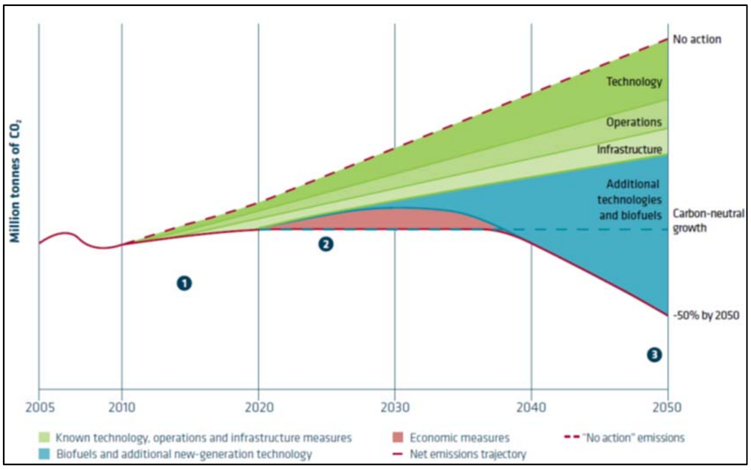
Aircraft Productivity and Fleet Development Planning

Master‘s Thesis of Laura Bellhaeuser

Supervision:
Dr.-Ing. Antonios Tsakarestos

Mentoring:
M.Sc. Oluwaferanmi Oguntona (Bauhaus Luftfahrt e.V.)



Development of the world’s emissions from aviation

Aviation has a great impact on the environment, in terms of pollution, noise and emissions. Especially the greenhouse gas emissions leading to climate change are a key topic for the future of aviation. Therefore, global aviation emissions will constantly increase if no measures are taken. Due to that, in 2009, the International Air Transport Association has set targets to reduce the CO_2 emissions of the aviation sector, including the following:

- Improving the fuel efficiency of the world fleet by an average 1.5 percent per year from 2009 to 2020
- Capping net aviation CO_2 emissions at 2020 levels by carbon-neutral growth
- Halving CO_2 emissions by 2050, referred to a 2005 baseline

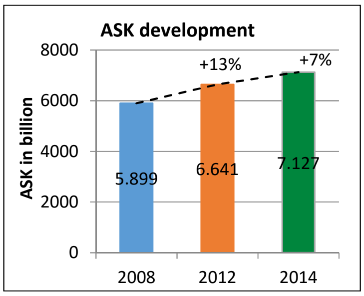
Displayed on the left is a scenario how the global aviation emissions will develop depending on the actions taken – without any action, emission levels will more than double until 2050. The goal is to untie capacity growth from emission development.

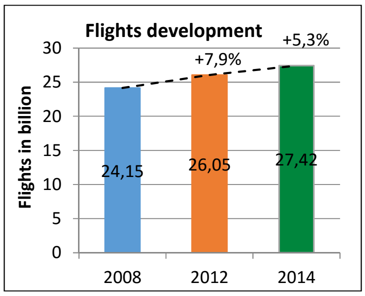
Effects on aircraft productivity

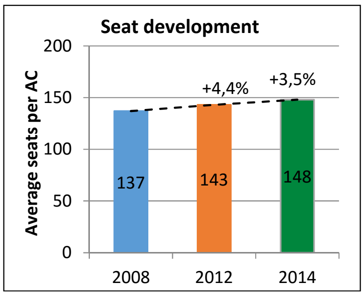
One question of this analysis is, if the productivity of aircraft in service increases over time, meaning that the capacity supply is more efficient and rises proportionally greater than the number of aircraft. To evaluate this thought, the productivity of the world fleet as a whole is addressed. The productivity of aircraft is measured by the amount of capacity offered over a specific time span per unit of aircraft. The seat capacity is calculated based on the available seat kilometers (ASK):

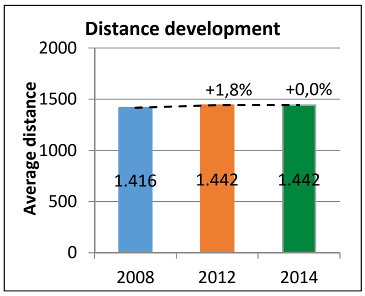
$$ASK_{acft} = \text{seats} \times \text{distance} \times \frac{\text{frequency}}{\text{time}}$$

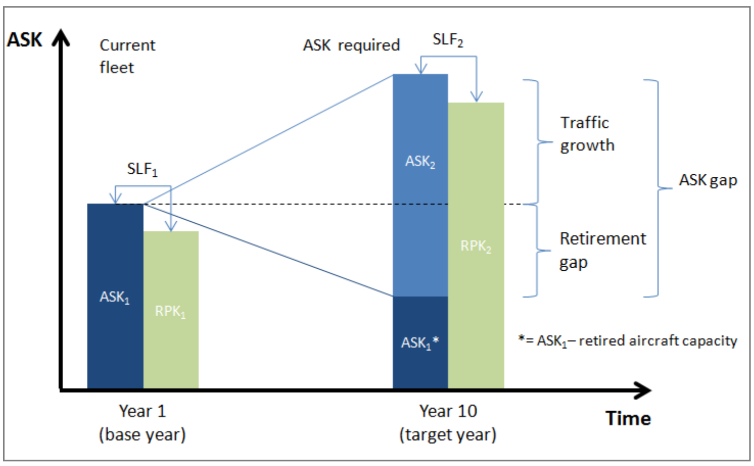
The figures on the right show that the ASK grew constantly between the three observed years, but in comparison, the development of flight frequencies, did not rise to the same extent. That implies, that the higher production of ASK is not only due to additional flights, but the configuration of aircraft in service has changes as well. This being the case, the average seat capacity of the overall fleet shows that an increase of seats evolved over the years. The reason could either be a higher number of built-in seats in the various aircraft types, which would be indicative for a productivity increase, or a development towards operating bigger sized aircraft types. In contrast to that, the distance shows very little variance, almost constant. So, it can be said, that the rise in ASK is covered by more flights per year with more seats.











Macro approach to fleet planning

Fleet planning is part of the strategic planning of an airline to ensure their medium- and long-term market position. There are two fundamental drivers for fleet planning – the replacement of exciting aircraft due to inefficiency and high operating costs – and the growth in demand that requires higher capacities. The goal of fleet planning is to reach a cost-efficient production of capacity corresponding to the network with a minimum number of aircraft.

The macro-approach can best be explained by the figure to the left:
In the base year the airline operates the current fleet with a specific amount of capacity (ASK_1) and load factor (SLF_1). Based on forecasts, a yearly traffic growth rate is applied predicting a traffic demand for the target year (RPK_2). Hence, assuming an anticipated SLF_2 for the target year, the amount of ASK required can be determined. Part of the ASK required is covered by the existing fleet of year 1, So, the ASK gap between the base year and the target year (ASK_2) is composed of the retirement gap and the traffic growth. This ASK gap needs to be filled by acquiring new aircraft to generated the desired ASK. The most suitable aircraft type can be chosen and the number of necessary aircraft calculated.

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Technische Universität München
Lehrstuhl für Verkehrstechnik
Univ.-Prof. Dr.-Ing. Fritz Busch