

CASE STUDY 4

FUEL CONSERVATION FOR SHORT HAUL OPERATORS

EVENT

This case study demonstrates perfectly how monitoring and analysis of a short-haul customer enabled them to make recommendations on how to streamline their operation and save money.

FDS started a fuel saving assessment for the customer by examining the climb profile, which is typically where many gains can be made. FDS collated data from a number of flights, by taking average values of key parameters.

On any flight there are factors that a pilot can influence and factors they cannot. For example, aircraft weight, external cleanliness, aerodynamics and air temperature are clearly beyond a pilot's control. However, the pilot can determine the rate of climb and airspeed and as a consequence the power and fuel burn. FDS started by examining the airspeed and rate of climb to see what actions the pilots are taking in the climb. The ideal climb profile may also be affected by ATC restrictions.

INVESTIGATION

Climb airspeed

The airspeed achieved for each 1,000ft of altitude (from take-off to 39,000ft). Each point represents the average airspeed - from one flight - as the aircraft climbs from 500ft below the altitude, to 500ft above the altitude.

This airframe has a 250 knot 'bird-strike' limit up to 10,000ft which is clearly being observed by most crews. At 10,000ft they accelerate sharply towards 290 knots. Above 25,000ft (depending upon atmospheric conditions) the aircraft becomes Mach limited. Immediately apparent is the wide range of rates of climb which may be dependent on weight, speed and ATC.

These variations may depend on company/cost index requirements, but this does allow FDS to make a quick assessment of the performance over a range of flights.

Climb rate of climb

As a result of the variations in aircraft weight, engine performance and atmospheric conditions, there is a much wider variation in climb performance.

The reduced rate of climb as the aircraft is accelerated above 10,000ft. This is a direct result of acceleration to optimum climb speed.

There are also a few exceptional flights with much higher than normal rates of climb. These were found to relate to aircraft at light weight or that were trading speed for rate of climb over short "zoom" climbs, possibly for ATC or weather reasons.

One consequence is that more fuel is consumed in the 10,000ft band than at any other altitude, because the rate of climb is reduced and traded for an increase in airspeed.

For this case study, we illustrate the data at 20,000ft, chosen because at this altitude:

- the acceleration phase has been completed,
- the aircraft is not Mach limited, and
- all the flights were in steady climb (i.e. all the initial cruise altitudes were well above 20,000ft).

At this altitude the N1 is close to 86.5% on all flights, and the autopilot is commanding 290kt on most flights. There is a weak correlation between the aircraft weight and the airspeed or rate of climb.

The question arises whether 290kts is the optimal speed on climbing through 20,000ft. To answer this we can use the fact that there is some scatter in the data and use regression algorithms to compute the effect of varying one parameter at a time. For example, in this case we were able to show that the climb efficiency (feet climbed per kg of fuel consumed) increased by 0.5% for each knot reduction in airspeed.

It is not surprising that the fuel consumed during climb reduces with airspeed. Reducing the airspeed will allow the aircraft to reach its cruising altitude, having used less fuel, although not having travelled so far.

Examination of the cruise data shows that in 20% of the flights the aircraft cruised at a lower airspeed than it climbed, with an average speed reduction of over 8kts. It was therefore clear that not exceeding the cruise speed during the climb would save fuel and provide a quantitative estimate of the savings possible.

Most significant from a fuel conservation perspective is the dominant area, which shows that the majority of crews for this airline are powering down the descent rather than flying minimum power descents.

Summary/Conclusion

The data monitoring and analysis techniques FDS use to report to their customers can only advise; highlighting ways to make – in this case - fuel savings. Without active participation from the airline and crews nothing will happen.

FDS identify areas for examination. Since all the data comes directly from flight recordings and there is no reliance upon manufacturers' test data, the operator can be sure that making the changes will have the predicted effect.