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Projekt / Project / Bachelor Thesis / Master Thesis

Aircraft Fuel Consumption – Estimation and Visualization

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Kurzreferat / Abstract

Purpose – In order to uncover the best kept secret in today's commercial aviation, this project deals with the calculation of fuel consumption of aircraft.
Methodology – With only the reference of the aircraft manufacturer's information, given within the airport planning documents, a method is established that allows computing values for the fuel consumption of every aircraft in question.
Findings – The aircraft's fuel consumption per passenger and 100 flown kilometers decreases rapidly with range, until a near constant level is reached around the aircraft's average range. At longer range, where payload reduction becomes necessary, fuel consumption increases significantly. Numerical results are visualized, explained, and discussed. With regard to today's increasing number of long-haul flights, the results are investigated in terms of efficiency and viability.
Research Limitations – The environmental impact of burning fuel is not considered in this report.
Practical Implications – The presented method allows calculating aircraft type specific fuel consumption based on publicly available information.
Social Implications – The fuel consumption of every aircraft can be investigated and can be discussed openly.
Originality – This seems to be the first report to explain and offer a user-friendly spreadsheet to calculate fuel consumption of passenger aircraft.

German: ***Kurzreferat***
English: ***Abstract***

Read about "Structured Abstracts":
https://www.fzt.haw-hamburg.de/pers/Scholz/ArbeitenHinweise.html#Title

DEPARTMENT OF AUTOMOTIVE AND AERONAUTICAL ENGINEERING

Aircraft Fuel Consumption – Estimation and Visualization

Task for a Project

Background

"3.85 liters per 100 passenger kilometers" – this was Lufthansa Group's specific fuel consumption in 2016, averaged over short-haul and long-haul flights. The statement was taken from Lufthansa Group's Sustainability Report 2017. The amount of consumed fuel depends on different factors: aircraft type, distance, payload, cruise Mach number, and more. It is evident: a) The longer the distance flown, the more fuel will be consumed. b) Is fuel consumption sufficiently constant versus range, if the fuel consumption is calculated per range? c) How does the picture change if we consider fuel consumption per range and per number of seats? Consider: Payload (and hence number of passengers) has to be reduced for flights at very long range. A nonlinear behavior is found for specific fuel consumption plotted versus range in all the cases mentioned. The problem: Publicly available aircraft data is always limited.

Task

Task of this project is to extract the aircraft's efficiency (aerodynamics and engines) from given payload-range diagrams. Here, help is available from previous project work. Based on this data the fuel consumption of an aircraft can be plotted, analyzed, and discussed. Following subtasks have to be considered:

- Analyzing payload-range diagrams with basic flight mechanics.
- Plotting and investigating fuel consumption versus range
- (Breguet Factor, "bath tub curve").
- Writing an Excel tool to support such fuel calculations and its visualization.
- Applying gained insight in a critical investigation of current long range aircraft operation.

The report has to be written in English based on German or international standards on report writing.

Table of Contents

[1] You can also combine to one chapter "Summary" and a second chapter "Conclusions and Recommendations" or only "Recommendations" if the conclusions are where drawn in the discussion and summarized in the summary.

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List of Symbols

B	Breguet Range Factor
c	Specific Fuel Consumption, thrust specific (for jets)

Greek Symbols

Δ	Difference

List of Abbreviations

MTOW	Maximum Take-Off Weight

List of Definitions

Fuel Jettisoning
The emergency discharge of fuel from an aircraft in flight. (**MAD 1980**)