Airports Commission

Economy:
Delay Impacts Assessment Methodology Paper

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An independent commission appointed by Government

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1. Introduction

1.1 This paper sets out the methodology for the analysis that has been undertaken to estimate benefits from reduced delay time to airlines and passengers from changes in aviation capacity constraints in UK.[1] Delay costs are assessed for every airline and passenger movement for 60 years from scheme opening[2] and presented in 2014 prices.

1.2 This work builds upon preliminary work undertaken in the Airport Commission's *Interim Report*.[3] This analysis considered the delay costs mainly to airlines and estimated these costs as £5.1 billion between 2021 and 2080.[4] The most significant updates to the analysis since the *Interim Report* are the monetisation of passenger and carbon benefits, a distinction between summer and winter delay benefits and extension of the model to several airports that are likely to reach demand to runway capacity of over 80% before 2050.

1 For the purpose of this analysis this consists of Heathrow, Gatwick, Stansted, Luton, Aberdeen, Belfast city, Birmingham, Edinburgh, Southend, Manchester, and Newquay.

2 The two scheme designs at Heathrow have an appraisal period of 2026 to 2085 and Gatwick from 2025 to 2084.

3 Airports Commission. (Dec 2013) *Airports Commission: Interim Report*.

4 Our new estimate is significantly different in all do something scenarios because we use more robust and in some cases lower assumptions in delay times. Work undertaken for the *Interim Report* was based on the costs associated with a capacity constraint when compared to a capacity unconstrained system. The analysis undertaken in this appraisal is based on the benefit of releasing capacity at one location compared to the constrained do-minimum which delivers the difference in scale of impact.

2. Inputs and Methodology

Type of delays

2.1 The costs of delays can be calculated separately for strategic delays (those anticipated in advance) and tactical delays (those incurred on the day and not scheduled into passenger or airline schedules). Because evidence on delay time does not distinguish between strategic or tactical delays, it is assumed that any recurring average annual delay is factored into airline and passenger schedules. Therefore, for the purposes of this analysis delay time is assumed to be entirely strategic.

Delay time

2.2 Summer and winter season arrival delay times at various demand capacity ratios are set out below in table 1. This table also shows departure delays in the summer and winter seasons. Delay times are applied equally across all airports that experience a capacity constraint depending upon their demand capacity ratio. Delay times and their relationship to demand capacity ratios are based on evidence of delay times at Heathrow after the application of short-term options.[5]

Table 1: Relationship between demand to capacity ratios and average delay times (minutes per flight)

Demand / Capacity ratio	Summer arrival delay	Summer departure delay	Winter arrival delay	Winter departure delay
0.1	0.0	0.0	0.0	0.1
0.2	0.0	0.0	0.0	0.8
0.3	0.0	0.0	0.0	1.6
0.4	0.0	1.0	0.0	2.3
0.5	0.0	2.0	0.0	3.1
0.6	0.0	3.1	0.0	3.8
0.7	0.0	4.1	0.0	4.6
0.8	0.5	5.1	1.0	5.3
0.9	3.3	6.2	6.5	6.1
1.0	6.0	7.2	12.0	6.8

5 Leigh Fisher (Dec 2013), *Development and Assessment of Airport Capacity Options Short Term Options: Technical Report*.

2.3 The delay times described above are averages across all inbound or outbound traffic. It includes flights that experience no delay (i.e. 0 minutes) as well as flights that experience significantly greater arrival or departure delay. For instance, the arrival delay time that might be expected in the 95th percentile of a capacity constrained airport are two and three times greater. Similarly departure delay in the 95th percentile would be two times greater than the average.

2.4 The following assumptions have been used to estimate arrival and departure delay times in the London airport system:

- For the purpose of this analysis, arrival and departure delay time resulting from capacity constraints refer to the phases of a flight when an airline is held in a stack, waiting to land or on the ground, ready to depart. There are other types of delays, for instance ATFM[6] and at gate holding. ATFM delays occur at the departure airport for Heathrow arrivals and are mostly associated with weather or other disruptions but some of this is due to lack of capacity at LHR. At gate delays for departure depend on ATC[7] policy and are not wholly attributable to capacity constraints.

- Based upon evidence of the relationship between average stack holding time and the demand/capacity ratio at Heathrow,[8] it is assumed that arrival delays only occur when an airport's capacity is above or equal to 80%. Arrival delays are assumed to increase as the demand/capacity ratio increases. We assume that in summer there is 0.5 minutes of delay per flight (1 minute in winter) at a demand capacity of 80 per cent. This builds up to a maximum delay time of 6 minutes (12 minutes in winter). Similar evidence on the relationship between average ground holding time per flight (defined as the difference between actual and perfect taxi time) and the demand/capacity ratio shows that departure delays builds up consistently as demand capacity ratios increase. We assume that a zero demand capacity ratio, there is 0.6 minutes of delay in summer and 3.1 minutes in winter. To this a delay reduction of 2.7 minutes and 3 minutes for summer and winter respectively is applied based upon e evidence of delay times at Heathrow after the application of the short-term options.[9]

6 Air Transport Flow Management.
7 Air Traffic Control.
8 ICF International (Dec 2008) *UK CAA Runway Resilience Study – Final Report*.
9 Leigh Fisher, Short Term Options Technical Report, 9th December 2013.

Airline costs

2.5 Delay costs to airlines haven been based upon a study on European airline delay costs[10] to which a number of assumptions are applied for the purpose of this analysis:

- Next generation aircraft are assumed to be 10% more fuel efficient than current aircraft, and next but one generation aircraft are assumed to be 50% more efficient, in line with EU objectives[11].
- Maintenance costs are decreased by 20% with each new generation of aircraft. A conservative approach is taken to all the other parameters which remain the same over time as new aircraft enter the fleet
- Fleet and crew costs decrease by 50% in 2050
- An exchange rate of 0.8 GBP to 1 Euro has been applied

Passenger costs and values of time

2.6 Values of time (VoT) for leisure and business passengers are used to estimate passenger delay costs in the UK airport system. Business passenger values of time are further broken down into UK and foreign resident VoT. This analysis omits connection passengers. The values used in this analysis are presented below.

Passenger type	Value of time (£/hours) 2014 prices
Leisure passengers	6.60
UK Business passengers	49.20
Foreign business passengers	46.80

2.7 A leisure value of time is available as part of the DfT aviation model. Business values of time for both UK and foreign residents are based upon survey data from 32 UK airports. These values are based upon data collected in 2011 as this is the most comprehensive collection of survey results. Several growth indexes (also from the DfT aviation model) for each VoT are then applied so that they can be used in successive years.

10 https://www.eurocontrol.int/sites/default/files/content/documents/single-sky/pru/publications/other/european-airline-delay-cost-reference-values-final-report-v3.2.pdf

11 Flightpath (2050) http://ec.europa.eu/transport/modes/air/doc/flightpath2050.pdf

Carbon costs

2.8 Carbon costs are incurred when a flight experiences departure delay. The following assumptions have been used to estimate a carbon cost.

- Estimates of fuel burn for stack holding and taxiing for different aircraft are based upon the University of Westminster study.
- Fuel burn is converted in to $C0_2$ emissions on the basis that 1kg of kerosene (jet fuel) emits 3.15kg of $C0_2$.[12]
- Carbon values are provided in DECC's supplementary Green Book guidance.

Capacity and demand forecasts

2.9 Forecasts of airplane traffic, fleet mixes, passenger (including splits between business and leisure) volumes and airport capacity from 2025 to 2085 have been taken from the DfT aviation model. The following assumptions have been applied to these forecasts:

- Traffic forecasts have been split into summer (seven months) and winter (five months).
- The fleet mix is based on the categories of aircraft type used in the DfT's Fleet Mix model. These categories are used to derive broad averages for costs from the University of Westminster European airline delay cost reference values (see Airline costs).

What is not included

2.10 This analysis focuses on airline costs, passenger costs and carbon costs. It does not include any assessment of the impacts on noise respite, air-quality impacts, or any resilience or reliability benefit.

12 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/4503/uk-aviation-forecasts.pdf

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