



# Air Carrier Efficiencies

Kevin Morris  
Manager Environmental Affairs  
British Airways



# Air Carrier Efficiencies - Goals

- **To always operate:**
  - the lightest aircraft,
  - with the maximum payload,
  - perfectly maintained for fuel conservation,
  - following the most direct (air) route,
  - always at the optimum altitude,
  - and following the most efficient speed/Mach schedule

## From the manufacturers:

- **We want aircraft that:**
  - don't burn any fuel
  - don't make any noise
  - don't produce any emissions
  - don't require any maintenance
  - Does make money for the operator...



**.....and now back to the real world!**

## Focussing on Weight and Non-revenue Flights

- Drivers:
  - Fuel is **expensive** ( $\approx 15-20+\%$  of total costs)
  - Heavier aircraft burn more fuel
  - Non-revenue flights burn fuel for no return
- Weight effects
- Reduction initiatives
- Monitoring
- Non-revenue flights
- Diversions
- Flight testing

# Why look at weight?

➤ A “Rule of thumb”:

➤ Additional fuel requirement

= 3-4% of weight increase x hours flown

➤ e.g. extra weight = 500 kg

➤ Flight time = 10 hours

➤ Extra fuel burn = 150-200 kg

➤ Extra CO<sub>2</sub> = 470-630 kg

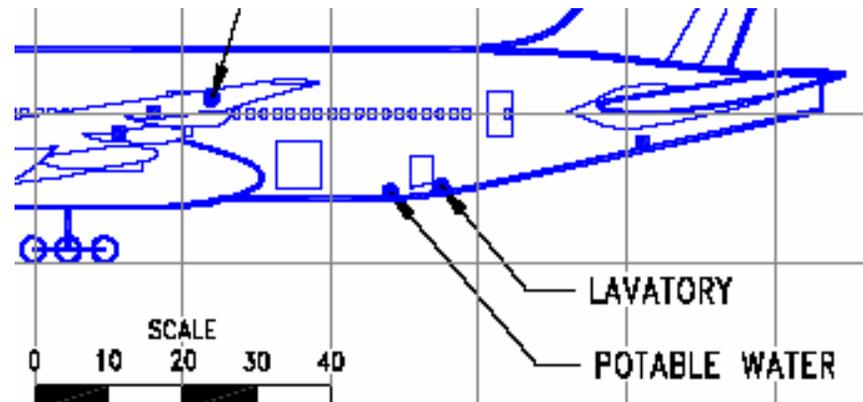
➤ For Every flight!

## Costs of weight (1 aircraft)

- Assuming utilisation = 5000 hrs/year
  - Extra fuel burn = 87 500 kg
  - Extra CO<sub>2</sub> = 276 000 kg
  - Extra cost = \$64 750 (@ \$740 per tonne)
    - And that's just the fuel!
  
- So weight control is very important.

# Case study: Potable Water

- Aircraft carry potable water in water tanks for use in flight
- Not all are necessarily required, but mostly always filled to capacity for every flight



## B777 Potable water

- Blanking off 1 out of 3 possible water tanks for “medium haul” B777-200, prevents their use
- 100 kg of water, per flight not loaded as a result
- Annual savings (for BA) estimated as
  - 380 tonnes fuel
  - 1 200 tonnes of CO<sub>2</sub>

# Plastic Gin Bottles

- Duty Free bottles of Gin
  - Opportunity to substitute plastic bottles for glass ones (Gin is unaffected!)
  - Weight saving approx. ½ kg per bottle
  - Average of 12 bottles carried on each long-haul flight



# Plastic Gin Bottles

- ↗ Total annual fuel savings for long-haul flights
  - ↗ B747-400 = 64 200 kg
  - ↗ B777-200 = 48 450 kg
  - ↗ B767-300 = 6 400 kg
  
- ↗ Total fuel saved = 119 050 kg
- ↗ Total CO<sub>2</sub> saved = 375 480 kg
- ✓ **Conclusion: help the environment - buy your duty free on board!**



# Weight monitoring and control

- You can't control what you can't measure
  - Modifications (mandatory & other)
  - Unaccounted weight growth
  - Fuel tankering
  - Extra fuel requirement, emissions
  - Extra expense, less profit!

# Monitoring and Control

- Weights Group:
  - Track aircraft weight over time
  - Monitor the actual weight of modifications!
- Fuel Efficiency Monitoring:
  - Track aircraft fuel efficiency over time
  - Allows the use of statistical contingency fuel (worth >\$10M per year to BA)
- Staff feedback and initiatives “BAfuelsaver”
- **Saves fuel/money/environment!**

# Modifications!

- Can add a lot of weight!
- Need to ensure that they are completely removed when not required!
- Some might also require test flights
- Minimise flight time, do as much on the ground beforehand as possible

# Non-revenue flights

- Any flight that doesn't generate money!
- Some non-revenue flying is unavoidable, but it is expensive, uses fuel, and creates unwanted emissions
- Can sometimes be reduced, combined or coupled with a commercial service

# Engine Ground Running

- Post maintenance action, e.g.:
  - Check starts
  - Function checks
  - Thrust reverser correct operation
  - Pressure leak tests
- Aim is to minimise:
  - Running time
  - Power settings
- Lower fuel burn, noise and emissions!



# Diversions & positioning



# Diversions/positioning

- Diversions are **BAD NEWS!**
- Choice of suitable alternate is important:
  - Too close – both can have same weather (weather is greatest cause for diversions)
  - Too far – high cost in time and fuel for both diversion and recovery.
- Need to choose wisely!

# Positioning flights

- Split operations or remote maintenance can require positioning of aircraft
- Positioning empty is the cheapest on fuel but most expensive on revenue
- Not always possible, but sometimes a commercial load can be carried
- e.g. B777-200 delivery flight with cherries!
  - Some revenue for BA (the operator)
  - Happy Seattle cherry grower!

# Flight Testing



# Maintenance Verification

- Results of some maintenance actions can not be accurately verified on the ground e.g.
  - Engine re-light envelope
  - Manual reversion
  - Some emergency systems, etc.
- Some test flying may be necessary

# Flight Testing - Minimisation

- Use B.I.T.E where possible
- Do what can be done on the ground
- Record everything, and review/relate to in flight measurements:
- e.g. B737 manual reversion
  - Check required after changes to elevator control rods
  - Requires manual reversion check at FL350 (1-2 hrs)
  - Correlation found between ground, FL100 and FL350 checks
  - Allowed revision to a manual reversion check at FL100
  - Short flight (1/2 hr) as a result, saving fuel and time.

# Flight Testing

➤ Potential may exist to combine tests?

e.g:

- Concorde AWFT and Noise measurements
- Function tests during positioning flights
- B737 Alternate flap checks by mgmt pilots into LHR

➤ But it's not always possible, and some things just have to be found out in the air...

... unable to reproduce on the ground!





to represent, lead and serve the airline industry

**THANK YOU!**

