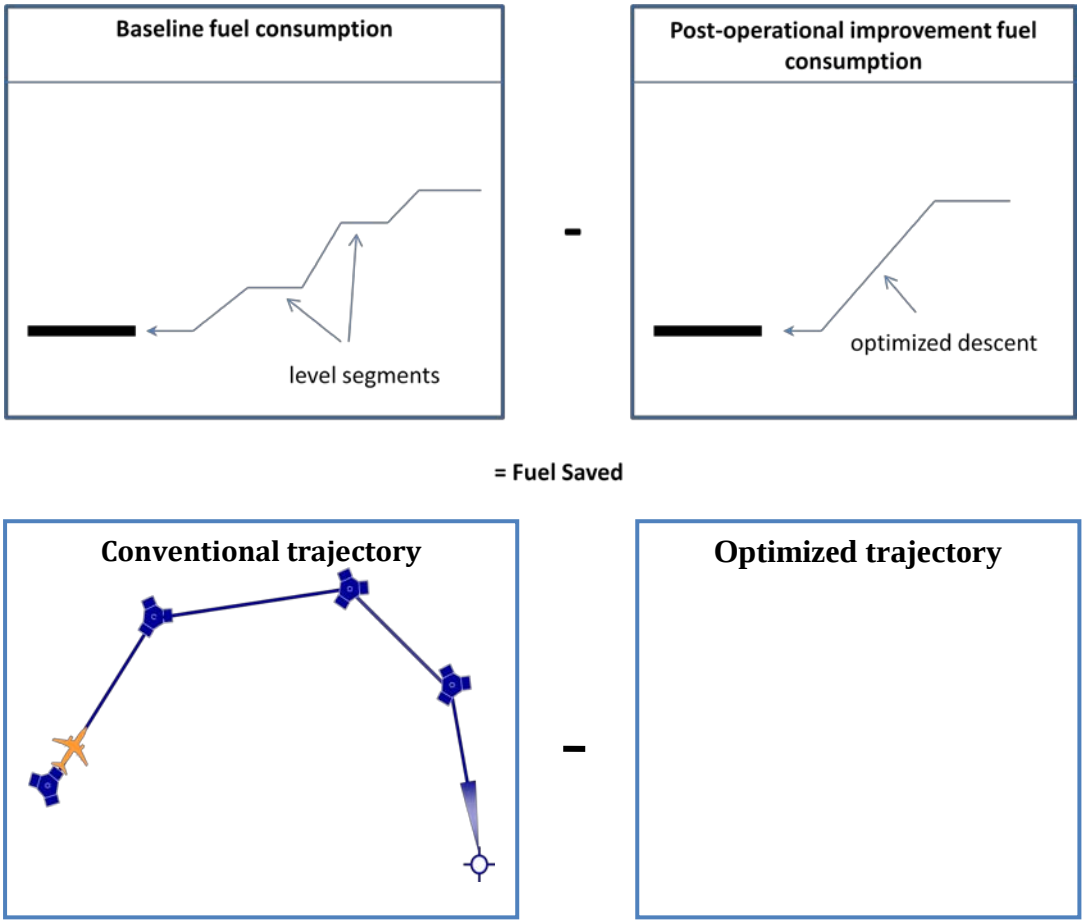


Figure 2. Notional illustration of fuel savings.

In order to compute the fuel consumed in two different scenarios, the following information listed in Table 2 will be required for both scenarios.

Table 2. Data required to compute fuel consumption changes.

- Number of operations by aircraft category (See Appendix 1)

Plus, 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 descent procedure

6-Requirements

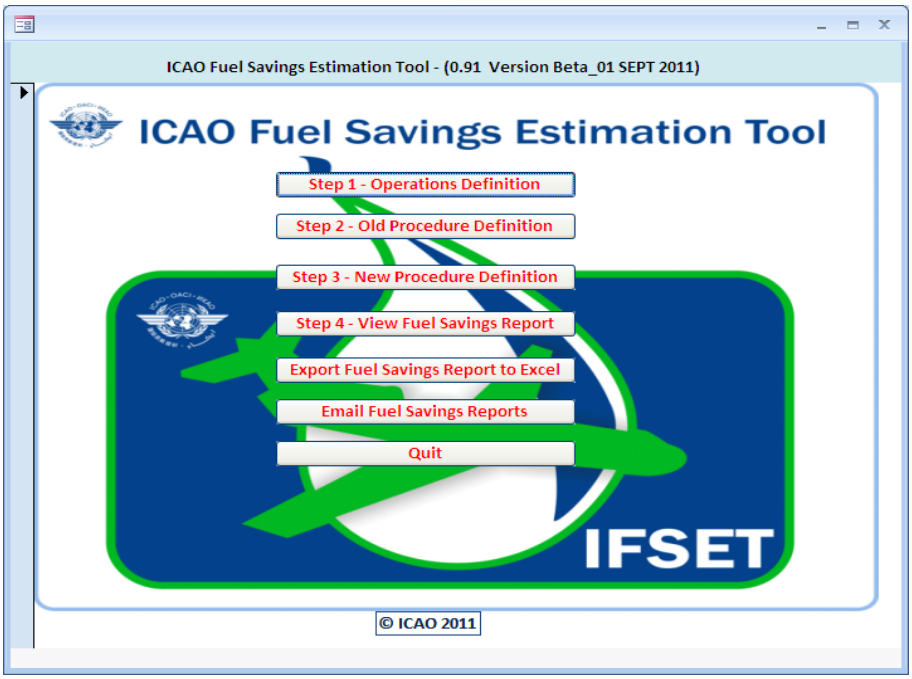
The tool will be a Microsoft Windows application that requires running an operating system of Windows XP or newer. The user interface is intended to be easy-to-use, requiring minimal input from the user.

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 types from a dropdown list of available types and then entering the number of operations. The list also contains basic aircraft categories that can be selected. Those aircraft categories include: single engine piston, multi engine piston, turboprop, short range single aisle jet, medium range single aisle jet, twin aisle jet (2 engine), and twin aisle jet (3+ engines). 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.

7-The tool Step by Step

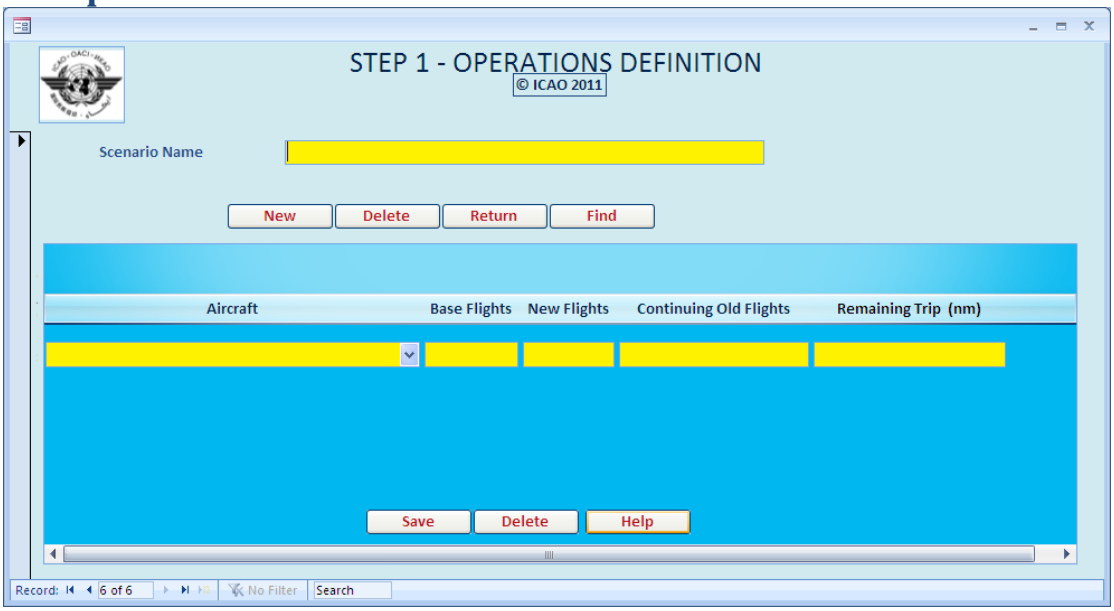
7.1 Main Screen



INPUT

Start by selecting **Operations definition** tab, the following screen opens

7.2 Operations definition



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 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.

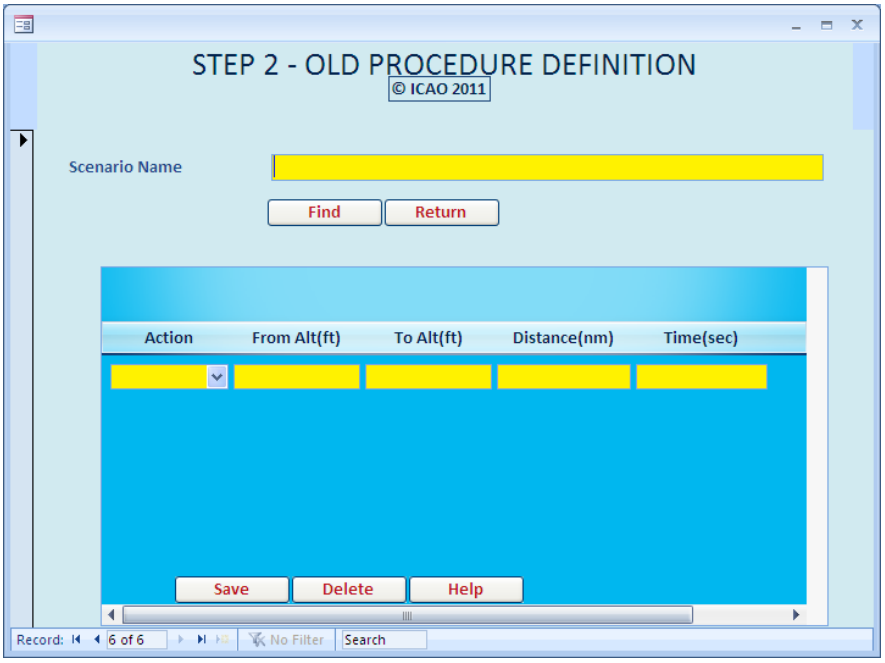
Continuing Old flights - indicates those flights though being part of the new operational scenario continues to follow the old operational definitions. It means number of operations not benefiting from the operational improvement.

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.

7.3 Old procedure definition



Find the **scenario name** which you have entered earlier under 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.

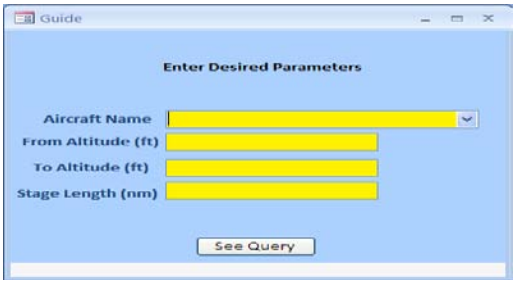
Return will bring the user to the main screen.

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.



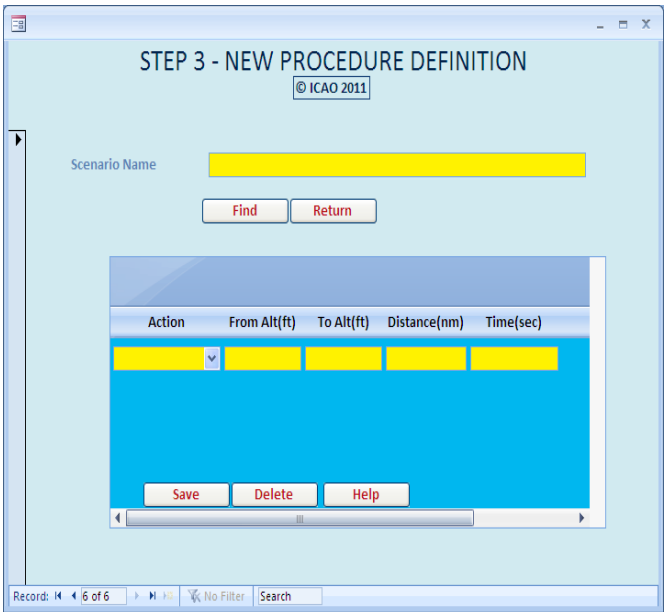
On generating the query the user can view the distance in nautical miles, time in seconds and speed (Kts) for his selection criteria which is static in the database and inherent to the model.

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**".

7.4 New procedure definition

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

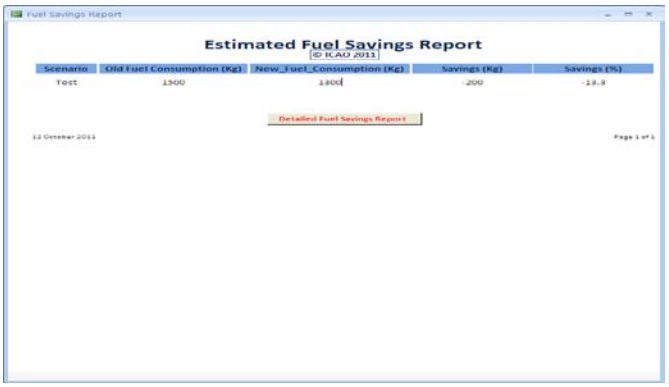


Enter the new operational procedures associated with the selected scenario as described under the "**Old Procedure Definition**". All the command buttons in this screen are identical to the ones explained under the Old Procedure Definition **(7.3)**

Clicking on Return will bring you to the Main Screen where the user can select "**View Full Burn Report**".

7.5 Report generation

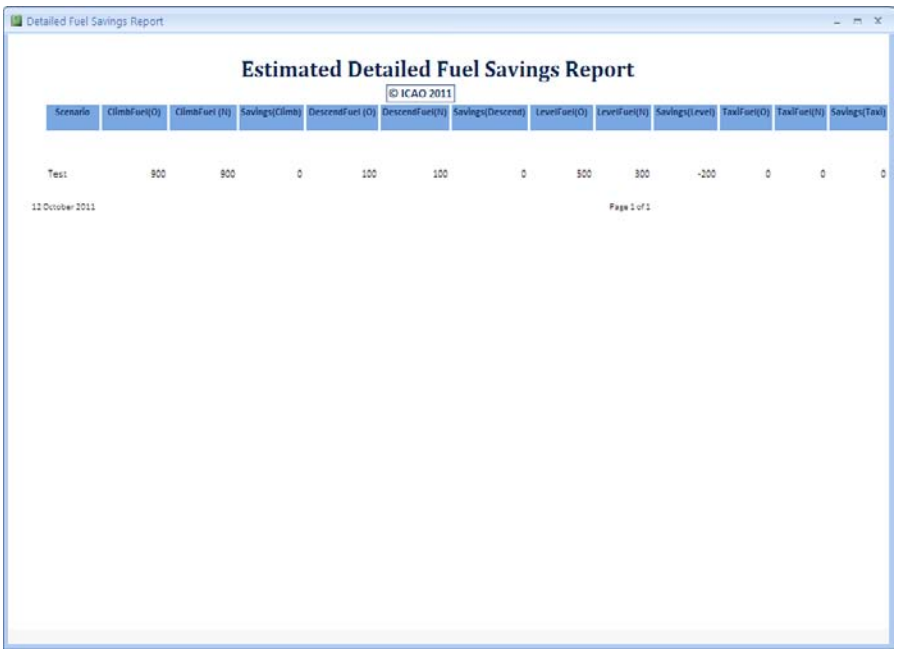
On clicking the View Fuel Savings Report Tab, the consolidated report will be displayed as in the screen below.



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.

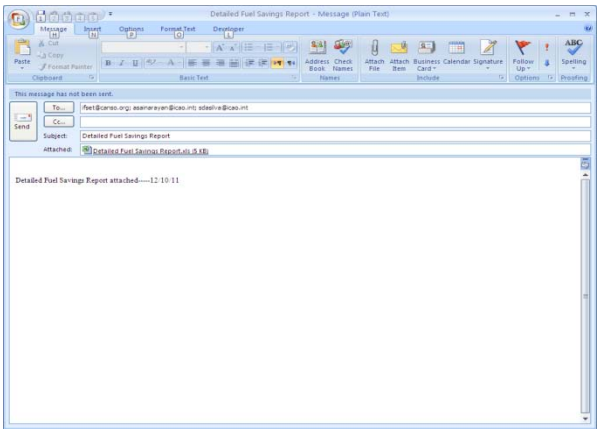


7.6 Report generation in Excel

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 Fuel Savings Report to Excel” key. An Excel file of the consolidated and the detailed fuel savings reports will be generated for the user’s information and can be stored by the user in a desired directory on his computer.

7.7 Sending the report via Email

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



APPENDIX B

TABLE TO REPORT ENVIRONMENTAL BENEFITS OF OPERATIONAL IMPROVEMENTS

Region	State	Current fuel burn (Kg)	Current CO2 emissions (Kg)	Op. Improvement	Savings-Fuel (Kg)	Savings-CO2 (Kg)	Savings-Fuel-%	Savings CO2-%	Tool
EURNAT	France	1	3.16	RNAV in FIR and TMA	7182902	22697970.32	7182902	7182902	IFSET
EURNAT			3.16			3.16	#DIV/0!	1	IFSET
			3.16			3.16	#DIV/0!	1	
			3.16			3.16	#DIV/0!	1	
			3.16			3.16	#DIV/0!	1	
			3.16			3.16	#DIV/0!	1	
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APPENDIX C

AIR TRAFFIC MANAGEMENT MEASUREMENTS TASK FORCE

1. TERMS OF REFERENCE

a) follow-up the implementation of the ATM operational improvements required in the Regional Air Navigation Plan (ANP) or in national plans and to place special emphasis on identifying and estimating the fuel savings accrued from the corresponding improvements;

b) carry out permanent coordination with various MIDANPIRG contributory bodies in order to ensure appropriate integration of all tasks contributing to the estimation of environment benefits related to the implementation of the ANP or national operational improvements;

c) harmonize, at a regional level, the estimation of the environment benefits from operational improvements in order to reach consistent results;

d) take into consideration the material prepared by ICAO, develop proposals to keep and upgrade the ICAO Fuel Savings Estimation Tool (IFSET) as necessary; and

e) the ATM/M TF will Report its progress to CNS/ATM/IC SG.

1.2 **Work programme for the ATM/M Task Force shall be to:**

a) improve Airport Accessibility;

b) improve operations through enhanced En-Route trajectories; and

c) improve flexibility and efficiency in Decent Profiles (PBN/CDO)

2. COMPOSITION

2.1 The Task Force is composed of:

a) MIDANPIRG Member States;
b) ACAC, CANSO, IACA, IATA, and IFALPA as observers; and
c) other representatives from industry and user Organizations could participate as observers whenever required.

- END -