The impact of climate change policy by enhancing Aviation Emission on Data System in Thailand

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Abstract

From September 2013 when the first Action Plan was submitted to ICAO till December 2017, Aviation sector in Thailand has made significant strides. A new Independent Entity- c.d. Authority- (Civil aviation authority of Thailand-CAAT-) in charge of regulating the sector was created in October 2015 through the emergency decree B.E. 2558. The structure, the organization chart and the Board of Directors have been settled and with a decision of Board of Directors Aviation Environmental Division was created aimed at: "Developing Environmental Policy for Thailand's aviation industry, Collecting, Monitoring and Verifying emissions data in aviation sector and Developing and updating a Greenhouse Gas Database System call Thailand Aviation Emission Data System ($AEDS^{TH}$)."

Keywords**:** *Emission Reduction, Aviation Greenhouse Gas Database, Climate Change*

1. Introduction

CAAT is leading the way to start a new phase in the aviation sector, a new phase characterized by transparency, accuracy of data, making goals more SMART (Specific, measurable, achievable, realistic and Time-bound), introducing KPIs indicators, break them down into discrete objectives or benchmarks, link goals to existing measures/programs, to next policy, to monitoring/verification of the sector trends and data with dedicated QA/QC procedures. CAAT as the new Regulator is in the process of start implementation of all the above topics and it is well aware of the challenges is facing, however, this research has included well planned and programmed workplan with objectives and targets established considering priorities and obligations for all involved airlines, it has been possible to deliver the action plan in developed AEDSTH with new realistic mitigation measures, with controlled and verified data considering the shortage of time available for the newly established Environmental division inside CAAT. (Adela, 2012), (Richard, Willium, Benjamin, 2013)

This paper purposes developed GHG database for The Civil Aviation Authority of Thailand (CAAT). It has intension to assist the effective implementation of the climate change mitigation actions in the Aviation Sector in Thailand. Furthermore, the aim is to encourage airlines to use this database by replaced the process of filling in excel files on existing ICAO forms (A, C and M). A new database can implement new operating workflows and reduce manual processes. Meanwhile AEDSTH must prepare data for ICAO tools and support to generate Carbon Emission report to CAAT for reviews and can easily provide feedback to airlines. (Chen, 2013) (Matasci, Kruse, Barawid, Thalmann, 2014)

2. Objectives

1. To encourage environmental standard development to comply with Thailand and to improve aviation's energy savings and environmental friendly;
2. To Establish Action Plan in establishing aviation emission database for air Transportation emission following the commitment with ICAO;
3. To monitor and inspect aviation industry in order to reduce environmental impact;
4. To encourage and support functions concerned aviation environment management.

3. Materials and Methods

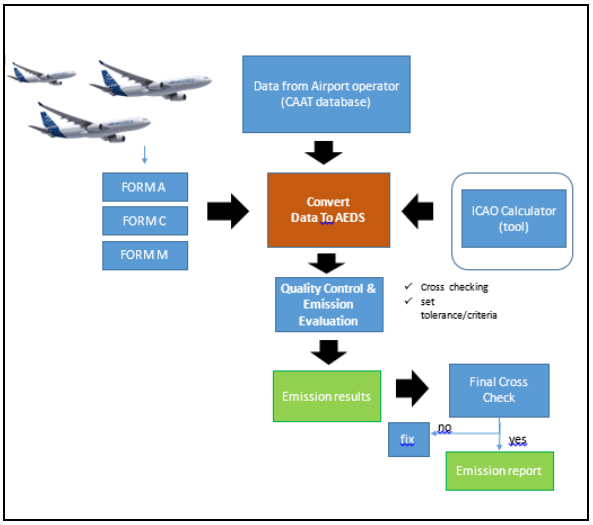

Figure 1 Workflow Diagram for designing AEDS[TH]

Operational workflow has been pointed out to analyze the existing processes between CAAT and airline operator. It has been seen that the data come from airline operator entry data FORM A, C and M and cross check data with Data from Airport operator and prepare data ready in use with ICAO tools. (Tony, 2015) As a result AEDS can evaluate and give quality and control data and generate emission report. AEDS can compare with this report and crosscheck to ensure that all data are qualified and no additional feedback from CAAT officer. After that the report shall be sent to airline operator and to give notification that emission report is complete. Whereas if the final crosscheck is not accepted by CAAT, however the officer can send notification to individual airline to resubmit the emission report. (Christiana, 2015)

Dynamic System Development Method (DSDM) methodology was introduced in this paper as it is widely accepted in IT industries for carrying out business projects successfully within timeframe. (See Figure 2)

The main principles of DSDM genuinely suppose of building a rapid prototype and empowering user in making-decision. The benefits of the DSDM framework is that it allows the development life cycle to be more flexible in redesigning a prototype, and user can participate and contribute their suggestions throughout development. This helps the new design to more closely resemble the real business needs.

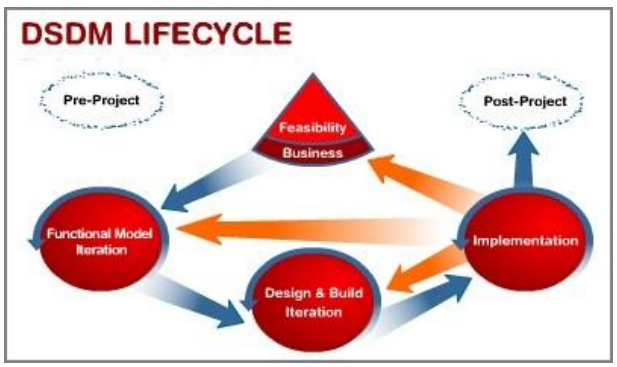

Figure 2 Dynamic System Development Method (DSDM)

3.1 Application Fundamentals

In this study, the important concepts in iOS application development. This is to understand the AngularJS design pattern and some basic concepts. Design pattern are AngularJS applications follows the MVC design pattern as the following A.) Model: Represents the business logic of your application B.) View: Represents what the user sees in the device.

3.2 Application Framework

AngularJS Framework is a free and open source mobile HTML framework to develop hybrid mobile apps or web apps with iOS & Android native look and feel. It is also an indispensable prototyping apps tool to show working app prototype as soon as possible.

The main approach of the AngularJS Framework is to give an opportunity to create AngularJS apps with HTML, CSS and JavaScript easily and clear. It can offer ways of any solutions somehow. However, it is not compatible with all platforms. It is focused merely on AngularJS and Google Material design that could bring the best experience and simplicity. See Figure 3 AngularJS Framework. (Stephen, 2015)

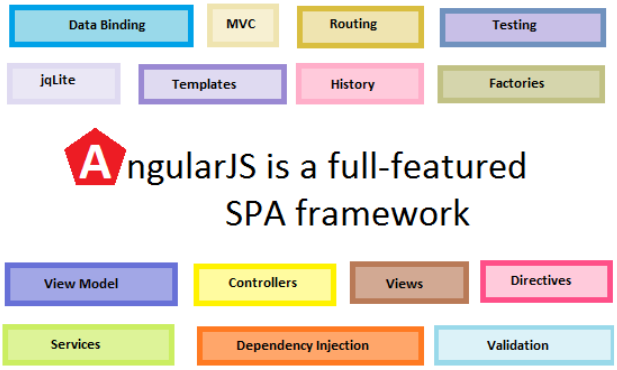

Figure 3 AngularJS Framework

AngularJS Framework is definitely to build iOS or Android hybrid app (PhoneGap) or web app that looks like and feels as great native Google Material apps. To create apps using a AngularJS framework is easy as website creation. It needs just a simple HTML layout and attached framework's CSS and JavaScript files. There is no need to write some custom tags that will be converted by JavaScript to something else. It does not force to write and describe all content in JavaScript (or JSON). Just plain HTML and it always get exactly the same to get when writing in the HTML.

3.3 AEDS propose new formulas leading to baseline

Passengers carried x Flight Distancex100kg)/1000 = Passenger tonne/km-PTKM-
Freight tonnes carried x Flight Distance = Freight tonne/km-FTKM-
Mail tonnes carried x Flight Distance = Mail tonne/km-MTKM-

The Rate of efficiency is an indicator of the efficiency of fuel usage per each tonne of revenue load carried (passengers, freight and mail).
Formula used:

$$\text{Fuel efficiency} = \frac{\text{Volume of fuel}}{\text{RTK}}$$

The construction of a baseline scenario is required in analyses and prospective studies aiming at comparing different possible future situations. Many criteria have to be taken into account to build such

scenarios, from socio-economical to environmental aspects. Each assessment builds its own baseline scenario, not really based on a strict common methodology but rather on similar key components to respect.

3.4 Rationale of existing data

A) RTK calculation

- Passengers carried x Flight Distance x 100kg)/1000 = Passenger tonne/km-PTKM-
- Freight tones carried x Flight Distance = Freight tonne/km-FTKM-
- Mail Tonnes carried x Flight Distance = Mail tonne/km-MTKM-

B) CO2 calculation

- Amount of fuel burn x emission factors.

4. Results and Discussion

Thailand Aviation Emission Data System has consisted of login Page and Four main functionalities; list of screen functionalities as following bellows; (see Figure 4)

1. Emission Data: Airline operator can enter data in AEDS
2. Mitigation Measures: Airline operator can enclose and enter relevant data according to State Action Plan 2018
3. CORSIA: Emission Monitoring Plan (EMP): Airline operator can enclose and enter relevant data for monitoring data according to CORSIA
4. CORSIA: Aviation Emission Report (AER) Airline operator can enclose and enter relevant data for monitoring data according to CORSIA

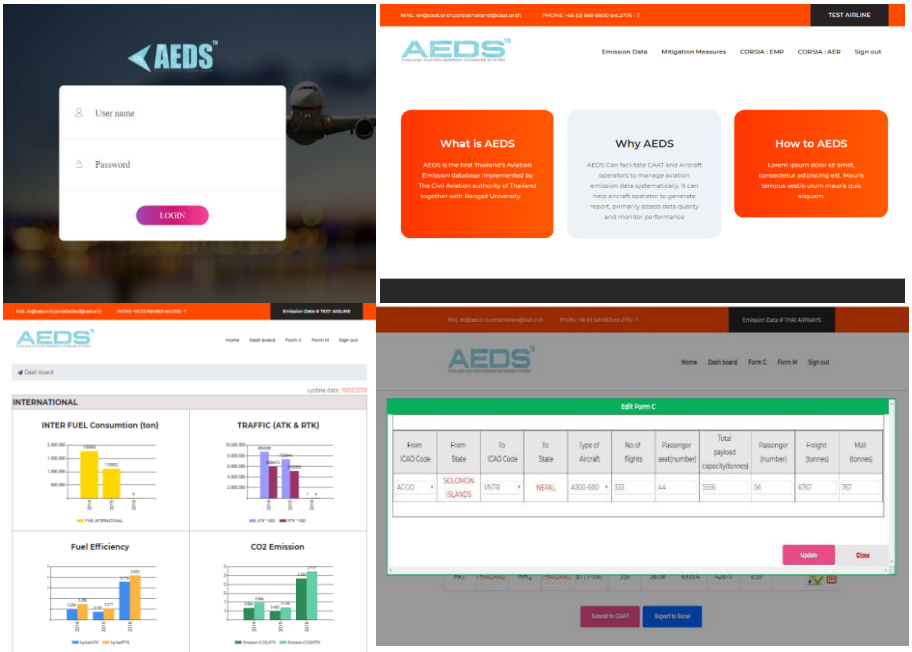

Figure 4 AEDS: Iteration Screens

Quality of data

Aviation sector data are affected mainly by two problems:

A) Lack of completeness

From 2010 till 2016 available data were not complete and precise, because not all airlines had enough experience in managing with and submitting M form properly (e.g. M FORM is related to fuel

consumption as per ICAO procedures). Therefore, to face the situation different solutions were used. (Passavi, 2016)

First solution: to cover the gap from 2010 till 2012, assumption approach was introduced based on data resulted from the calculation of fuel consumption from 2014 till 2016 (Hagmann, Semeijn, Vellenga, 2015). In details, the average increase of fuel consumption registered each year from 2014 till 2016 was used as parameter to calculate the average fuel consumption of airlines not reporting through M form using the following formula:

(Average increased % of fuel consumption for non M- form reporting carriers/ estimated fuel consumption per all other airlines as estimated by DCA per each year*100)+ estimated fuel consumption per all other airlines as estimated by DCA per each year)

New data deriving from the adopted formula amending DCA previous assessment point out that the increase of fuel consumption of the non-M form reporting carriers is around 5.7% compared to data as included in M- form and therefore, the average contribution of these non-M form reporting carriers represents 5.4% of the total value of fuel consumption from 2014-2016 (Table 1). (Davison, Littleford, Ryley, 2014)

Table 1 Contribution in percentages of fuel consumption for non-M- form reporting carriers of the total value of fuel consumption during 2010 -2016

YEAR	CONTRIBUTION (%)
2010	5.40
2011	5.40
2012	5.40
2013	5.40
2014	5.58
2015	5.70
2016	4.90

Second solution: For 2014 till 2016, missing data were calculated using ICAO calculator and AEDS considering as parameter: The annually information for flight stages extrapolated from AEDS, updated starting from 2014, and the distance flown (approximation by great circle distance). In addition, using ICAO Carbon Emissions Calculator Version 2.6 (2016), the value of the annual fuel consumption for each year can be calculated and this value shall be added to the annual fuel consumption as provided in the M – form submitted by sector stakeholders. Therefore, it emerges that through the combination of both methods- disaggregated/aggregated methodology- CO2 estimations and missing data are complete through the adoption and interaction of the different suggested solutions. This fact will allow having a real sector background and real numbers in terms of GHG for the period going from 2010 to 2016 and for the next future in case submitted data will not be enough. (Cheung, Kragt, Burton, 2015), (Cliff, 2014).

B) Time series consistency

The applied calculation method is based on the surrogate technique given of the 2006 IPCC Guidelines. The calculation shows that this share remains at a constant level with the largest deviation of 4% for this period, indicating that this approach can be used to calculate missing statistical data (fuel burn, RTK, FB/RTK). In addition, figures emerged from the IPCC guideline application have been cross-checked using statistical indicator available from 2014- (i.e. kg fuel burn per passenger)-, and the result of this additional analysis demonstrated the reasonable margin of accuracy using the above mentioned methodology once more. (Kroesen, 2013), (Mair, 2011)

Monitoring/qc of estimated emissions

These deviations are not absolutely unexpected, considering the fact that the ICAO calculator accounts the amount of fuel burn during the flight, while the M-form shows the value of the fuel uplift.

CAAT will pay close attention to establishing a methodology for obtaining better quality data within the MRV system, as this is a major prerequisite for allowing CORSIA working. (Chula, 2018)

CAAT management, CAAT staff, and representative of Airline Operators were selected for the interviewed

- AEDSTH reduce a process of data validation from 120 minutes to 10 minutes
- CAAT decrease no. of admin staff, only one person who supports the system and corresponds to airline operators
- AEDSTH helps to validate information for keying input data into the system. For example, flight stage, aerodrome pairs, etc
- AEDSTH helps to summarize fuel consumptions for aircraft and divided into international flights and domestic flights
- AEDSTH can generate emissions report for CAAT to review and give feedback to airline operators
- From this study, CAAT are satisfied with this system and provide emission report ICAO and UNFCCC for the progress. At the moment CAAT cooperate with European Union Aviation Safety Agency (EASA) to expand this system to Department of Civil Aviation in Asian regions

5. Conclusion

Thailand's GHG database (AEDSTH) can appear too ambitious considering the real recent establishment of the Civil Aviation Authority of Thailand, nevertheless, the new sector Regulator is fully and completely engaged in the fight against climate change and on a daily basis it is cooperating with all other governmental bodies, already dealing and facing inauspicious effects of climate change at national level and in the framework of the signed international agreements, as well as with sector stakeholders and operators.

The next step, CAAT supposes to arrange capacity building activities and create awareness campaigns supported and financed by international donors have been organized and will be further implemented to train private sector towards CORSIA, GMBMs and MRV as first steps to support them moving on a new vision and approach of environment and climate change in the aviation sector.

The links between health and air quality will be better communicated by all public bodies involved in air quality assessment and management in order to raise awareness of the critical issues with policy and decision makers as well as with the general public. In line with the 2ºC warming limit and the need to lessen the risks and impacts of climate change, aviation emissions need to be curbed and then to decline. In this paper, it can be described in this report are moving in this direction, contributing to a more efficient and effective transport system at national, regional and international level.

CAAT is strongly committed to achieve GHG emission reduction through a multi-dimensional approach integrating innovation solutions, cooperation at regional and international levels, policy and regulatory tools in a coordinated and shared way agreed with public and private sector stakeholders acting together and with a sense of urgency towards future generation legacy.

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