CAA

BENCHMARKING OF HIGH LEVEL ECONOMIC AND FINANCIAL METRICS OF HEATHROW AIRPORT

CAA contract reference 2550

FINAL REPORT

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CONTENTS

FIGURES AND TABLES

FIGURES

TABLES

1 INTRODUCTION

This study forms a part of an initial suite of consultancy work that the CAA is executing in its duties as the economic regulator of Heathrow Airport. This section of the report describes the context of this study within the process of preparing for the H7 control period and its purpose and objectives.

1.1 Context of this study

The Civil Aviation Authority (CAA) is responsible for the economic regulation of Heathrow Airport Limited on a five-yearly (quinquennial) cycle. Under the Civil Aviation Act, the CAA's single, primary duty in this regard is to further the interests of the users of air transport services, which, in the airport context, concerns the range, availability, continuity, cost and quality of airport operation services.

The current regulatory controls (the sixth quinquennium (Q6)), have recently been extended by one year to mitigate some of the uncertainty associated with the expansion of runway capacity in the south-east and are now due to expire on 31 December 2019. In preparation for the establishment of H7 regulatory control period, the CAA has launched a programme to investigate the most appropriate regulatory arrangements to be applied to Heathrow.

This study forms a part of a suite of consultancy work that the CAA is executing in support of the H7 programme. We understand that this series of qualitative and quantitative studies is intended to build up a broad picture of the efficiency of HAL's current operations. Whilst this particular study addresses top-down airport benchmarking, other studies focus on:

- Cost and revenue allocation,
- Capital expenditure (capex) governance review,
- Operational expenditure (opex) efficiency review, and,
- Review of commercial revenues.

Whilst these studies are linked and there would be expected to be some overlap between them, we have had limited visibility of the results of the other studies as they have been undertaken in parallel time frames. It may therefore be necessary to update this study at a later date to ensure consistency across the suite.

Again, it is our understanding that this broad picture will then be used to identify priority areas for more detailed, deep-dive analysis during 2017.

1.2 Scope

1.2.1 Data sources

We have undertaken this study on the basis of the definition provided by the CAA that the study should only make use of information on airport performance that is publicly available. This means that we have predominantly used airport operators' published statutory accounts (and Regulatory accounts for Heathrow), alongside other presentations and reports the operators provide.

This principle applies to Heathrow Airport in exactly the same way as to the comparator airports considered. In the case of Heathrow, we have not requested nor utilised any information specifically provided for the purposes of this study. Whilst we have had access to Heathrow Airport staff during the course of this study, this has been limited to sharing the approach and methodology used and seeking some minor clarifications on publically available information. We have engaged in a similar way with Heathrow's main airlines and their representatives.

1.2.2 Data principles

Minimise adjustments

As a principle we have endeavoured to use data that has been accessed from as close to the original source as possible. To this end, we have only made four sets of adjustments to the raw data published in statutory account and/or annual reports as follows:

- We have excluded cost and/or revenue lines for activities that are reported explicitly but are not related to the main activities of an airport operator. These include rail operations at Heathrow and Tokyo Narita and ground handling operations at Vienna, for example, and which have been excluded throughout this report. However, publicly available data does not enable all such activities to be isolated; for example some airports generate costs and revenues from air traffic control but do not report these explicitly. There is therefore uncertainty in the comparability of the portfolio of activities included in cost and revenue figures.
- We have adjusted for inflation to 2015 values using World Bank inflation statistics
- We have converted local currency to GBP using World Bank exchange rates
- Where necessary, we have adjusted financial/reporting years to common calendar year basis by simple scaling.
- All results have been calculated using Purchasing Power Parity (PPP). The advantage of which is that this approach avoids the concerns associated with currency volatility. It is worth noting, however, that the reliability/accuracy of utilising PPP can be impacted by a number of factors that may differ between the airports being compared; including transport costs of goods, governmental sales and VAT tax, governmental interventions/tariffs for imported goods, comparative costs for non-traded goods such as overheads and competition/monopolisation of the provision of airport services.

Do not use proprietary data

We are clearly aware that proprietary airport benchmarking reports have been produced by various organisations over a number of years. As they are generally subscription based they may not be considered fully in the public domain. Examples include the Jacobs/LeighFisher (and prior to that Transport Research Laboratory (TRL) annual reports) on airport performance indicators and airport charges; and, the series of ATRS Global Airport Benchmarking Reports and associated database.

The current study has not referenced proprietary benchmarking reports and other studies which are not in the public domain as they contain processed rather than raw data so some insights may be lost.

We do not consider this to be a constraining factor as we have knowledge of the analysis techniques used to derive the results and they originate from public domain source data, which is readily accessible.

1.2.3 Top down approach

By definition, this study considers top level financial performance and other operating metrics at the enterprise level. It does not attempt to comment on the efficiency of the organisation at activity or functional process level as we have not considered detailed information at that level.

1.2.4 Role of seminars/ workshops

In our experience, stakeholder engagement is critical to the success of benchmarking projects. Airport stakeholders - the airports themselves and airline users - are usually experienced in using benchmarking for their own purposes, both regulatory and non-regulatory. For this reason we undertook a series of stakeholder engagement sessions (listed in the Appendix) during the course of this study.

These sessions resulted in sharing of experience and valuable input into the study methodology.

1.3 Objectives

Four objectives were described in the CAA's brief for this top down benchmarking study. In summary, these were:

a. Perform a high-level review of previous top-down benchmarking studies that have been carried out by the CAA, Competition Commission, overseas aviation regulators and others to understand:
   - the availability of data and metrics to inform this study
   - the likely limitations of these data and metrics
   - possible ways to overcome or mitigate these limitations

b. Develop a framework for identifying:
   - the economic and financial metrics which are likely to be most relevant for the CAA's purposes
   - for each metric, suitable comparators for Heathrow Airport, noting that different comparator sets may be needed for different metrics

c. Benchmark the appropriate economic and financial metrics for Heathrow against suitable comparators:
   - in a static analysis for a suitable base year
   - as a time-series analysis over a number of years where suitable data is available

d. Comment on Heathrow's performance in each of the chosen metrics:
   - taking into account, at least qualitatively, inherent and structural drivers for difference to understand Heathrow's position relative to the comparators
   - describing limitations on the method and underlying data
   - highlighting the lessons learnt
   - suggesting further, more detailed analysis to focus on areas of concern, reduce uncertainties and produce more reliable results

1.4 Use of this report

Clearly the future use of the results and findings from this study and the part that it will play in determining the H7 settlement is a matter for the CAA to determine as they see fit.

However, we would observe that this study will form only one of a number of relevant inputs that will come together during the course of the H7 preparation process. The restricted scope of the data used in the study and the limitations of any benchmarking approach as an indicator of absolute efficiency mean that it is only possible to use it to inform and to provide directional indications and it should not be treated in isolation from other parallel related workstreams.

2 APPROACH

Benchmarking is a well-established tool used to compare enterprises, costs, processes or activities, where the results of the benchmarking show the relative positions of each of the comparators on some predefined scale. Enterprise-level benchmarking is typically conducted from a top-down basis, and can thus indicate where there may be significant differences, for example in performance or competitive cost position, between peers.

From the CAA's perspective, to be relevant and useful, the metrics used in benchmarking must be aligned with the scope of the CAA's duty covering the range, availability, continuity, cost and quality of airport operation services. For this study of economic and financial metrics, cost and quality have been the principal considerations, acknowledging that there is often trade-off or balance between cost and quality.

2.1 Selection of metrics

2.1.1 Aligning metrics to the study objectives

The purpose of this benchmarking study, along with other parallel studies, is to inform the CAA's regulatory process. This means that metrics selected should align with the key elements of the regulatory regime to ensure that comparisons made are relevant and informative.

The CAA applies a single-till, regulatory asset base (RAB) regulatory model to Heathrow, calculated using a standard regulatory building blocks approach. The price control is set as a price cap per passenger.

The building blocks approach is illustrated in the Figure 1 using financial figures taken from Heathrow's 2015 regulatory accounts. This figure illustrates how the main metrics being benchmarked in this study are linked to the building blocks regulatory approach.

The following sections describe the way in which the key metrics are used in this study.

2.1.2 Operating cost metrics

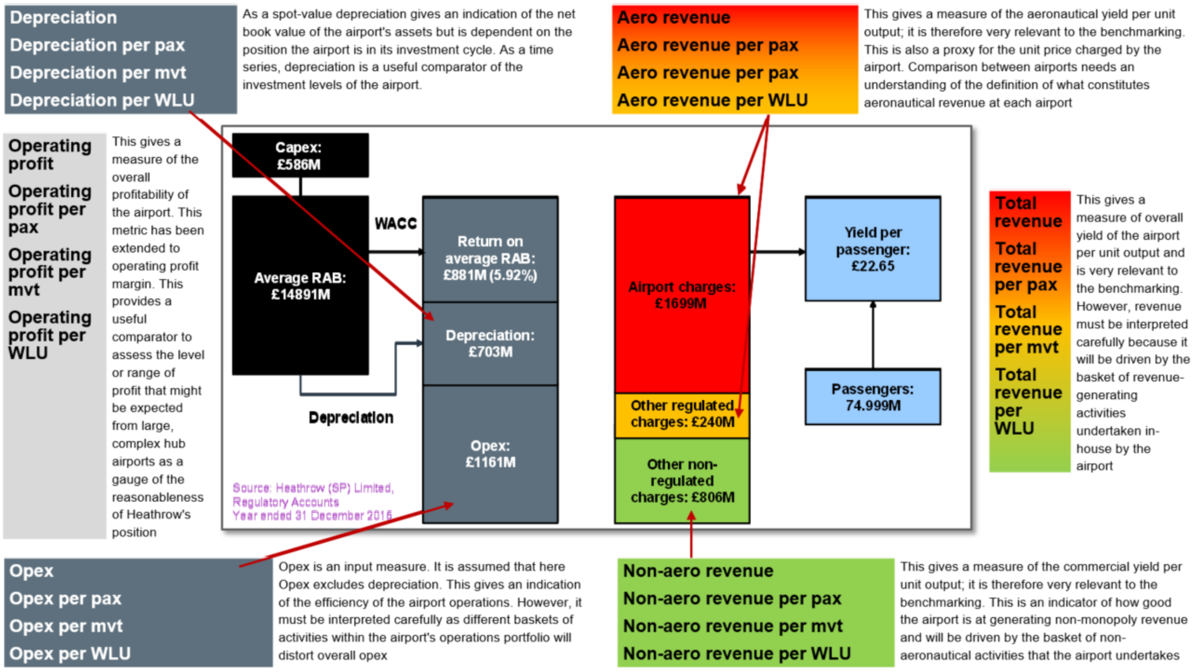
Operating cost is linked to the opex element in the building block approach shown in Figure 1 and is an input measure. Benchmarking operating costs will give an indication of the efficiency of the airport operations. However, operating costs must be interpreted carefully as different baskets of activities within the airport's operations portfolio will distort overall opex. As noted in 1.2.1, we have adjusted where necessary to make sure comparisons are on a like-for-like basis.

Sub-components of Operating Expenditure

In the airport context, operating expenditure is comprised of many sub-components, including staff costs, materials and services, utilities, rent and rates and other administrative costs.

With sufficient access to data it would be possible to benchmark each of these components, normalised by an output measure or driver, with comparator airports. This may lead to consideration of metrics such as materials and services costs per passenger or utilities cost or energy usage per square meter of terminal space.

Figure 1: KPIs used in this study are aligned to the Building Blocks regulatory approach



However, we have not analysed benchmarks at this lower level of opex for two key reasons:

1. A detailed examination of the efficiency of these sub-components of opex is the subject of the Operational expenditure (opex) efficiency review conducted by Cambridge Economics Policy Associates (CEPA) in parallel with our study, and;

2. Although Heathrow publishes data at this granularity, robust, consistent, comparable, quality data is often not available from the majority of public accounts that form our other data sources.

Staff costs

The one exception to this staff costs. At Heathrow where a large population of directly employed staff perform security duties, we understand that staff costs and efficient staff utilisation are of significant interest to the regulator and airport users. We have therefore added some limited consideration of staff efficiency by analysing staff numbers per million passengers processed and staff costs per employee.

Through further studies, it may be of value to analyse costs associated with particular staff groups by considering metrics such as security cost per passenger and security cost as a proportion of overall opex.

Depreciation

Timely and efficient capital investment in airport infrastructure to provide capacity and deliver customer service can be considered a desirable outcome of the regulatory process and in the interests of the end user. Depreciation gives an indication of the net book value of the airport's assets.

However, due to the long term nature of airport infrastructure investments and the associated depreciation policies, the depreciation cost recorded in an airport’s accounts in a particular year is, to a large extent dependent on the position of the airport in its infrastructure investment cycle.

Metrics such as depreciation costs per passenger have been considered as part of this study but have only received partial analysis as depreciation policies vary widely between companies and countries, and publicly sourced values may inject inconsistencies. Moreover:

- A thorough investigation would require more granular data than is publicly available

- Capital investment would need to be considered over a longer time horizon than analysed in this study
- Capital efficiency and processes will form the subject of other studies informing the H7 regulatory determination such as the Capex Governance Review being carried out as part of this initial suite of studies

2.1.3 Revenue metrics

Aeronautical revenue

Aeronautical revenue is linked to a combination of the airport charges and other regulated charges elements in the building blocks approach shown in Figure 1 and gives a measure of the aeronautical yield per unit output; it is therefore very relevant to the benchmarking. This is also a proxy for the unit price charged by the airport. Comparison between airports needs an understanding of the definition of what constitutes aeronautical revenue at each airport.

Non-aeronautical revenue

This is linked to the other non-regulated charges elements in the building blocks approach shown in Figure 1 and gives a measure of the commercial yield per unit output; it is therefore very relevant to the benchmarking. This is an indicator of how good the airport is at generating non-monopoly revenue and will be driven by the basket of non-aeronautical activities that the airport undertakes including retail, food and beverage and real estate activities.

2.1.4 Overall operating performance metrics

Earnings before interest, tax, depreciation and amortisation (EBITDA)

Consideration of overall financial performance provides a useful comparator to assess the level or range of profit that might be expected from large, complex hub airports as a gauge of the reasonableness of Heathrow's position. In this context we have taken EBITDA as the most meaningful measure of overall performance.

EBITDA Margin

We have extended consideration of profit to include analysis of EBITDA margin. This is defined as total airport earnings, excluding expenditure on interest, tax, depreciation and amortisation, as a proportion of total revenues. By breaking down EBITDA as a percentage of revenue, the use of the EBITDA margin allows comparisons between operations of different sizes (and potentially in different industries).

Earnings before interest and tax (EBIT)

For comparison with the EBITDA-based metrics, we have also considered Earnings before Interest and Tax (EBIT) as a means of including financial costs but eliminating the impact of the depreciation effects described above.

2.1.5 Use of metrics

The metrics selected in this study have been used in a number of different ways:

- Absolute values: these are dominated by the scale of the airport and, as such, are only of limited use for direct comparison but can form a vital input to understanding drivers for difference when interpreting the comparisons between airports.
- Normalised to the number of passengers: this is effectively normalising to one of the principal output measures of the airport - passenger throughput - and enables comparison between passenger related performance indicators.

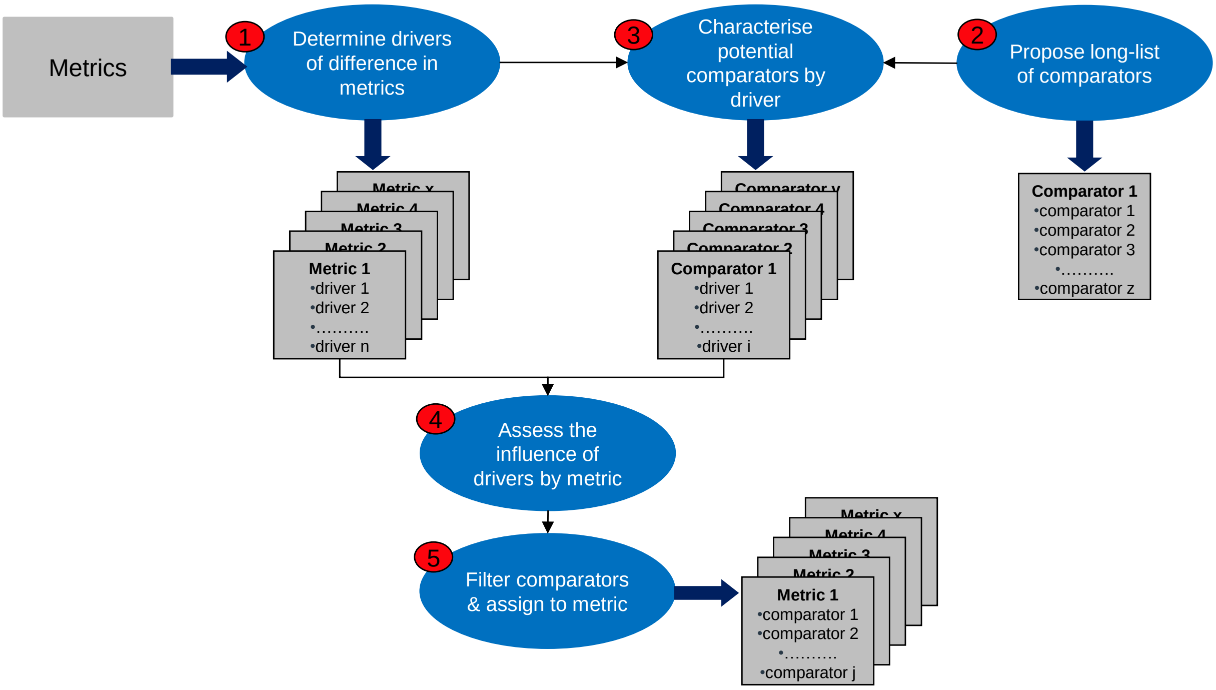
- Normalised to the number of workload units: this normalisation takes into account cargo and freight as a further output measure of the airport and is done by normalising to workload unit (WLU) defined as either one passenger or 100kg of freight.
- Normalised to the number of air transport movements: this is effectively normalising to one of the principal output measures of the airfield - runway throughput - and enables comparison of airfield performance indicators.

2.2 Selection of comparator airports

Selection of comparator airports is one of the critical components of the top-down benchmarking process. This is important to ensure that the airport extraneous or uncontrollable characteristics that influence the metric being compared across the sample are similar, ensuring as far as possible a like-for-like comparison.

The following figure illustrates our approach to selecting comparator airports, taking into account that there are different samples of comparators for some or all of the metrics.

Figure 2: Selection of comparators by metric



There are five main steps in our approach which are described in sections 2.2.1 to 2.2.5:

- Determine the drivers for difference for each of the metrics
- Propose a long-list of potential comparator airports using previous experience and evidence from other studies for suitable, general comparators for Heathrow
- Characterise each of the potential comparators by driver for each of the metrics being assessed
- Assess the influence of the drivers for each metric to understand their impact and relevance in the benchmarking analysis
- Filter the comparators for each metric to create a sample that comprises a set of comparators that is reasonably similar to Heathrow to allow reliable comparison

2.2.1 Determining the drivers of difference

Drivers of airport performance indicators or metrics can be divided into two groups:

- External or non-controllable by the airport

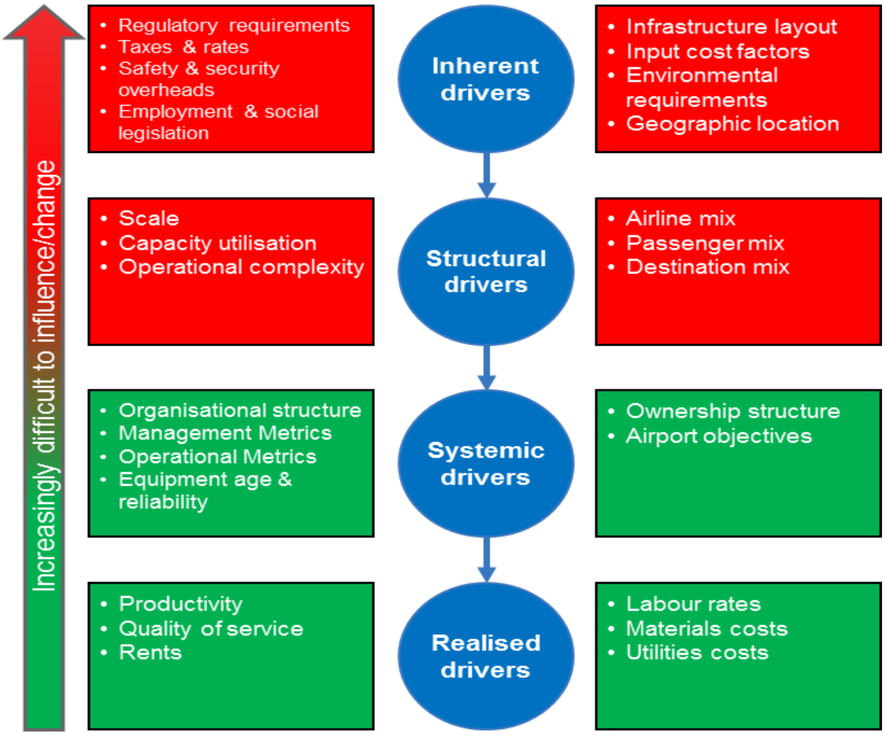
- Internal and controllable by the airport.

To perform the benchmarking, the effect of the non-controllable factors must be isolated as far as possible to give a true picture of the differences or relative performance of the airports based on what the airport can actually influence.

The widely-used ISSR framework (Inherent, Structural, Systemic, Realised), first used by Booz Allen Hamilton to support cost benchmarking, provides a way to break down the drivers in order to identify the fundamental causes and to interpret differences between, in this case, performance metrics. The ISSR framework allows the isolation of non-controllable and external factors with the objective of identifying real, controllable efficiency and effectiveness differences that can be used to determine potential improvements. An understanding of the drivers of the metrics is vital to produce meaningful results as without it the differences between comparators cannot be interpreted and, potentially, removed.

The following figure illustrates the framework, highlighting the drivers that affect airport performance. The framework has been populated using our experience accrued over many similar studies and refinement during the initial phases of the project based on lessons learnt from previous studies. It has been utilised to the fullest extent possible throughout the following assessments of the available data.

Figure 3: The ISSR framework applied at airport level



Within the ISSR framework, it is the difficult-to-influence drivers, in red in the upper half of the graphic, that need to be understood and accounted for when selecting the comparators.

2.2.2 Long list of comparator airports

We have developed a long-list of comparator airports from which comparator sets for individual metrics will be derived. This has been done by applying an initial set of filters to identify likely comparators.

First and foremost, it was our objective to ensure that the airports on the long-list are credible. For comparison, in 2015, Heathrow's traffic was approximately 75M passengers and 1.5M tonnes of freight carried on approximately 472,000 air transport movements operated by 80 airlines to 185 destinations. The airport has two parallel runways and four main terminals, with T5 having satellites.

Approximately 32% (24M) passengers connected through the airport rather than it being an origin or destination. British Airways is the dominant carrier, holding approximately 50% of Heathrow slots

To pass the credibility test, the following qualitative criteria have been considered as relevant in the selection of appropriate comparators:

- Scale and complexity: The comparators must be large airports with multiple runways and terminals. It would not be credible to compare Heathrow with small, regional airports, even though the comparison might be justified for some metrics.
- Operating model: The comparators must have broadly similar operating models. This means that US airports are not suitable comparators because of their - airline driven - approach to terminal management and operations
- Capital city airport and national gateways: The comparators should serve a capital or major city and be one of the main entry points for international traffic
- Destinations: The airport should serve a large number of international destinations
- Traffic mix: The airport should support a substantial proportion of connecting traffic
- Airline mix: The airport should support a home carrier with a significant share of the traffic. The proportion of legacy carriers should be high and low cost/no frills carriers should be low
- Utilisation: The airport must be heavily utilised, with traffic demand reaching a high proportion of capacity.

2.2.3 Characterise comparators by driver

Each of the comparators has been characterised by its inherent and structural drivers for difference in accordance with the aforementioned ISSR model. We have used this approach to create a fact-sheet for each potential comparator airport.

2.2.4 Identifying and assessing the influence of drivers for each metric

It is important to understand the influence that the above drivers have on each of the metrics to assess whether the driver is important for the specific metric or whether it can be disregarded altogether. If the driver is important, its influence on the metric needs to be estimated so that the suitability of the comparator can be assessed.

The influence of drivers has been assessed both qualitatively and via multi-variable regression as indicated below.

Qualitative

Qualitative arguments were formulated to describe the intuitive impact of the drivers on the metrics. This approach is based on judgement and experience.

Multi-variable regression

If sufficient data are available, simple, linear multi-variable regression can be used to indicate the influence of drivers on the performance metric, as used in the study of LeighFisher "*Comparing and capping airport charges*"[1].

Linear regression models are designed to identify relationships between a dependent variable and one/many independent variables. In our case, the performance metric is the dependent variable and the potential drivers for difference are the independent variables. The approach enables significant predictors of the dependent variable to be identified as well as their relative impact on the dependent variable. The significance of each independent variable (each driver) in the overall value of the performance metric is indicated by the P-value. This gives the level of confidence that an individual driver influences the performance metric: the lower the P-value the higher the confidence that the

[1] Comparing and Capping Charges at Regulated Airports, April 2013 – LeighFisher for CAA

driver has a significant influence on the metric. The magnitude and direction of the impact of each independent variable on the dependent variable is expressed in terms of model coefficients. Each coefficient describes the rate of change in a metric resulting from a unit change in a specific driver, assuming levels of all other drivers remain unchanged.

Linear regression is therefore a technique which could be used to understand the relative influence of different drivers on a specific performance metric. A linear regression model was built for each metric and P-values were used to identify the main drivers of each metric. The results of the regression analysis, which are necessarily different for each metric, are presented in Section 5 – 7. Colour coding has been applied to indicate drivers with the highest impact: (i) green – most relevant drivers with p-value below 0.1, (ii) orange – relevant drivers with p-value between 0.1 and 0.2, (iii) yellow – semi-relevant drivers with p-value between 0.2 and 0.3, and (iv) white – drivers not significantly relevant with p-value above 0.3.

As with the majority of statistical methods, regression analysis is based on a number of assumptions, which when violated may affect the results of any analysis performed. In this instance, it should be acknowledged that the list of independent variables assessed were not necessarily entirely independent of one another, and the sample sizes are relatively small (only 20 airports were considered). However, given that we are only using this technique to shortlist the independent variables and consequently identify the most comparable airports to Heathrow, these potential concerns do not have a significant impact on the overall benchmarking exercise performed.

2.2.5 Filtering by driver to create comparator sets for each metric

In order to ensure a reliable benchmarking process it was necessary to select, for each performance metric, a set of comparator airports with similar characteristics (from the 20 airports for which data was obtained).

Comparable airports have been selected using the shortlisted set of independent (predictor) variables for each performance metric (identified as those with a significant P-value as described above). For each of these independent variables (drivers), airports are identified which have a relatively similar value to Heathrow; airports were considered to be comparable if their value was within +/- 50% of the “normalised” Heathrow value for a particular variable[2]. Airports for which all significant drivers had been indicated as relevant were selected as comparator airports and indicated with green colours in the Figures discussed in Section 5 – 7. Airports for which majority of significant drivers were considered as relevant were also included in the comparators set and were indicated in orange (e.g. airports of which certain significant drivers were just outside the indicated range). Remaining airports were not considered as suitable comparators for Heathrow.

2.2.6 Demonstration of the methodology – the Opex example

In the following section the described methodology is explained based on the Opex metric.

In the first step, the regression analysis was run in order to identify the drivers that are most significant for the analysed metric (see the results in Table 1). The selection of the drivers have been conducted in line with the rules described in the paragraph entitled “Multi-variable regression”; the colour coding has been applied accordingly, i.e. green – most relevant, amber - relevant, yellow - semi-relevant, white – not relevant. Drivers with P-value below 0.3 were considered as significant. In essence, the highlighted cells in the first columns indicate which drivers had greatest effect on the Opex metric; these were: Skytrax ratings, the number of runways, the runway demand/capacity ratio and proportion of long haul destinations, and to a lesser extent the proportion of connecting passengers.

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[2] **Heathrow normalised drivers have been calculated by dividing Heathrow’s metric value by the regression coefficient for each specific driver. This has been done in order to address the sensitivity of each metric to changes of the different drivers.**

Table 1: The results of the regression analysis – the Opex metric

Drivers	Coefficients	Standard Error	t Stat	P-value
Intercept	87.87	58.87	1.49	0.20
Price cap regulation	-1.06	2.88	-0.37	0.73
Skytrax rating (stars)/5	-6.80	2.90	-2.35	0.07
Number of simultaneously active runways	-17.33	7.60	-2.28	0.07
Number of terminals	0.89	1.32	0.67	0.53
Number of passengers per year	0.00	0.00	1.19	0.29
Runway demand/ capacity ratio	-46.24	22.26	-2.08	0.09
Proportion of connecting passengers	48.36	29.42	1.64	0.16
Number of airlines	-0.05	0.27	-0.18	0.87
Proportion of network carriers	-35.53	51.53	-0.69	0.52
Number of destinations	0.05	0.04	1.13	0.31
Proportion of long haul destinations	44.32	19.35	2.29	0.07

In the second step lower and upper bounds for the values of driver parameters have been calculated. As described in the section above, airports were considered to be comparable if their value was within +/- 50% of the "normalised" Heathrow value for a particular variable. The calculated ranges of significant parameters are presented in **Error! Not a valid bookmark self-reference.**.

Table 2: Lower and upper bounds for values of significant drivers of the Opex metric

	Skytrax rating (stars)/5	Number of simultaneously active runways	Runway demand/ capacity ratio	Proportion of connecting passengers	Proportion of long haul destinations
Lower Bound	3.0	1	0.7	0.14	0.20
Upper Bound	5.0	3	1.2	0.46	0.60

In the final step, values of significant drivers have been compared against the calculated ranges. The values that are relatively close to Heathrow value, i.e. that fall within the calculated ranges, are considered as relevant and indicated with the blue background (see Table 3). Airports with a high level of significant drivers that were identified as relevant have been selected as relevant for Heathrow benchmarking (see airports indicated with green and amber). In case of the Opex metric these were: LGW, PEK, AMS, NRT, SIN, HKG, ZRH, ICN and MEL.

Table 3: Relevant drivers and identified comparator airports for the Opex metric

Airports	Skytrax rating (stars)/5	Number of simultaneously active runways	Runway demand/ capacity ratio	Proportion of connecting passengers	Proportion of long haul destinations
LHR	4	2	1.0	0.30	0.42
LGW	3	1	1.0	0.04	0.21
SYD	4	2	0.6	0.21	0.14
PEK	4	3	0.8	0.30	0.25
AMS	4	3	0.7	0.40	0.27
ADR	3	3	0.5	0.30	0.20
NRT	4	2	0.5	0.17	0.35
SIN	5	2	0.7	0.30	0.34
HKG	5	2	0.8	0.36	0.26
VIE	4	2	0.5	0.32	0.11
OSL	2	2	0.5	0.17	0.08
CPH	4	2	0.5	0.23	0.14
ZRH	4	2	0.5	0.33	0.20
ICN	5	2	0.6	0.16	0.41
MAN	3	2	0.3	0.03	0.16
MEL	3.5	1	0.9	0.11	0.20
DUB	2.5	1	0.8	0.05	0.09
CDG	4	4	0.5	0.24	0.35
FRA	4	3	0.6	0.59	0.33

2.3 Limitations of approach

High level benchmarking is a tried and tested technique for comparing enterprise performance, but has well documented shortcomings. As noted above there are several examples of drivers of differences between enterprises, including:

- Portfolio of services within the cost base
- Physical architectures, driving reasonable costs
- Traffic mix and temporal distribution
- Legitimate service standards, tailored to customers' needs
- Differences in cost accounting procedures

- Hidden or implicit subsidies
- Local tax rates and exemptions
- Social costs

It is therefore essential to isolate the impacts of uncontrollable factors to ensure a like-for-like comparison. This is particularly challenging when the comparator pool is limited both in size and composition as is inevitably the case in airport benchmarking.

Furthermore, benchmarking is only an indicator of relative position; it cannot give an indication of absolute efficiency. Benchmarking can provide an indication of reasonable efficiency improvement targets when its subject is less efficient than the best in class in the comparator group – although the nearer the subject is to best in class the smaller in percentage terms the prescribed improvements would likely be.

However, should Heathrow's position, for example, be shown to be the "best in class" for a metric, it would indicate little scope for efficiency improvement in that metric relative to those other comparators in the sample. However as benchmarking is only relative that is not to say that an efficiency improvement in the metric is not possible but rather the reasonable magnitude of such an improvement would need to be identified through alternative analyses.

In summary, despite benchmarking having a number of inherent limitations, it can be a powerful tool to assess airport performance when these issues are taken into account.

3 PREVIOUS STUDIES

There have been numerous top down benchmarking studies of airports, funded by airports themselves, aviation and competition regulators, and consultancy and research organisations. We have considered the extent to which these studies might be useful sources of data and insights to inform the CAA of the comparative high-level performance of Heathrow.

3.1 Scope

We have identified ten previous studies carried out between 2009 and 2016 which are in the public domain and which have some relevance to the current top down benchmarking study. The objectives and relevance of these previous studies are detailed in Table 4 below.

Table 4: Previous studies and their relevance to the current top-down benchmarking study

	Title	Date	Sponsor:	Author:	Objectives	Relevance to LHR benchmarking
1	Evaluation of the 2009 Competition Commission's BAA airports market investigation remedies	May-16	CMA	ICFi	To understand the effects of the CC's remedies for the UK airports market and estimate the consumer benefits.	Considers relative performance in terms of charges and operating efficiency (but primarily for STN and LGW rather than LHR)
2	Evaluation of the Competition Commission's BAA airports market investigation	Jan-16	Gatwick Airport Limited	Oxera	To analyse whether the CC's expectations about the competition that would arise due to the divestment of Gatwick have actually transpired	Some comparative analysis of revenue and cost per passenger comparing Gatwick to other European airports
3	Scarcity rents and airport charges	Apr-15	Airports Commission	SEO/ ITF	To analyse technical responses submitted during the Airports Commission consultation process and understand whether scarcity rents benefit airlines at LGW and LHR	Provides some limited context information on aspects of airport charges
4	European airport operating cost benchmarking 2010–14	2015	Internal study	Strategy &	To compare cost revenue and operations at European airports based on publically available information	Provides summary data comparing financial performance metrics for European airports

5	Evaluation of Directive 2009/12/EC on airport charges	Sep-13	DG MOVE	Steer Davies Gleave	To assist the Commission in understanding to what extent the Directive's objectives have been attained	Provides analysis of the transparency of charging and the relationship between cost and charges for major European airports
6	CAP1060 CAA Airport Operating Expenditure Benchmarking Report 2012	Jun-13	CAA	CAA	To review and assess airport opex benchmarking evidence available to CAA based on publically available sources in order to inform Q6 initial proposals	Directly relevant literature review and benchmarking from publically available sources
7	Comparing and Capping Charges at Regulated Airports	Apr-13	CAA RPG	Leigh Fisher	Objectives included identifying whether it is possible to benchmark prices at comparable airports to assess the "affordability" or reasonableness of charges at LHR	Directly relevant in terms of selecting airport comparators and benchmark price information in comparator groups
8	Regulated regimes at airports: an international comparison	Jan-13	Gatwick Airport Limited	Oxera	A review of the economic regulatory regimes in place at seven international airports, characterising their main features, practical application and regulatory burden.	Provides background understanding of regulatory regimes which informs an appropriate selection of benchmark comparators for Heathrow
9	Guide to Airport Performance Measures	Feb-12	ACI	Oliver Wyman	To provide a useful set of defined airport performance measures and discussion of the factors that drive particular results	Context on the relevance and importance of KPIs to assist in selection of metrics for the LHR benchmarking study
10	Dublin Airport Terminal 2 Operating cost assessment	Nov-09	CAR	Booz & co.	To provide an assessment of the impact on opex of the opening Terminal 2 at Dublin Airport to inform determination of an appropriate price cap for DAA	General background on the constituent elements and drivers of airport opex, crated from a bottom up analysis.

It should be noted that the previous studies listed have not all been driven by the same objectives as the current top down benchmarking study and some are not directly related to benchmarking of airport operational and financial performance. However, despite their differing objectives and purposes, they each have some elements of comparison in their methodology and results.

Whilst we are aware that other detailed benchmarking studies have been carried out, for example the Booz study[3] commissioned by HAL in 2011 in support of the Q6 regulatory process, we have not referenced this in our work as it is not publically available. Whilst a copy is, theoretically, available through the CAA it continues to be excluded from this assessment so as to preserve the proprietary data principle indicated in section 1.2.2, especially as such data has been processed from its raw state.

3.2 Review of previous studies

In reviewing previous studies, we assessed whether:

- the metrics that are being compared are relevant to the CAA's purpose
- the airports in the sample for each metric are broadly comparable to Heathrow taking into account the potential driver for difference
- the data are well-defined and available at sufficient detail and granularity to be useful

3.3 Observations from previous studies

Two of the ten studies were directly relevant as they supported similar objectives for the CAA in the previous regulatory cycle. These studies were the Leigh Fisher Comparing and Capping Charges[4] study from 2013 and the CAA's own Airport Operating Expenditure Benchmarking[5] review from 2012.

We also noted that the Strategy& Airport Operating Cost Benchmarking[6] reference guide uses publically available information from annual reports to benchmark opex and a limited set of other financial KPIs. Although the dataset used in this study comprises European airports only and its KPIs are normalised by passengers only, it provided some useful context to the current study.

As this study appeared only to make a few adjustments to source data, we also found it possible to readily replicate the results found in this guide document.

3.4 Conclusions

In conclusion, there were some useful aspects of this literature review, in particular the way in which previous studies had gone about the selection of comparator groups. This informed the methodology which we used in this study.

We also observed that the number of adjustments and factors applied to raw data by a number of the studies added complexity to the methods used and potentially made the results obtained more 'opaque'. This reinforced our principles of minimising the number of adjustments made to those which were absolutely necessary and creating a process that could be recreated by an independent body outside of our study if necessary.

Whilst the Strategy& Airport Operating Cost Benchmark guide used a brief that was most similar to the scope of our study, there were no studies in the literature review that we felt were directly comparable and we have therefore collated all of the raw data which forms the basis of this benchmarking study directly from primary sources.

[3] European Airport Benchmarking Study, May 2011 - Booz&co for Heathrow Airport Ltd

[4] Comparing and Capping Charges at Regulated Airports, April 2013 – Leigh Fisher for CAA

[5] CAP1060 CAA Airport Operating Expenditure Benchmarking Report 2012

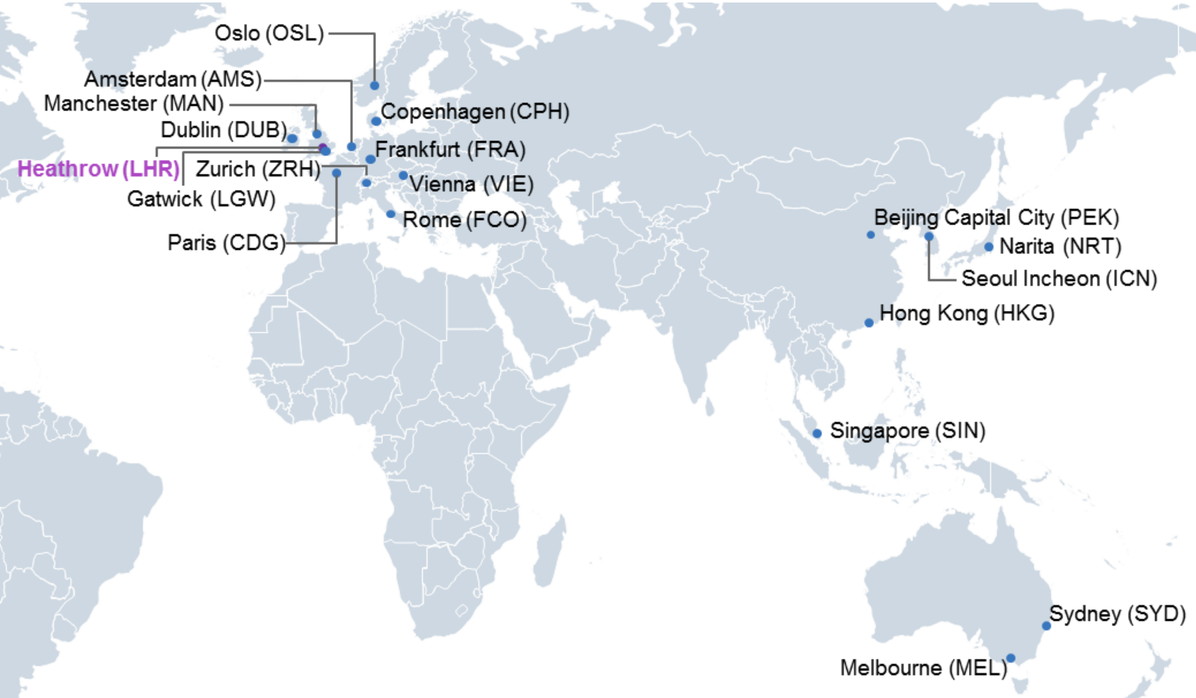
[6] European airport operating cost benchmarking, 2010–14 – Strategy& internal study

4 COMPARATOR AIRPORTS

4.1 Airports included in the long-list

Applying the simple criteria described in section 2.2.2 and assessing the quality of data available from each, we have included the following airports in the long-list of comparator airports shown in Figure 4.

Figure 4: Comparator airports used in the long-list



4.1.1 Significant exclusions

We have excluded North American airports from the comparator list because of their significantly different operating model - where terminals are often operated by airlines, not the airport - and the use of the passenger facility charge to fund Federal Aviation Administration (FAA) approved projects that enhance safety, security, or capacity; reduce noise; or increase air carrier competition.

There were also several airports which were considered to be comparable to Heathrow on a number of the qualitative criteria such as scale and complexity but were excluded from the study as publicly available data was not available. Examples of such airports include Istanbul Ataturk (IST) and Dubai (DXB).

4.1.2 Limitations of data from airport operating groups

We have also encountered a number of airports which would be relevant comparators but which are part of airport groups operating multiple airports. In most cases it is difficult to extract individual airport performance data from published group level accounts without introducing estimations through pro-rating total group data.

In the cases of Aéroports de Paris (ADP), Fraport and Aeroporti di Roma (ADR) we have therefore used group data as a proxy for the performance of the operations of the main airports within the groups at Paris Charles de Gaulle (CDG), Frankfurt (FRA) and Rome Fiumicino (FCO) respectively. This approximation is appropriate as long as the contribution of the principal airport operations is high as a proportion of the groups and therefore dominates overall group performance. This assumption is:

- likely to be valid for ADR/FCO where FCO comprises nearly 90% of the group's traffic
- probably valid for ADP/CDG, where CDG comprises just over two thirds of the group's traffic
- may break down for Fraport/FRA, where FRA represents less than half of the total traffic served by Fraport's complex portfolio of airports.

Munich Airport Group reports on a number of other activities not directly related to local airport operations. Costs and revenues associated with these other activities are not differentiated in annual reports and cannot be isolated from airport activities. We have, therefore, excluded Munich Airport (MUC) airport from our long-list of potential comparators.

4.2 Comparator airport characteristics

Full information on the characteristics of each of the comparator airports have been collated as a series of 'factsheets' in a supporting spreadsheet to this analysis. These characteristics are further summarised in Table 5 below.

Of note are the following definitions:

Proportion of network carriers: the number of network carriers operate a network of routes (rather than point to point arrangement) over the total number of carriers at the airport.

Proportion of long haul destinations: long haul flights can be presumed to be between 6-12 hours in duration and undertaken by wide-bodied aircraft, typically without stopping.

Table 5: Characteristics of comparator airports on the long-list – 2014 data

	Price cap regulation[7]	Skytrax rating (stars)/5	Number of simultaneously active runways	Number of terminals	Number of passengers per year (m)	Pax per movement	Number of ATMs per year (k)	Runway demand/ capacity ratio	Proportion of connecting passengers	Number of airlines	Proportion of network carriers	Number of destinations	Proportion of long haul destinations
LHR	1	4	2	4	73.4	156	471	0.97	30%	81	99%	206	42%
LGW	0	3	1	2	38.0	150	254	0.99	4%	51	88%	231	21%
SYD	0	4	2	3	38.5	127	304	0.63	21%	43	91%	86	14%
PEK	0	4	3	3	83.7	147	568	0.78	30%	83	99%	265	25%
AMS	0	4	3	1	60.6	125	484	0.67	40%	89	94%	307	27%
ADR	1	3	3	4	43.6	121	362	0.50	30%	89	85%	225	20%
NRT	0	4	2	3	36.0	159	226	0.47	17%	62	90%	127	35%
SIN	1	5	2	3	53.9	158	341	0.70	30%	70	92%	153	34%
HKG	0	5	2	2	63.7	163	391	0.81	36%	91	85%	176	26%
VIE	1	4	2	4	22.4	98	229	0.47	32%	73	82%	209	11%

[7] It is understood that not all airports that are marked '1' in this column are subject to exactly the same form of price-cap regulation. However, this broad approach is appropriate as this column is simply used to inform the selection of the comparator group.

OSL	0	2	2	1	24.3	101	241	0.50	17%	43	93%	154	8%
CPH	1	4	2	2	25.5	104	245	0.51	23%	65	88%	201	14%
ZRH	1	4	2	3	25.5	110	231	0.48	33%	62	87%	182	20%
ICN	0	5	2	1	45.5	157	290	0.60	16%	61	86%	180	41%
ADP	1	4	4	3	65.8	139	472	0.82	35%	135	93%	259	40%
FRA	0	4	3	2	59.6	127	469	0.93	55%	118	93%	294	34%
MAN	0	3	2	3	25.6	122	171	0.51	3%	62	52%	205	19%
MEL	0	3.5	2	4	33.7	143	235	0.90	4%	30	87%	65	23%
DUB	1	2.5	2	2	21.7	121	180	0.62	5%	37	57%	180	10%

4.3 Comparison of output measures

There are three key output measures of airport operations:

- Passenger numbers
- Work Load Units (WLU) where a WLU is defined as one passenger or 100kg of freight or cargo
- Air Transport Movements (ATMs) where an ATM is either an aircraft landing at or taking off from the airport in question

Each of these outputs is used in later stages of this study to normalise the performance of different airports to enable comparison.

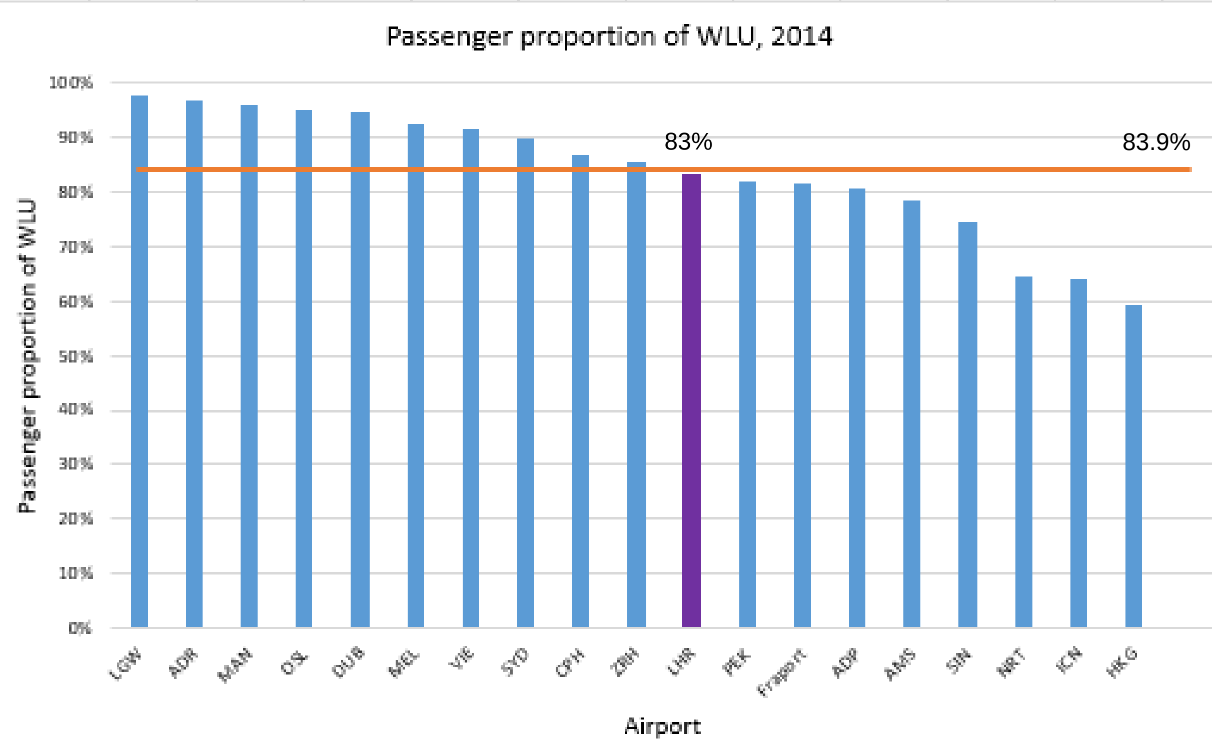
The number of passengers processed through an airport is a proxy measure for the total volume of activity required but will most directly reflect the work required in the landside and terminal aspects of the operation. By further considering WLUs, the volume of non-passenger (e.g. cargo) activity at an airport is incorporated, in addition to the passenger demand. The total number of movements is another proxy for the total process output of an airport but in this case it most accurately reflects demand on the airside infrastructure (and again includes non-passenger movements/cargo only traffic and so normalising revenues per ATM can provide different useful results for some airports compared with revenues per pax).

Before we go on to benchmark Heathrow's performance in terms of the cost, revenue and overall operating performance metrics in Sections 5, 6 and 7 of this report, we have compared the relationship between these output measures for the airports in the sample group to determine the extent to which differences in these characteristics are likely to influence the benchmarking results.

4.3.1 Passenger traffic as a proportion of total workload units

Figure 5 below shows that the proportional contribution of passenger traffic to the total workload units handled at Heathrow is similar to the average of the complete comparator long-list group of airports used in this study (NB: LHR data has been included in all average calculations). The range of results around the average reflects the differing commercial models between airports with established cargo hubs such as Amsterdam and Hong Kong having higher contributions from their freight operations.

Figure 5: Passengers as a proportion of total workload units



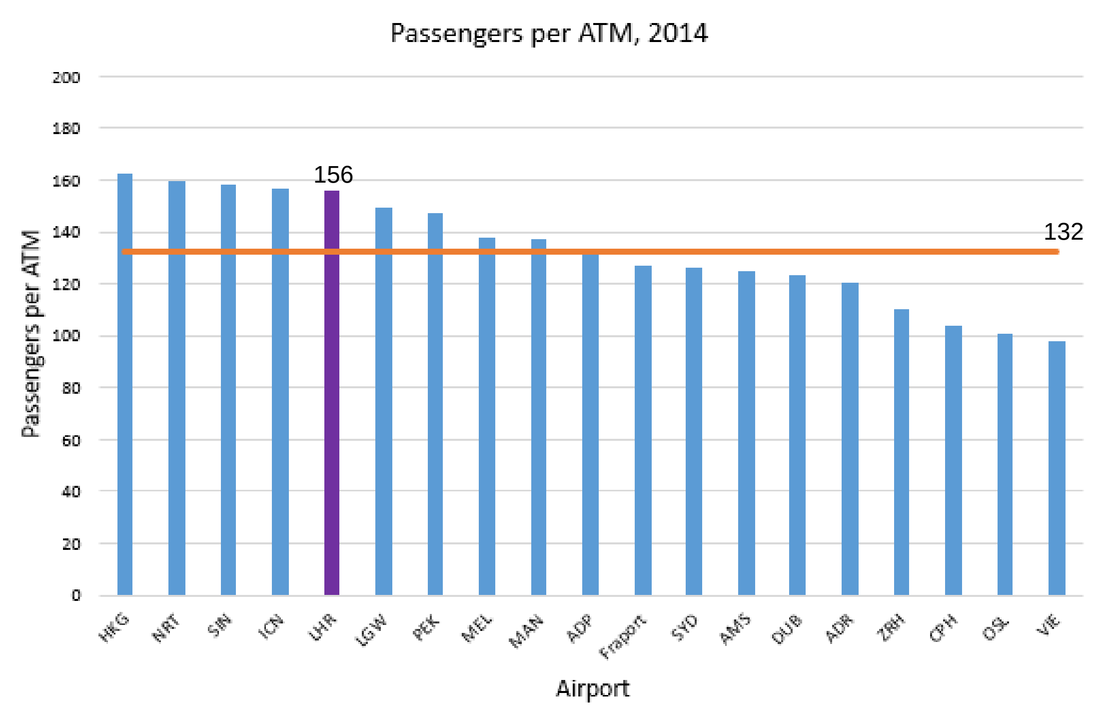
Whilst the relative importance of commercial passengers at AMS and HKG has grown slightly over time, Heathrow's percentage and its position relative to the group mean has remained fairly stable as shown by Figure 6 below. This reflects its limited ability to grow the cargo operation in a highly constrained operating environment.

Figure 6: Passengers as a proportion of total workload units 2007 - 2014

4.3.2 Passengers per ATM

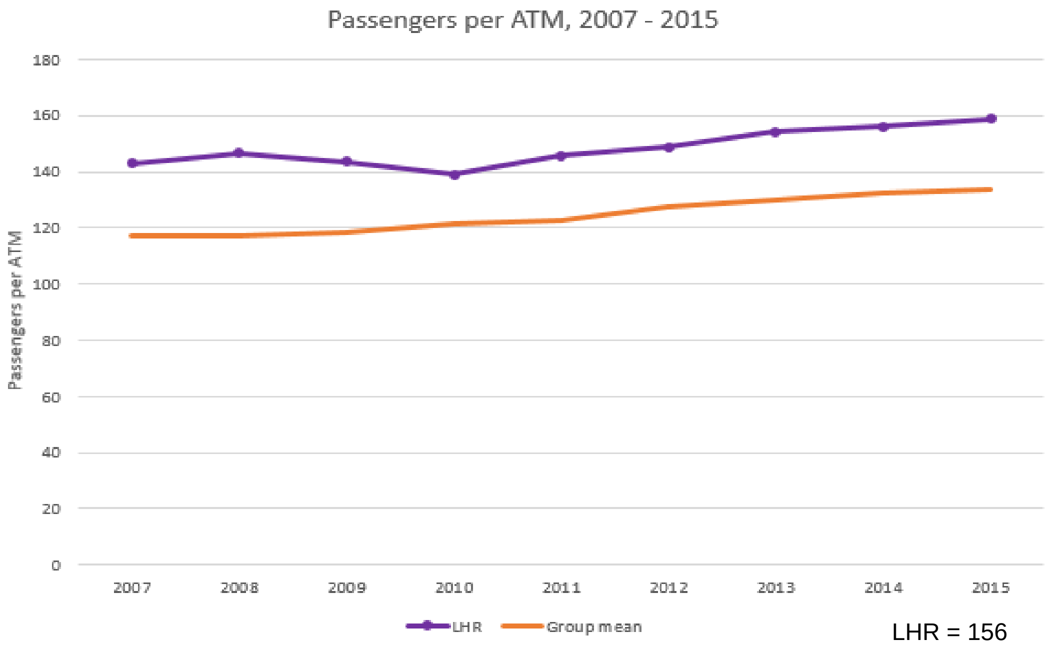
Figure 7 below illustrates that Heathrow handled 18% more passengers for each movement that the mean of the comparator group of airports used in this study. This variable has a moderate correlation with the proportion of long haul traffic handled at each airport.

Figure 7: Passengers per ATM at Heathrow and comparator airports, 2014



As a general trend in the comparator group, the number of passengers carried for each ATM has increased in recent years and this trend has also been reflected at Heathrow as shown by Figure 8. This metric is closely related to changes to airline fleet strategies and a trend towards new larger aircraft.

Figure 8: Passengers per ATM at Heathrow and comparator airports, 2007 - 2015



5 OPERATING COSTS

In this Section we consider Heathrow's performance benchmarked against the operating cost metrics discussed in Section 2.1.2.

This section includes consideration of total opex from all activities and a limited analysis of staff costs, to the extent possible with the available data. We expect that the efficiency of staff costs (which make up over 30% of Heathrow's total opex) will be a key topic informing the H7 process and have therefore recommended further routes of analysis beyond this study.

We have also included a high level overview of non-staff costs and depreciation costs but conclude that these topics will be best informed by future studies, including the Operational Expenditure (opex) Efficiency review and the Capital Governance (efficiency) review being carried out as part of this initial suite of studies.

To enable comparisons within the peer groups, we have generally normalised the benchmark figures against one or more of the three typical output measures for any airport; Passengers, Work Load Units (WLUs, where a work load unit is defined as one passenger or 100kg of freight) and Air Transport Movements (ATMs). Note that we have not presented charts in this report for all three normalisations where similar results are obtained.

Heathrow benchmarking is made against the most relevant comparator airports. The comparator airports have been selected following the methodology described in section 2.2.4 and 2.2.5.

In the following Sections 5 – 7 we present the results of the regression analyses that identify the significant drivers for each metric, followed by comparison charts used for Heathrow benchmarking analysis.

Each table with the regression analysis contains, among others, the information on each driver's coefficient that expresses the magnitude and direction of the driver's impact on the analysed performance metric, and the information on each driver's P-value that indicates the significance of each driver in the overall value of the analysed performance metric. The previously described colour coding have been applied to indicate the significance of each driver, i.e.:

- green – most relevant drivers with p-value below 0.1,
- orange – relevant drivers with p-value between 0.1 and 0.2,
- yellow – semi-relevant drivers with p-value between 0.2 and 0.3,
- white – drivers not significantly relevant with p-value above 0.3.

In the figures used for benchmarking analysis, the values of each metric and the total average of the selected comparator airports (including Heathrow airport) are presented. The comparator airports have been indicated using previously described colour coding, i.e.:

- green – airports for which all significant drivers were considered as relevant,
- orange – airports for which majority of significant drivers was considered as relevant,
- grey – airports for which none or proportion of significant drivers was considered as relevant (these airports were not included in the comparators set).

5.1 Total operating cost

Operating cost is an important constituent element in the building block approach regulatory model for Heathrow Airport and is a key input measure. Benchmarking operating costs by normalising against one of the output measures gives an indication of the efficiency of the airport operations. In this section we present the results of the regression analysis identifying the significant drivers for the Opex metric and discuss how Heathrow's Opex compares to the comparator airports' Opex.

In the table below (Table 6) the results of the regression analysis are presented. As one can see, following the methodology described in Section 2.2, five drivers were identified as having a significant influence on the Opex metric; these are: Skytrax ratings (stars)/5, Number of simultaneously active runaways, Runways demand/capacity ratio, Proportion of long haul destinations, and Proportion of connecting passengers.

Table 6: The results of the regression analysis for the Opex metric

Independent variables (the drivers)[1]	Coefficients	Standard Error	t Stat	P-value
Intercept	*87.873*	*58.87165217*	*1.49261999*	*0.195749998*
Price cap regulation	-1.05684	2.878651242	-0.367130086	0.728548132
Skytrax rating (stars)/5	-6.80151	2.89786464	-2.347078006	0.065798623
Number of simultaneously active runways	-17.333	7.602672155	-2.279857045	0.071550874
Number of terminals	0.885702	1.32332913	0.66929861	0.532963016
Number of passengers per year	3.88E-07	3.25855E-07	1.190516942	0.287278449
Runway demand/ capacity ratio	-46.2391	22.25688589	-2.077519857	0.092352543
Proportion of connecting passengers	48.36289	29.42192199	1.643770598	0.161144551
Number of airlines	-0.0476	0.269596959	-0.176547904	0.866791832
Proportion of network carriers	-35.5271	51.53461453	-0.689382803	0.521262933
Number of destinations	0.047806	0.04243269	1.126636491	0.31104411
Proportion of long haul destinations	44.31979	19.3494086	2.290498309	0.070605381

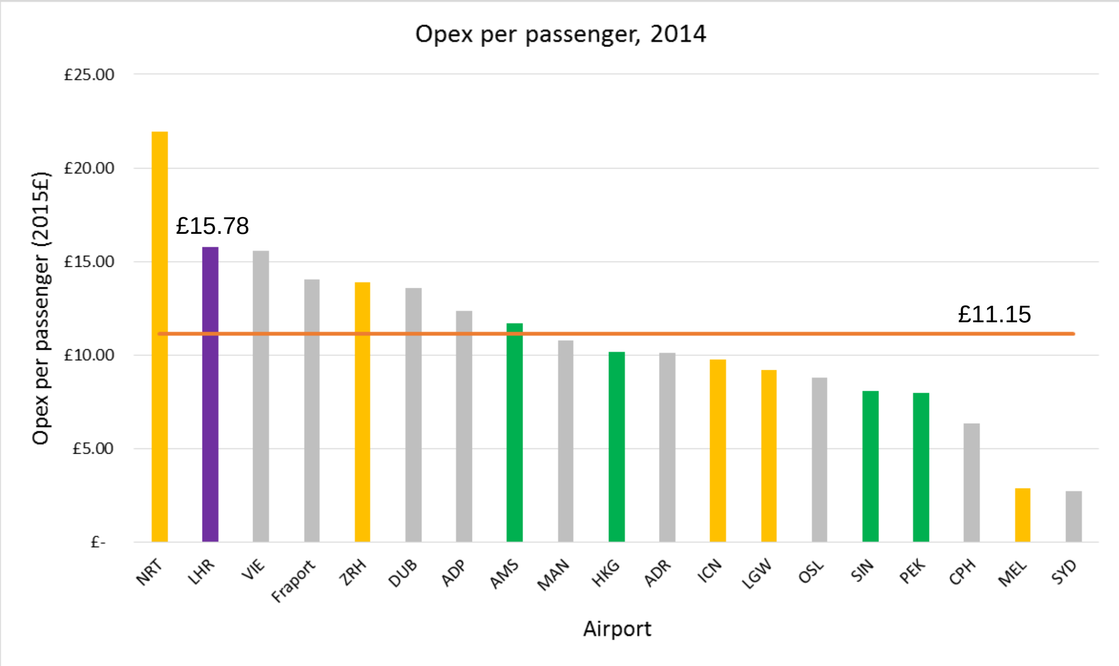
[1] Colour coding: green – most relevant drivers with p-value below 0.1, orange – relevant drivers with p-value between 0.1 and 0.2, yellow – semi-relevant drivers with p-value between 0.2 and 0.3, white – drivers not significantly relevant with p-value above 0.3

In the following section the comparison charts are presented for Total Opex per Passanger and Total Opex per ATM. As similar results are obtained when Total Opex per WLU is benchmarked - Heathrow holds a similar position in its peer group and in the time series analyses - no additional graphs were included for this normalisation.

5.1.1 Total opex per passenger

Figure 9 below shows that operating expenditure per passenger at Heathrow in 2014 was 42% higher than the average of the most relevant comparator airports used in this study (those shown in amber and green).

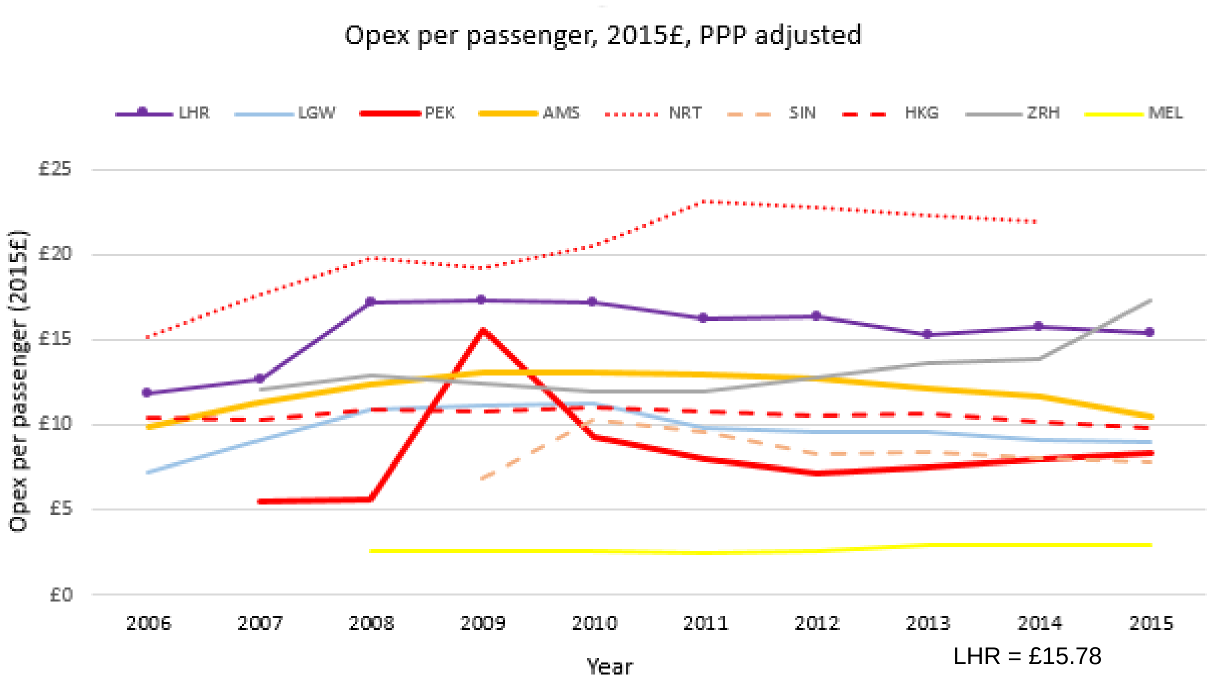
Figure 9: Opex per passenger, 2014



Heathrow has consistently been at the high end of its comparator peer group as shown by the time series analysis in Figure 10. Heathrow opex per passenger has reduced by 12% from 2009 to 2015. However in the same time period, the mean opex per passenger for the peer group considered has reduced by 18%. Of note is that figures provided by HAL provide an alternate calculation of a reduction of 13.2% between the same time period, and this is approximately equivalent to the results depicted here.

Note that the opex data illustrated for Incheon (ICN) in Figure 10 is likely to reflect the quality of data reported by that airport rather than show any meaningful trend.

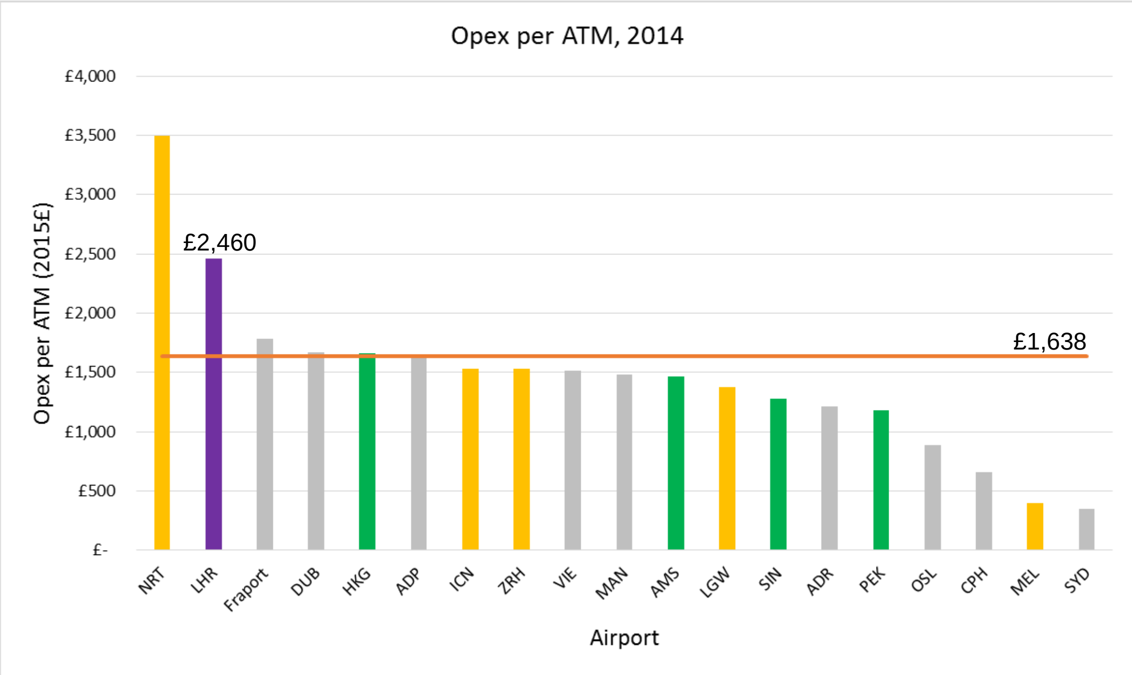
Figure 10: Opex per passenger, 2006 - 2015



5.1.2 Opex per ATM

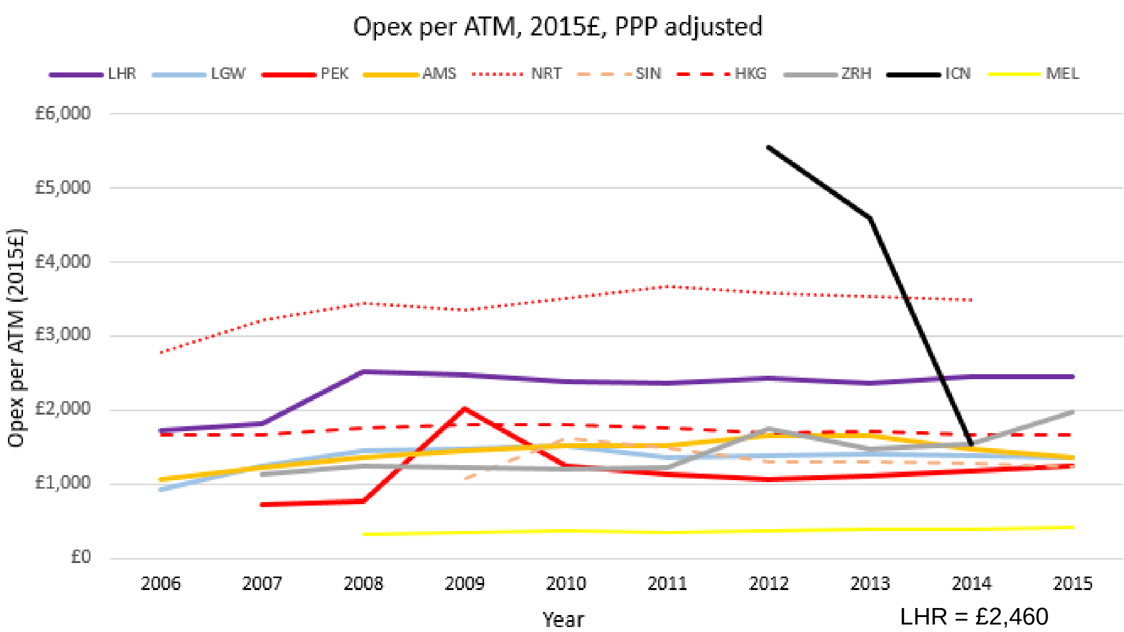
Figure 11 also shows Heathrow's opex to be significantly higher than its peer group average; in this case by 50%.

Figure 11: Opex per ATM, 2014



A time series analysis of this KPI as shown in Figure 12 shows that the improving trend in Heathrow's opex is less marked, showing only a 1% reduction from 2009 to 2015. The difference between this and the efficiency improvements observed when normalising opex by passengers is explained by the corresponding increase in passengers per ATM experienced at Heathrow in this period (as noted in Section 4.3.2).

Figure 12: Opex per ATM, 2006-2015



5.2 Staff Costs

As stated in Section 2.1.2 above, staff cost form a significant element of the total opex of Heathrow and the other comparator airports used in this study. Whilst our scope and other constraints of this study do not enable us to make a fully detailed benchmarking study of every element of opex, we have included some high level analysis of staff costs below.

Typically there are two factors which influence the total staff cost in any organisation; the level of reward and the number of staff employed.

(i) Pay rates

Whilst employment costs include wages and salaries, social security or national insurance costs and pension costs, it would be expected that an efficient employer would set pay rates competitively but within the typical market rate for the geographical catchment area they draw staff from.

We have therefore chosen to analyse unit staff costs i.e. staff costs per employee to understand Heathrow's relative position.

(ii) Staff numbers

It is also possible to benchmark the number of staff an airport employs and this is usually normalised by passenger volumes.

However, in considering the relative positions of comparator airports using this metric, it can be difficult to isolate absolute operational efficiencies from differences in the sourcing models of the airports. For example, the scope of services provided by directly employed airport staff often differs and each will have its own policy on whether to insource or outsource tasks carried out by the different staff groups. In particular, the airport operator's approach to the sourcing of passenger security screening staff (which form the largest staff group at Heathrow) will significantly influence their relative position in a benchmark comparison against this metric.

Comparisons with airport groups on this basis should also be treated with caution as a proportion of the overall staff numbers reported may include corporate or group staff not directly associated with the operation of a specific airport.

In the following part of this section we present the results of the regression analysis identifying the significant drivers for the Staff Cost metric and discuss how Heathrow's Staff Cost compares to the comparator airports' Staff Costs.

In the table below (Table 7) the results of the regression analysis are presented. As one can see, following the methodology described in Section 2.2, only one driver was identified as having a significant influence on the Opex metric, i.e. price cap regulation.

Table 7: The results of the regression analysis for the Staff Cost metrix

Independent variables (the drivers)[1]	Coefficients	Standard Error	t Stat	P-value
Intercept	*267729.0611*	*978457.219*	*0.273623676*	*0.795317005*
Price cap regulation	-81460.91181	58807.25198	-1.385218814	0.22460175
Skytrax rating (stars)/5	-44078.46631	49446.38622	-0.891439591	0.41352997
Number of simultaneously active runways	-148577.8475	162309.7967	-0.91539667	0.401974196
Number of terminals	-594.7258195	25886.91852	-0.02297399	0.98255968
Number of passengers per year	0.000535863	0.005474621	0.097881352	0.925829236
Runway demand/ capacity ratio	-299912.5245	436015.0041	-0.687849092	0.522150206
Proportion of connecting passengers	365776.979	614236.3531	0.595498748	0.577438517
Number of airlines	3467.618666	5064.506011	0.684690404	0.523980785
Proportion of network carriers	221895.5655	890156.4509	0.24927704	0.813062989

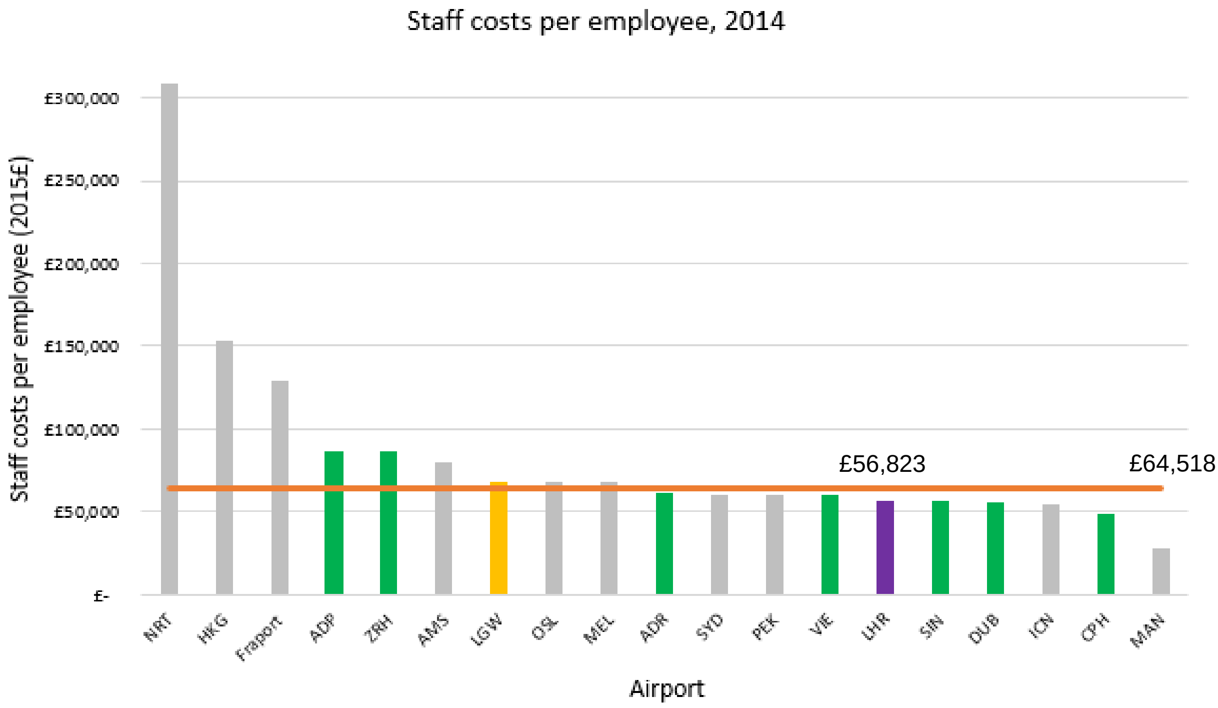
Number of destinations	-494.4090999	877.7117962	-0.563293215	0.597558135
Proportion of long haul destinations	293135.3561	357991.1858	0.818834004	0.450131215

[1] Colour coding: green – most relevant drivers with p-value below 0.1, orange – relevant drivers with p-value between 0.1 and 0.2, yellow – semi-relevant drivers with p-value between 0.2 and 0.3, white – drivers not significantly relevant with p-value above 0.3

5.2.1 Staff costs per employee

There is a large range of reported figures for staff costs per employee when considering the whole long-list of comparator airports in the study. However, when compared to the average of those airports considered as most relevant comparators to Heathrow i.e. those coloured green or amber, Heathrow compares favourably. In this case, Heathrow's 2014 staff costs per employee is 11% lower than the peer group average.

Figure 13: Staff costs per employee, 2014

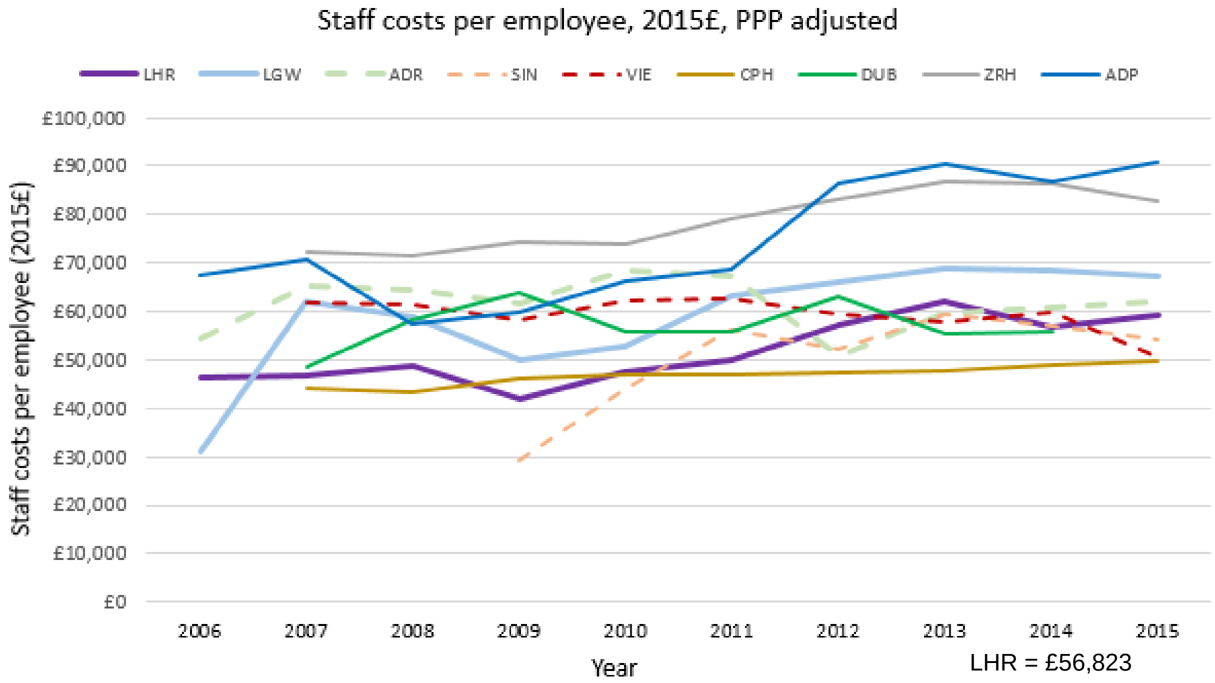


In relation to the data for Staff costs per employee it is important to note that at LHR prior to 2013 corporate staff costs were charged to the airport via an inter-company transaction so were not included within HAL staff costs. From 2013 corporate staff costs are included in HAL staff costs. Therefore, the numbers prior to 2013 are not directly comparable to the numbers from 2013.

The evolution of staff costs per employee at the airports shown in Figure 14 below shows that the increase in Heathrow's rates from 2009 to 2015 has been outstripped by other airports, notably Gatwick and ADP (used as proxy for Paris Charles de Gaulle).

Given the trends observed, we believe there are likely to be some exceptional items included in the staff cost data for 2012 and 2013 and these could be investigated further with reference to HAL.

Figure 14: Staff costs per employee, 2006 - 2015[8]



There are many further considerations when benchmarking the efficient use of operational expenditure attributable to staff at airports.

Staff costs per employee will be influenced, for example by the operator's approach to sourcing. At Heathrow where the majority of staff employed are security officers, average unit rates are likely to tend towards lower operational pay levels. Where a high proportion of operational roles are outsourced however, the reverse may be true and a higher unit staff rate may be expected.

Pay rates and their relative position in comparison to local market rates would be expected to be the subject of further, more detailed analysis outside the scope of this study following the brief and methodology used in previous investigations[9].

5.2.2 Staff per million passengers

From Figure 15 it can be seen that Heathrow has a higher than average number of staff directly employed per million passengers than the group mean and is in the upper region of the group alongside other airports who directly employ their own passenger security screening staff such as Dublin (DUB) and Copenhagen (CPH). At an airport where security staff are predominantly outsourced, for example Amsterdam Schiphol (AMS), the number of staff per million passenger directly employed is correspondingly lower.

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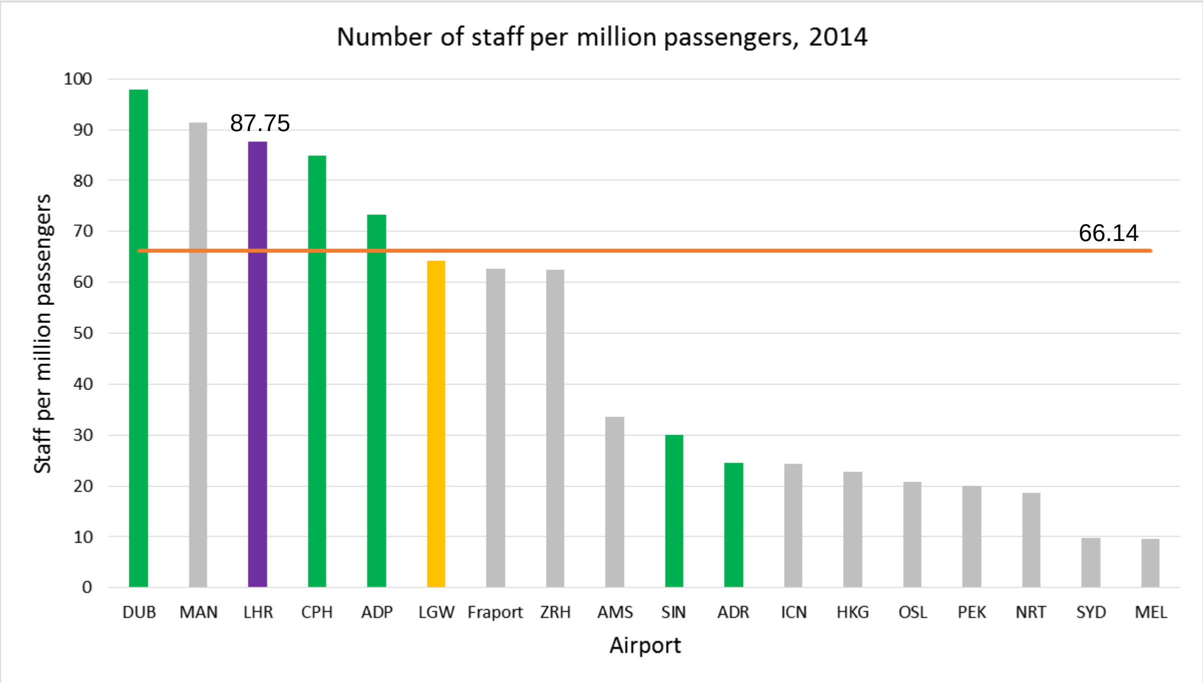
[8] 'Staff costs' represent normal employment costs only and exceptional items such as one-off pension scheme payments have been excluded where these are specifically identified in company accounts

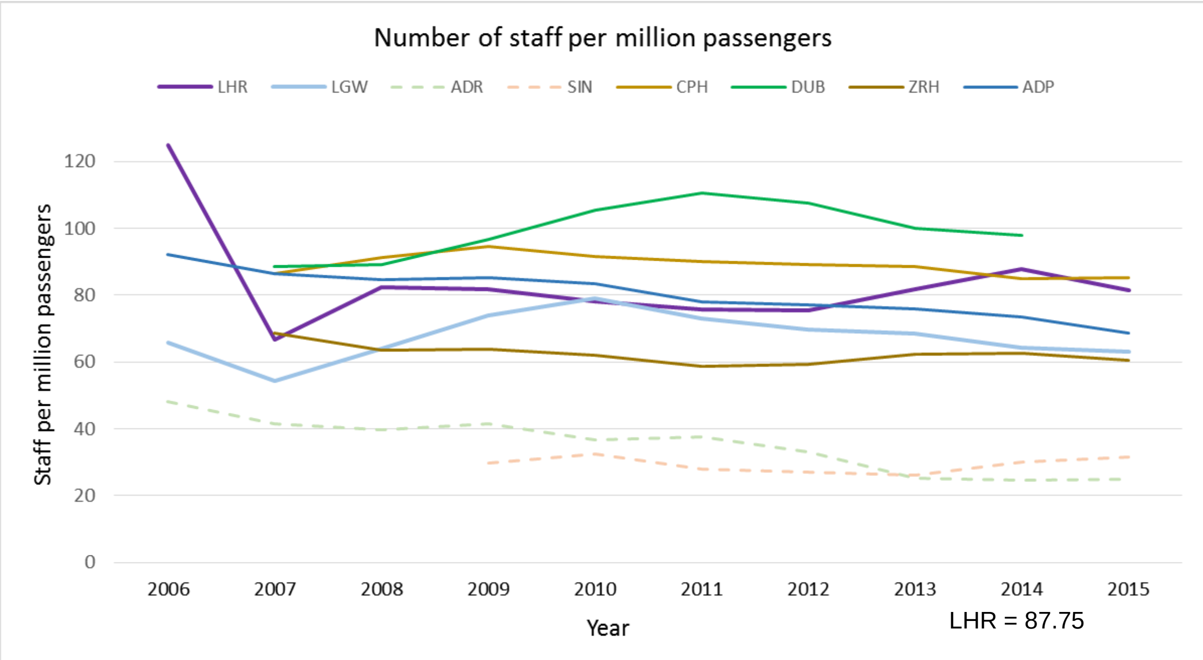
[9] For example, Benchmarking employment costs: A research report for the CAA Stansted January 2013 - Income Data Services, Thomson Reuters

Figure 15: Number of staff per million passengers, 2014



For the reasons outlined above, movements in this metric over time are considered more relevant to assist in understanding the operational efficiency of staffing at a particular airport than a snapshot comparison.

Figure 16: Number of staff per million passengers, 2006 - 2015



5.3 Non-staff operating costs

As already noted, a more detailed benchmarking of staff costs and the other sub-components of opex is outside of the scope of this study due to limited availability of detailed comparative data for other airports.

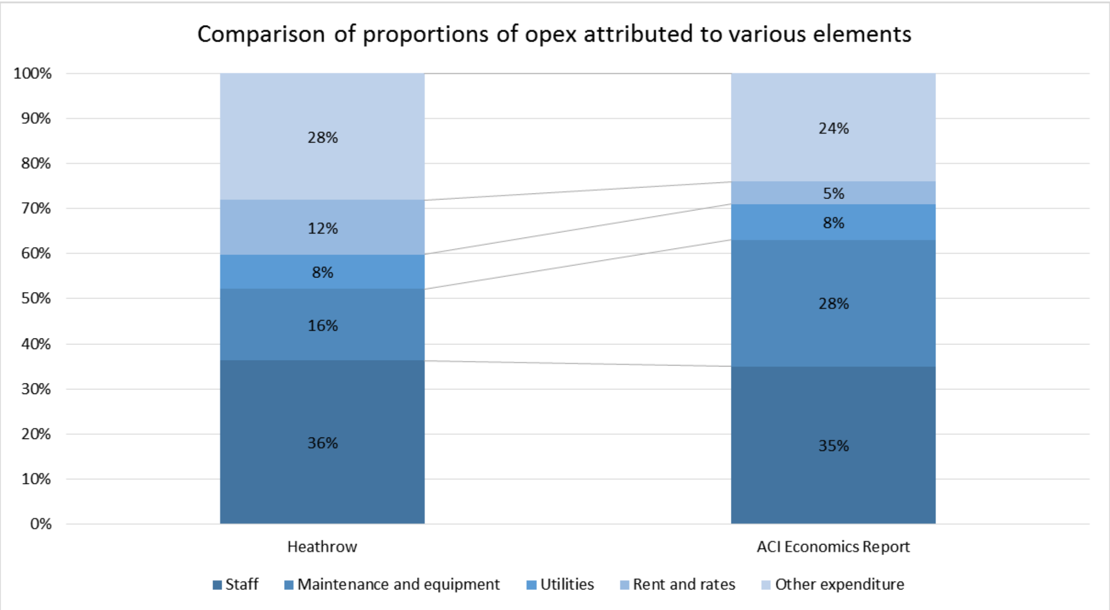
However, at a high level, we have carried out a comparison with an Airports Council International (ACI) annual study[10] which averages the financial performance for over 650 airports worldwide. Member airports are asked to complete a detailed questionnaire annually and the responses are collated and aggregated by ACI to provide an annual report.

This comparison should be treated as a high level indicator only for two reasons:

- The definitions used by the ACI programme are not particularly detailed and this may cause some of their survey responses to be inconsistent. There is also the potential that they do not align with the definitions that Heathrow use for these categories of cost.
- The ACI process aims to cover the largest possible sample of airports and their data will therefore include a number of smaller airports and airports which do not have similar characteristics to Heathrow

Figure 17 below illustrates that there are some similarities between the percentages of airport opex that Heathrow spends on staff and utilities when compared to the ACI Economic report. Other categories show differences although greater clarity on the definitions used in the two sources, and a lower level of granularity in the underlying data, would be required to understand thereasons for these variances. This comment is particularly applicable to the Maintenance and Equipment and Other Costs categories which would be worthy of more detailed analysis in a study specifically focussed on opex efficiency.

Figure 17: Sub-components of opex at various worldwide airports[11]



5.4 Depreciation Costs

As noted in Section 2.1.2 above, the depreciation cost recorded in an airport's accounts in a particular year is, to a large extent, dependent on the position of the airport in its infrastructure investment cycle.

Below we present the results of the regression analysis identifying the significant drivers for the Depreciation Cost metric and discuss how Heathrow's Depreciation Cost compares to the comparator airports' Depreciation Cost.

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[10] ACI Airport Economics Report 2014 (Published 2015) – Airports Council International

[11] Sources: PA analysis, Heathrow data derived from Heathrow (SP) Limited Regulatory Accounts Year ended 31 December 2015, ACI data from ACI Airport Economics Report 2014 (published in 2015)

In the table below (Table 8) the results of the regression analysis are presented. As one can see, following the methodology described in Section 2.2, four driver was identified as having a significant influence on the Depreciation Cost metric, i.e. Number of simultaneously active runways, Number of terminals, Runway demand/capacity ratio, and Proportion of connecting passengers.

Table 8: The results of the regression analysis for the Depreciation Cost metric

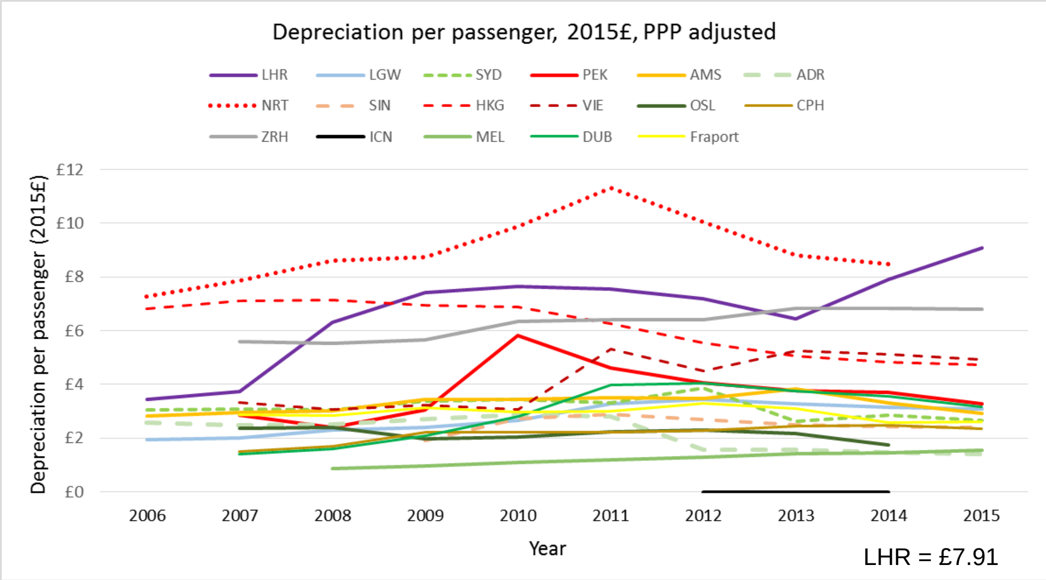
Independent variables (the drivers)[1]	Coefficients	Standard Error	t Stat	P-value
Intercept	5.628962656	29.61880665	0.190046909	0.856747147
Price cap regulation	-2.320555253	1.780150008	-1.303572869	0.249170557
Skytrax rating (stars)/5	-1.668833184	1.496787927	-1.114942975	0.315576162
Number of simultaneously active runways	-11.73056886	4.913267942	-2.387528829	0.06257881
Number of terminals	1.174313197	0.78362101	1.498572884	0.194259397
Number of passengers per year	1.52916E-07	1.65722E-07	0.922727171	0.398489807
Runway demand/ capacity ratio	-23.77528297	13.19857818	-1.801351831	0.131528481
Proportion of connecting passengers	31.65644173	18.59350355	1.702553886	0.149384149
Number of airlines	0.010814233	0.15330729	0.070539585	0.946498635
Proportion of network carriers	22.75088953	26.94586058	0.844318535	0.437013277
Number of destinations	0.025706513	0.026569149	0.967532391	0.377714796
Proportion of long haul destinations	6.186865987	10.8367249	0.570916586	0.592757577

[1] Colour coding: green – most relevant drivers with p-value below 0.1, orange – relevant drivers with p-value between 0.1 and 0.2, yellow – semi-relevant drivers with p-value between 0.2 and 0.3, white – drivers not significantly relevant with p-value above 0.3

In the time series analysis presented in Figure 18, increases in depreciation per passenger can be seen as airports bring major new infrastructure assets into operation. This is illustrated, for example, by the step up in depreciation per passenger for Beijing Capital City (PEK) airport following the opening of its Terminal 3 and Dublin Airport following opening of Terminal 2 in 2009. The differing positions of airports in their respective investment cycles is also seen by the decline in depreciation per passenger at Tokyo Narita (NRT) since its peak in 2011.

At Heathrow, the investment cycle over the last ten years is clearly illustrated by increases in depreciation per passenger (corresponding with increases in the regulatory asset base) which can be observed following the opening of Terminal 5 in 2008 and Terminal 2 in 2014.

Figure 18: Depreciation per passenger, 2006 – 2015

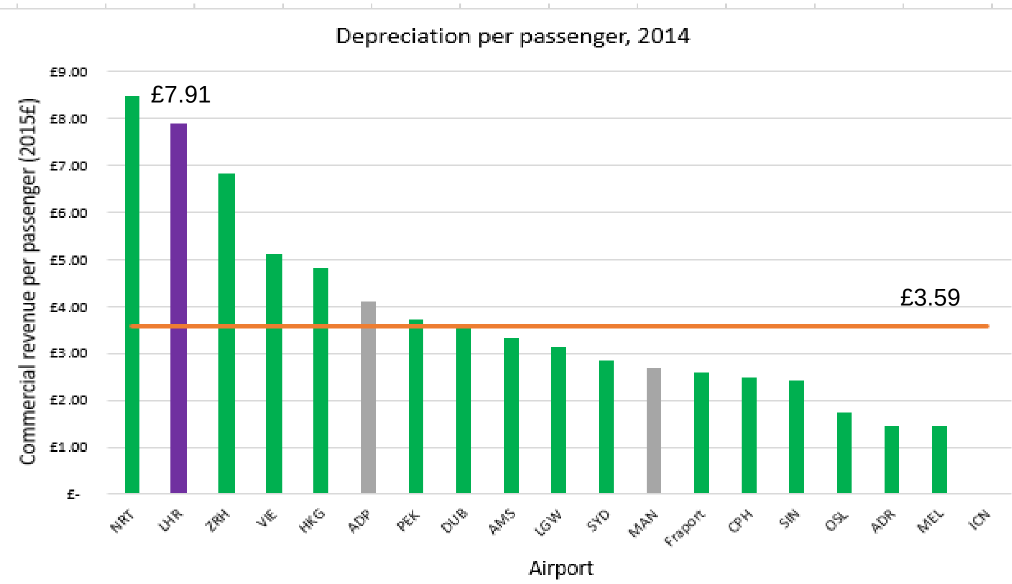


Whilst it is evident that airport operators in the sample are actively investing in their infrastructure, this metric does not provide insight into the efficiency with which this capital was deployed or the value for money created. These are factors which will be important to understand further in the H7 determination process, however we have not attempted to comment further on capital efficiency as:

- A thorough investigation would require more granular data than is publically available
- Capital investment would need to be considered over a longer time horizon than analysed in this study
- Capital efficiency and processes will form the subject of other studies informing the H7 regulatory determination such as the Capital Governance Review being carried out as part of this initial suite of studies

Correspondingly, Figure 19 below indicates that LHR has a high depreciation value per passenger in 2014 (£7.91 which is more than double the group mean value of £3.59) which tallies with the Terminal 2 investment mentioned above.

Figure 19: Depreciation per passenger 2014



6 REVENUES

In this section we consider Heathrow's performance benchmarked against revenue metrics discussed in Section 2.1.3.

This section includes consideration of aeronautical revenues arising from the range of user charges as well as commercial revenues (or non-aeronautical revenues) generated from retail and food and beverage offers and other commercial activities such as real estate.

The format of this section is similar to Section 5 on Operating Costs in that we have generally normalised the benchmark figures against one or more of the three output measures; passengers, work load units (WLU) or air transport movements (ATMs). Again, we have not presented charts in this report for all three normalisations where similar results are obtained.

As previously in this section we present the results of the regression analysis that identify the significant drivers for each metric, followed by comparison charts used for Heathrow benchmarking analysis (see Section 5 for more details).

6.1 Aeronautical revenues

Aeronautical revenue is linked to a combination of the airport charges and other regulated charges elements in the building blocks regulatory model. When normalised by an output measure it gives a measure of the aeronautical yield per unit output and is therefore very relevant to the benchmarking.

In this section we present the results of the regression analysis identifying the significant drivers for the Aeronautical Revenue metric and discuss how Heathrow's Aeronautical Revenue compares to the comparator airports' Aeronautical Revenue.

In the table below (Table 9) the results of the regression analysis are presented. As one can see, following the methodology described in Section 2.2, only one driver was identified as having a significant influence on the Aeronautical Revenue metric, i.e. Proportion of long haul destinations.

Table 9: The results of the regression analysis for the Aeronautical Revenue metric

Independent variables (the drivers)[1]	Coefficients	Standard Error	t Stat	P-value
Intercept	*127.0284073*	*85.30517879*	*1.489105458*	*0.196635212*
Price cap regulation	-1.228573811	4.171173219	-0.294539149	0.780182711
Skytrax rating (stars)/5	-5.091853516	4.199013482	-1.212630904	0.279434679
Number of simultaneously active runways	-11.07126227	11.01629194	-1.004989912	0.361030569
Number of terminals	0.301681999	1.917507389	0.157330293	0.881140576
Number of passengers per year	4.19219E-07	4.72164E-07	0.887866538	0.415275567
Runway demand/ capacity ratio	-40.48909167	32.25028617	-1.25546457	0.264787005
Proportion of connecting passengers	51.70458643	42.63244232	1.212799071	0.279375773

Number of airlines	-0.292146271	0.390646702	-0.747852907	0.488209175
Proportion of network carriers	-95.25191529	74.67379195	-1.275573569	0.258153622
Number of destinations	0.047427246	0.06148508	0.771361867	0.475347347
Proportion of long haul destinations	84.56922128	28.03734394	3.016306446	0.029541155

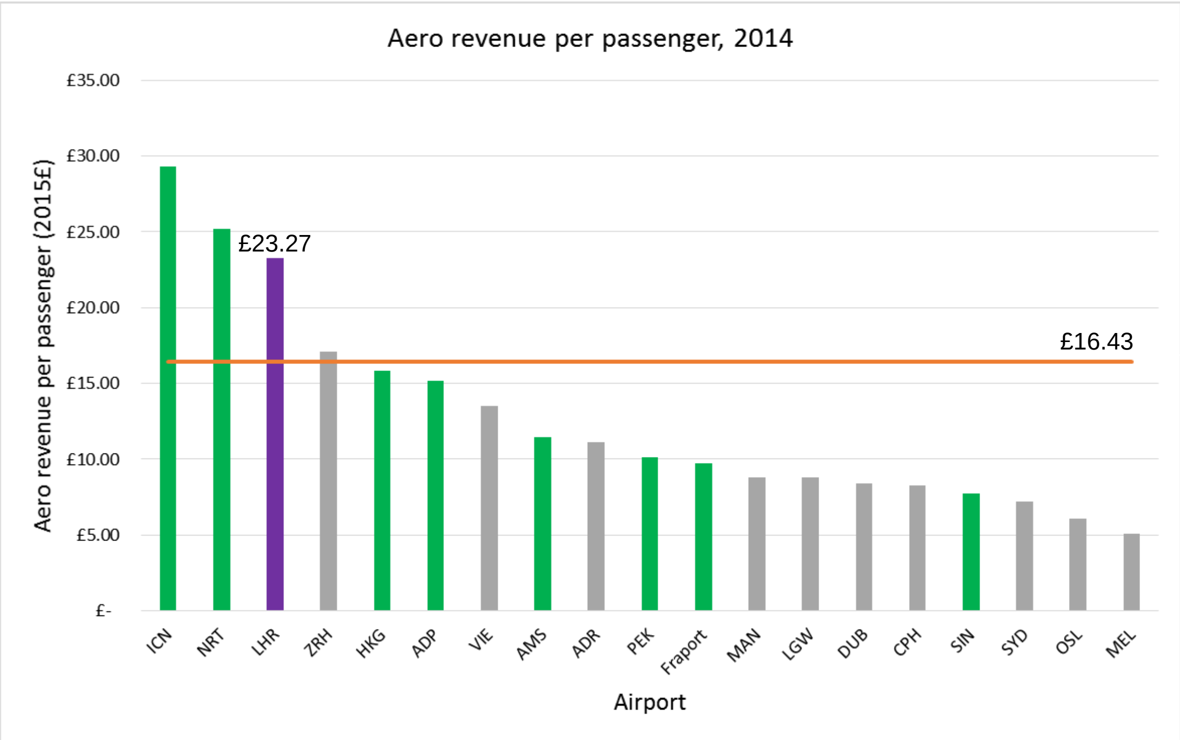
[1] Colour coding: green – most relevant drivers with p-value below 0.1, orange – relevant drivers with p-value between 0.1 and 0.2, yellow – semi-relevant drivers with p-value between 0.2 and 0.3, white – drivers not significantly relevant with p-value above 0.3

In the following section the comparison charts are presented for Aeronautical Revenue per Passanger and Aeronautical Revenue per WLU. As similar results are obtained when Aeronautical Revenue per ATM is benchmarked - Heathrow occupying a similar position in the peer group in both the one year and time series comparisons - no additional graphs were included for this normalisation.

6.1.1 Aeronautical revenue per passenger

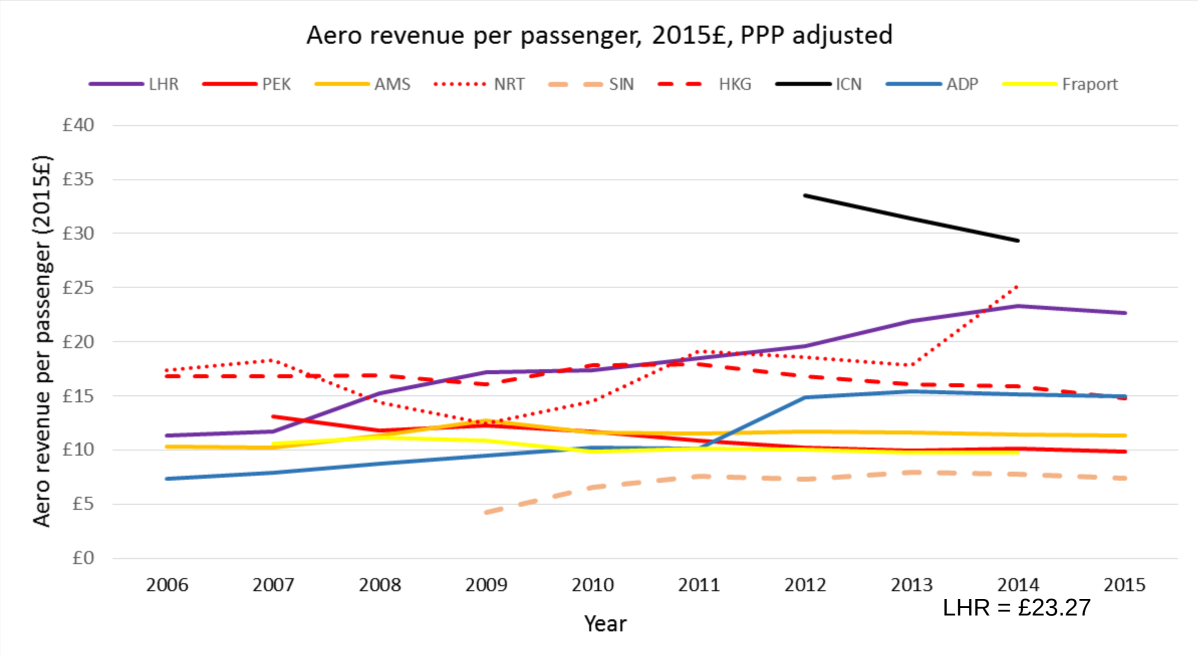
Figure 20 below shows a significant range in the aeronautical revenues achieved by each of the peer group airports when normalised by passenger numbers. Heathrow is positioned at the higher end of this range with a 2014 reported figure which was 42% higher than the mean of the most relevant comparators (shown in green).

Figure 20: Aeronautical revenue per passenger, 2014



The increase in aeronautical revenue per passenger observed for Heathrow (shown in Figure 21) has been sufficient to move the airport from a mid-range position in the peer group in 2006 to an upper position in 2015. This compares with a real terms reduction in aeronautical revenue per passenger seen at other airports in the group between 2009 and 2015, including Amsterdam Schiphol (AMS), Beijing Capital (PEK) and Fraport (as a proxy for Frankfurt).

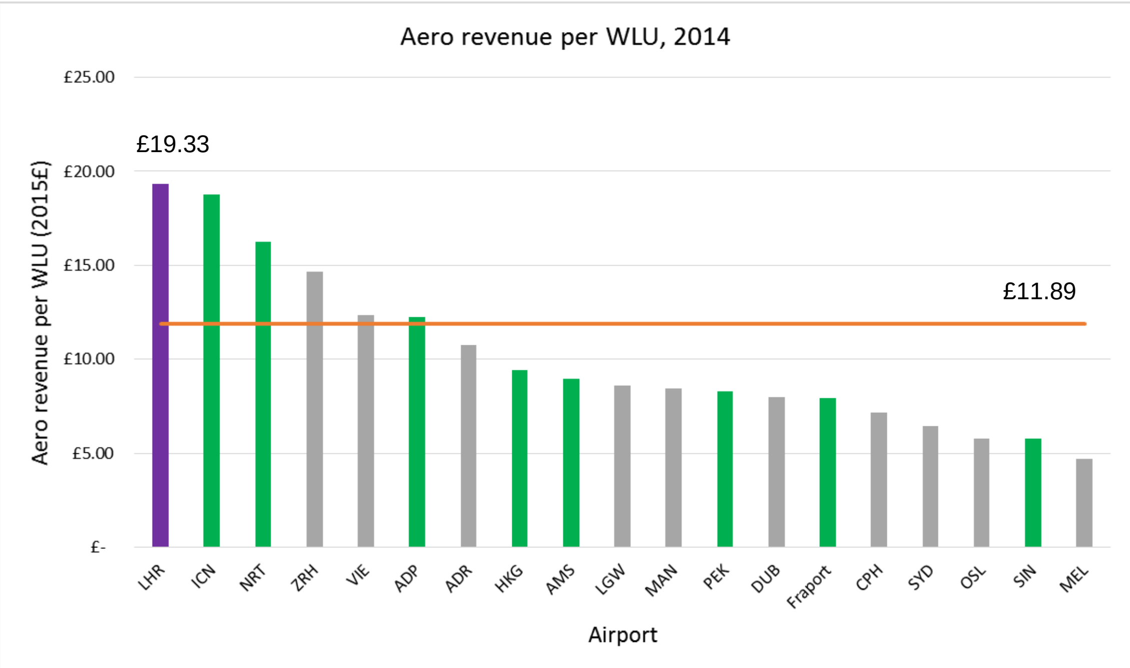
Figure 21: Aeronautical revenue per passenger, 2006 - 2015



6.1.2 Aeronautical revenue per workload unit

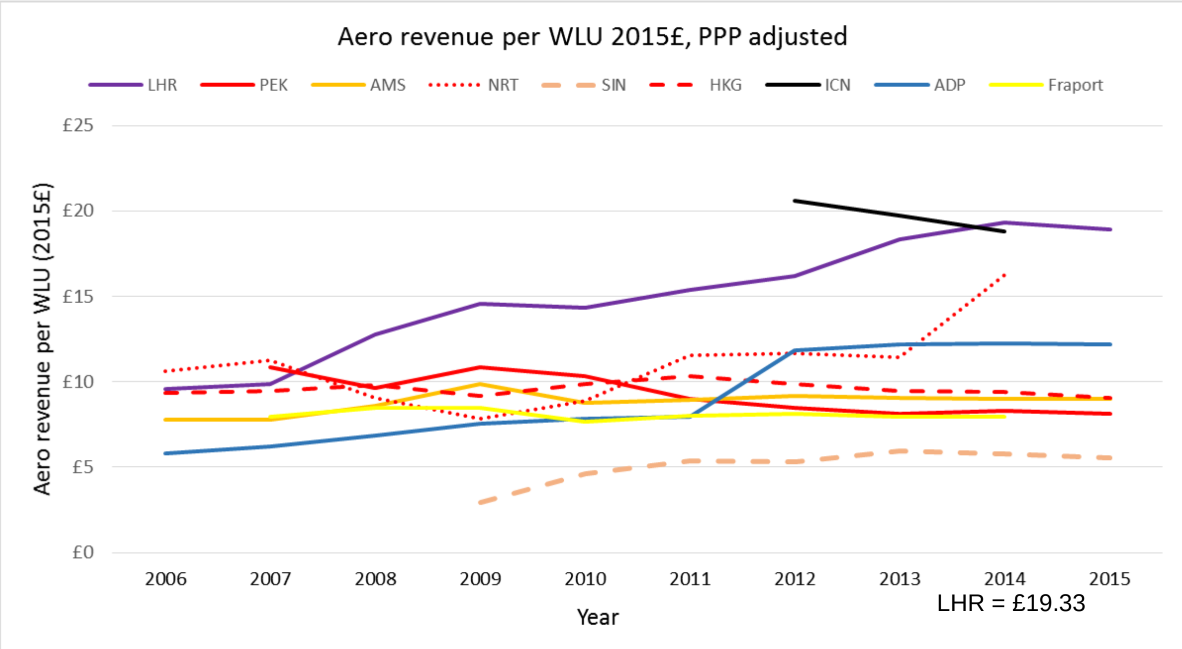
When normalised by workload unit, aeronautical revenues achieved at the comparator airports in the long-list show a smaller range than when considered on a per passenger basis. On this basis, Heathrow had the highest aeronautical revenue in 2014 and shows a significant variance to the mean of the group of most relevant comparator airport, as shown in Figure 22**Error! Reference source not found.** below.

Figure 22: Aeronautical revenue per WLU, 2014



A time series analysis illustrates an increase in aeronautical revenue per workload unit over the ten year period illustrated in Figure 23 below.

Figure 23: Aeronautical revenue per WLU, 2006 - 2015



6.2 Commercial (non-aeronautical) revenue

When normalised by one of the output measures, non-aeronautical revenue gives a comparative measure of the commercial yield per unit output and is therefore very relevant to the benchmarking. It provides an indicator of how good the airport is at generating non-monopoly revenue and will be driven by the basket of non-aeronautical activities that the airport undertakes including retail, food and beverage and real estate activities.

In this section we present the results of the regression analysis identifying the significant drivers for the Commercial Revenue metric and discuss how Heathrow's Commercial Revenue compares to the comparator airports' Commercial Revenue.

In the table below (Table 10) the results of the regression analysis are presented. As one can see, following the methodology described in Section 2.2, five driver were identified as having a significant influence on the Aeronautical Revenue metric; these are: Price cap regulation, Number of simultaneously active runways, Runway demand/capacity ratio, Number of airlines, and Proportion of network carriers.

Table 10: The results of the regression analysis for the Commercial Revenue metric

Independent variables (the drivers)[1]	Coefficients	Standard Error	t Stat	P-value
Intercept	*-18.01098403*	*45.81507552*	*-0.393123526*	*0.710430645*
Price cap regulation	-4.579727697	2.753578427	-1.663191305	0.157160396
Skytrax rating (stars)/5	-2.880968062	2.315267213	-1.244335015	0.268524626
Number of simultaneously active runways	-19.59356034	7.599959865	-2.57811366	0.049545281
Number of terminals	-0.014808774	1.212123641	-0.012217214	0.990724804
Number of passengers per year	1.57721E-07	2.56343E-07	0.61527362	0.565295897
Runway demand/ capacity ratio	-32.83494176	20.41587506	-1.608304403	0.168680854
Proportion of connecting passengers	34.39408409	28.76087411	1.195863657	0.285364172
Number of airlines	0.361883098	0.237139367	1.526035526	0.18752381
Proportion of network carriers	75.61559779	41.68049888	1.814172091	0.129375831

Number of destinations	-0.02631435	0.041097793	-0.640286201	0.550171839
Proportion of long haul destinations	-2.647030178	16.76250417	-0.157913767	0.880704133

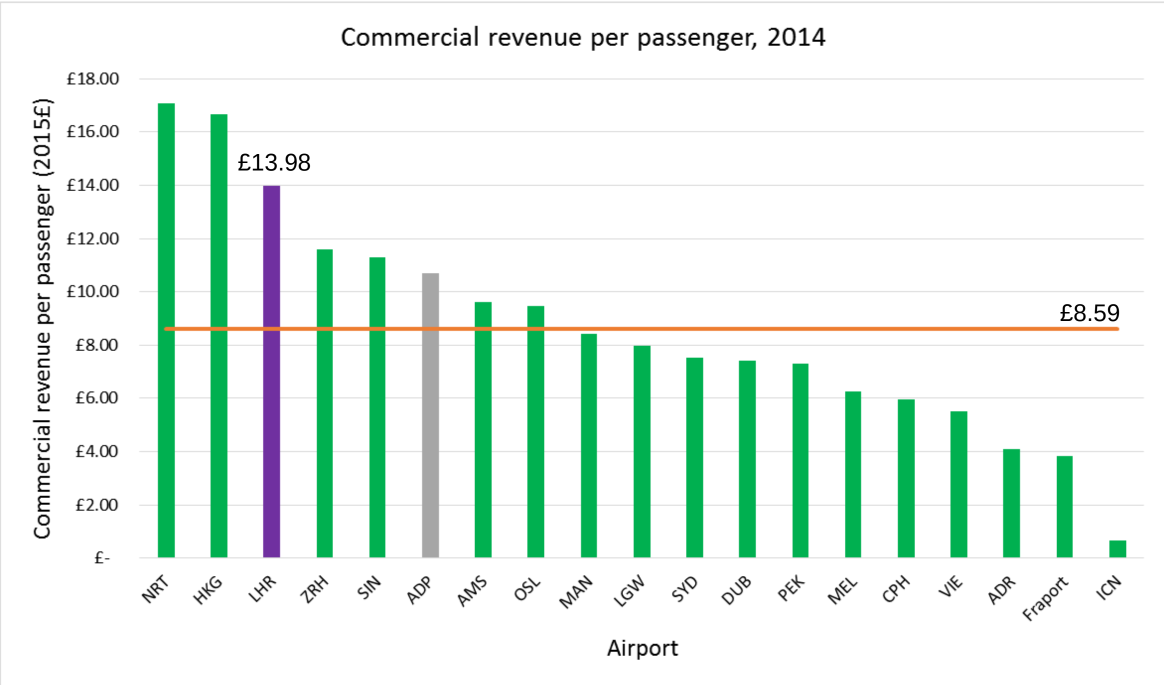
[1] Colour coding: green – most relevant drivers with p-value below 0.1, orange – relevant drivers with p-value between 0.1 and 0.2, yellow – semi-relevant drivers with p-value between 0.2 and 0.3, white – drivers not significantly relevant with p-value above 0.3

In the following section the comparison charts are presented for Commercial Revenue per Passenger. As similar results are obtained when Commercial Revenue per WLU is benchmarked - Heathrow occupying a similar position in the peer group in both the one year and time series comparisons - no additional graphs were included for this normalisation.

6.2.1 Commercial revenue per passenger

As with aeronautical revenue, Heathrow is seen to be at the upper end of the benchmark group when considering commercial revenue per passenger in 2014 as shown in Figure 24 below.

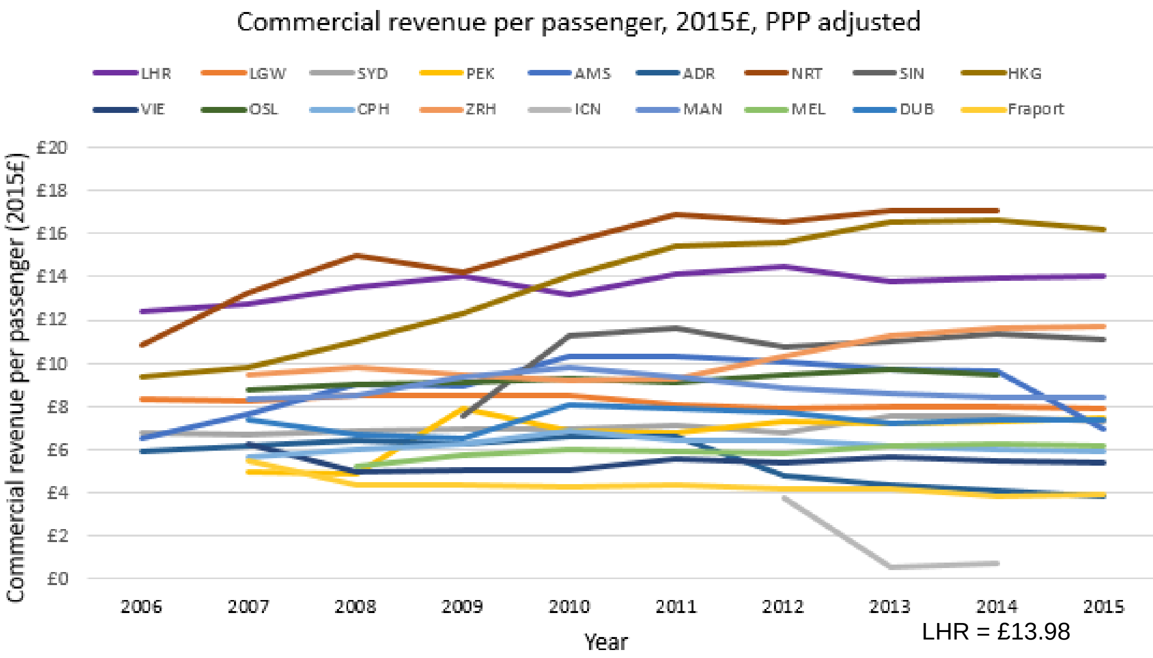
Figure 24: Commercial revenue per passenger, 2014



However, the direction and trends for this KPI show significant differences across the peer group when tracked on a time series basis as shown in Figure 25.

Airports such as Hong Kong (HKG) and Tokyo Narita (NRT) show significant and steady increases over the ten year period illustrated. Others, such as Fraport and ADR (as proxies for Frankfurt (FRA) and Rome (FCO)) show declining commercial revenues in real terms. Whilst Heathrow remains at the upper end of the peer group throughout the period, the absolute value for its commercial revenue is virtually unchanged between 2009 and 2015. [For clarity rail operations associated with Heathrow Express have been excluded in these calculations, in line with other rail operating airports to facilitate consistency].

Figure 25: Commercial revenue per passenger, 2006 – 2015



7 OVERALL OPERATING PERFORMANCE

In this Section, we consider Heathrow's performance benchmarked against the overall operating performance metrics discussed in Section 2.1.4.

Consideration of overall financial performance provides a useful comparator to assess the level or range of profit that might be expected from large, complex hub airports as a gauge of the reasonableness of Heathrow's position. Here we analyse Earnings before Interest, Tax, Depreciation and Amortisation (EBITDA) as the most meaningful measure of overall operational financial performance. We have extended consideration of overall performance to include analysis of EBITDA margin and, for comparison, Earnings before Interest and Taxes (EBIT).

The format of this section is similar to Sections 5 and 6 in that we have generally normalised the benchmark figures against one or more of the three output measures; passengers, work load units (WLU) or air transport movements (ATMs). Again, we have not presented charts in this report for all three normalisations where similar results are obtained.

As previously in this section we present the results of the regression analysis that identify the significant drivers for each metric, followed by comparison charts used for Heathrow benchmarking analysis (see Section 5 for more details).

7.1 EBITDA

By excluding the impact of financial costs of interest and taxes and the effects of depreciation, EBITDA is a measure of overall financial operating performance that focuses most closely on those aspects that can be directly influenced by an airport management team.

In this section we present the results of the regression analysis identifying the significant drivers for the EBITDA metric and discuss how Heathrow's EBITDA compares to the comparator airports' EBITDA.

In the table below (Table 11) the results of the regression analysis are presented. As one can see, following the methodology described in Section 2.2, only one driver was identified as having a significant influence on the EBITDA metric, i.e. Proportion of long haul destinations.

Table 11: The results of the regression analysis for the EBITDA metric

Independent variables (the drivers)[1]	Coefficients	Standard Error	t Stat	P-value
Intercept	12.00814676	59.17736653	0.202917897	0.84719829
Price cap regulation	-3.955593421	3.556679063	-1.112159223	0.316663468
Skytrax rating (stars)/5	-0.862588261	2.990531282	-0.288439806	0.784585137
Number of simultaneously active runways	-10.02240951	9.816541946	-1.020971495	0.354099825
Number of terminals	-0.859625714	1.565648079	-0.549054239	0.606586964
Number of passengers per year	1.01121E-07	3.31107E-07	0.305404125	0.772363706
Runway demand/ capacity ratio	-18.05331898	26.37030951	-0.684607777	0.524028728

Proportion of connecting passengers	27.55483433	37.1491866	0.741734526	0.491597026
Number of airlines	0.171952336	0.306302741	0.561380338	0.59876637
Proportion of network carriers	17.05760174	53.83691135	0.316838416	0.764167953
Number of destinations	-0.039949317	0.053084255	-0.752564326	0.485611755
Proportion of long haul destinations	37.57059589	21.65140714	1.735249614	0.143219125

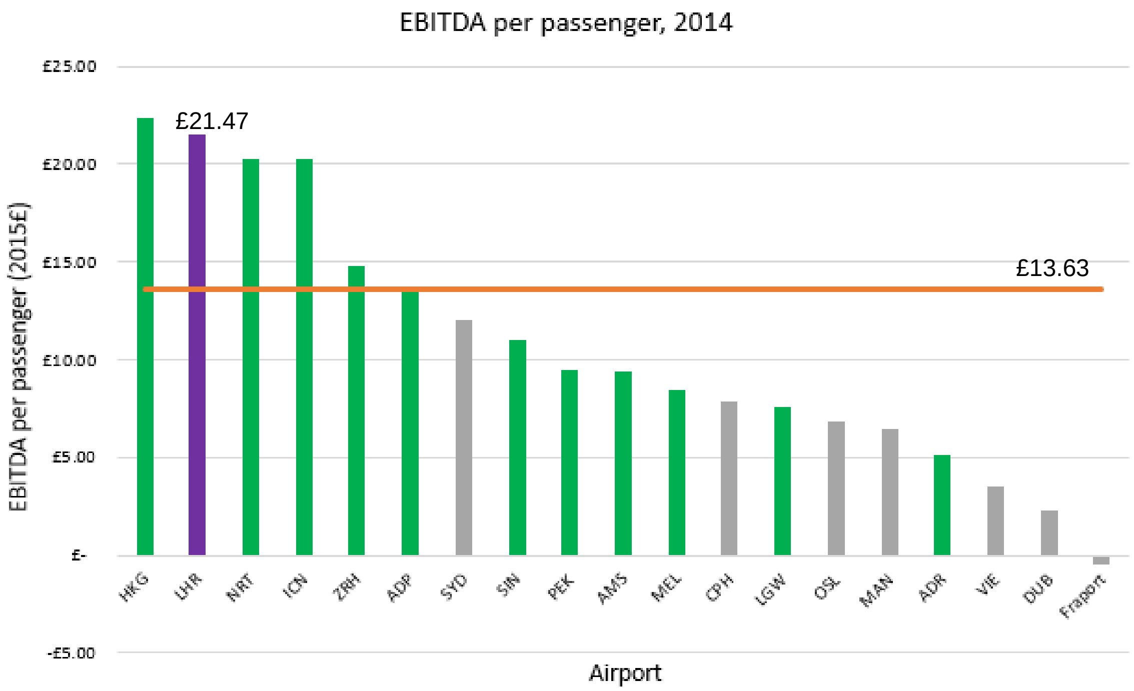
[1] Colour coding: green – most relevant drivers with p-value below 0.1, orange – relevant drivers with p-value between 0.1 and 0.2, yellow – semi-relevant drivers with p-value between 0.2 and 0.3, white – drivers not significantly relevant with p-value above 0.3

In the following section the comparison charts are presented for EBITDA per Passanger and EBITDA per ATM. As similar results are obtained when EBITDA per WLU is benchmarked - Heathrow occupying a similar position in the peer group in both the one year and time series comparisons - no additional graphs were included for this normalisation.

7.1.1 EBITDA per passenger

The 2014 data analysed in Figure 26 below shows that Heathrow had the second highest EBITDA of the airports in this peer group and the highest of the European airports considered in this study.

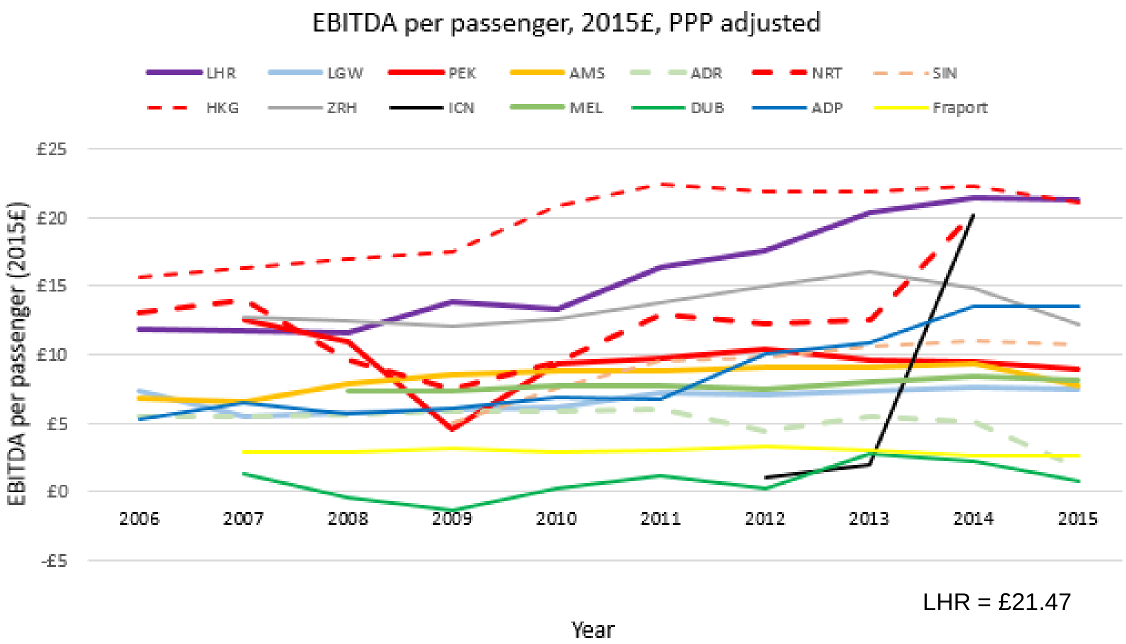
Figure 26: EBITDA per passenger, 2014



The EBITDA per passenger seen in the time series analysis in Figure 27 below shows a significant range of reported results. For example, in 2015, EBITDA at Dublin airport (DUB) was £0.83 per passenger whereas at Hong Kong (HKG) it was £21.09 on the same basis. Over the course of the period considered, Heathrow has consistently been in the upper region of this peer group and has steadily grown profits. In 2015, where it had the highest EBITDA per passenger in the comparator group, Heathrow's EBITDA per passenger was 46% higher than it was in 2008.

It may be noted that the significant change in EBITDA per passenger reported at Seoul Incheon (ICN) could reflect an anomaly in data reporting rather than true performance and some caution must be exercised when using this data series.

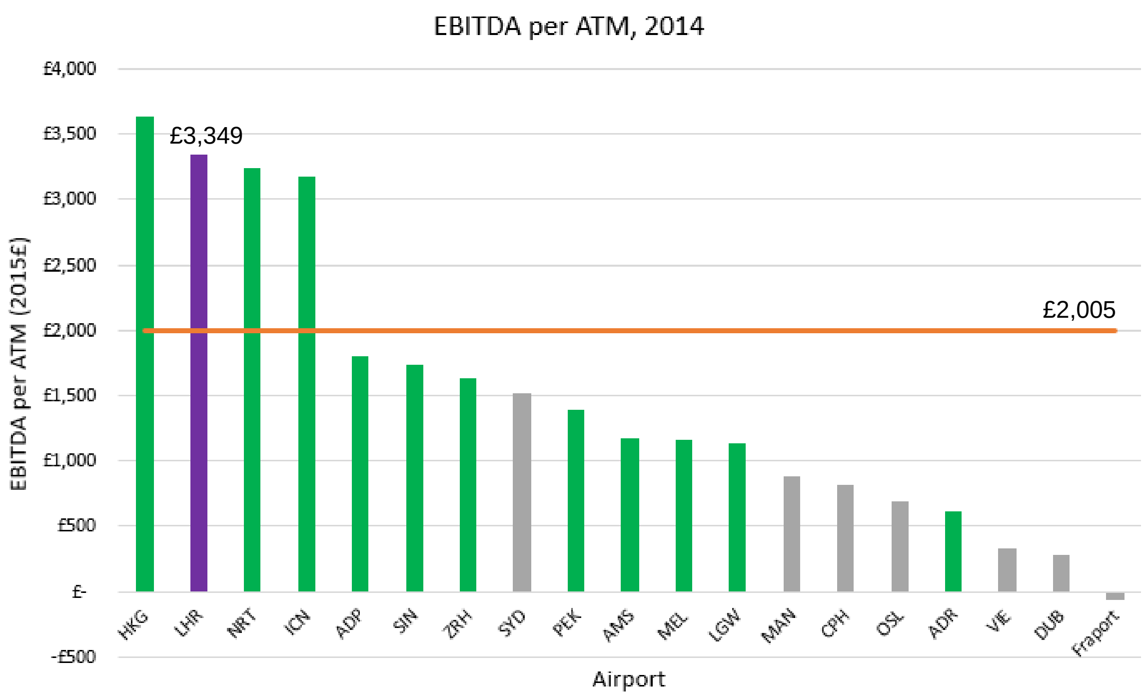
Figure 27: EBITDA per passenger, 2006 – 2015



7.1.2 EBITDA per ATM

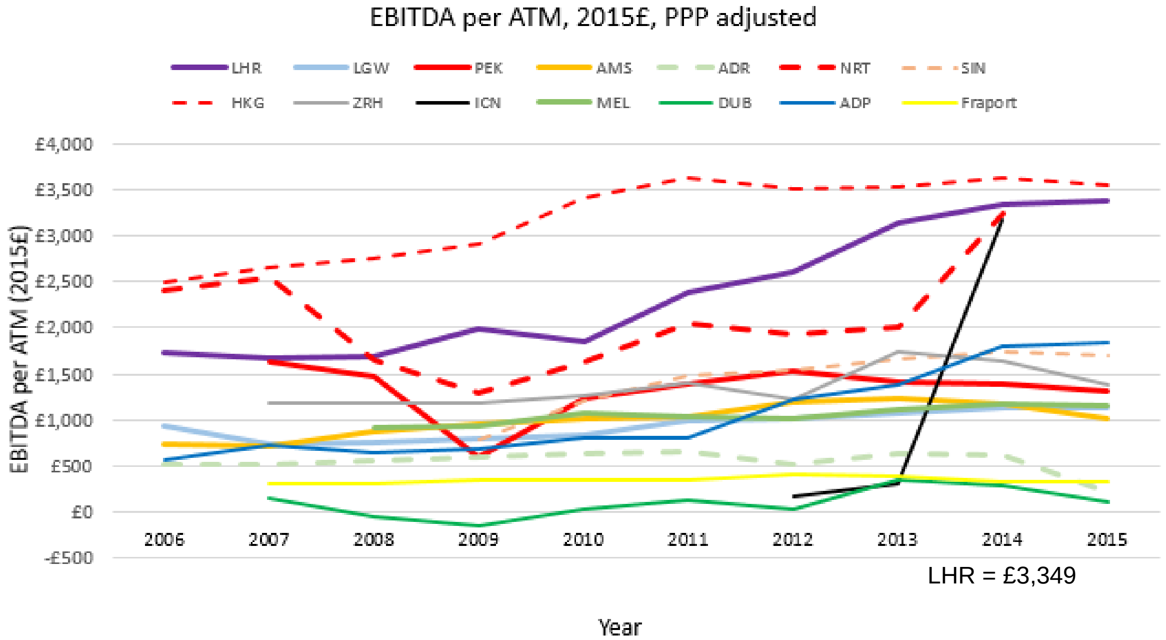
When EBITDA is considered in relation to ATMs, Heathrow is ranked second highest in the group of comparator airports shown in Figure 28 below. Heathrow's reported EBITDA per ATM is also significantly higher than any of the European airports in the peer group.

Figure 28: EBITDA per ATM, 2014



The time series analysis in Figure 29 shows that Heathrow's second place ranking in the peer group for this KPIs is one that it has held for each of the years from 2009 to 2015.

Figure 29: EBITDA per ATM, 2006 – 2015



7.2 EBITDA Margin

We have extended consideration of overall operating financial performance to include analysis of EBITDA margin. This metric is defined as total airport earnings, excluding expenditure on interest, tax, depreciation and amortisation, as a proportion of total revenues. By breaking down EBITDA as a percentage of revenue, the use of the EBITDA margin allows comparisons between operations of different sizes.

Below we present the results of the regression analysis identifying the significant drivers for the EBITDA Margin metric and discuss how Heathrow's EBITDA Margin compares to the comparator airports' EBITDA Margin.

In the table below (Table 12) the results of the regression analysis are presented. As one can see, following the methodology described in Section 2.2, seven driver was identified as having a significant influence on the EBITDA Margin metric, i.e. Skytrax rating (stars)/5, Number of simultaneously active runways, Number of passengers per year, Runway demand/capacity ratio, Proportion of connecting passengers, Proportion of network carriers, and Number of destinations.

Table 12: The results of the regression analysis for the EBITDA Margin metric

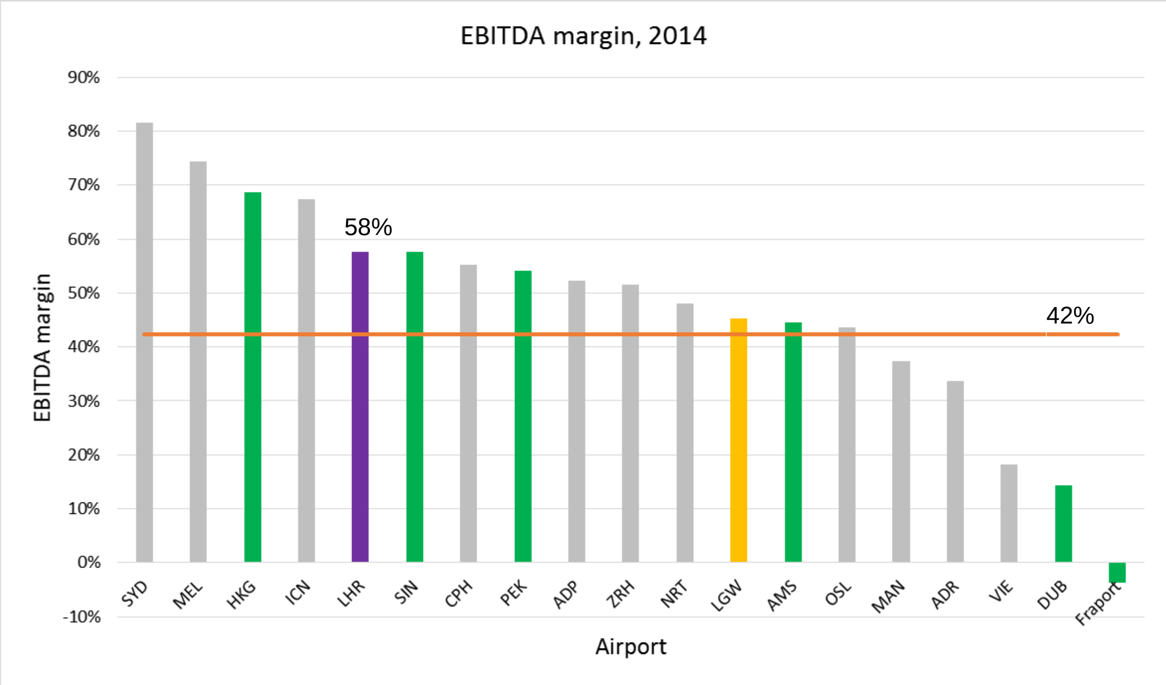
Independent variables (the drivers)[1]	Coefficients	Standard Error	t Stat	P-value
Intercept	*-2.332970081*	*1.177565578*	*-1.981180602*	*0.104420385*
Price cap regulation	-0.01288445	0.070774066	-0.182050437	0.862693797
Skytrax rating (stars)/5	0.1870313	0.059508337	3.142942788	0.025581401
Number of simultaneously active runways	0.488584996	0.195338565	2.50122138	0.054408758
Number of terminals	-0.039317338	0.031154703	-1.262003305	0.262613216
Number of passengers per year	-1.38917E-08	6.58866E-09	-2.108422573	0.08879935
Runway demand/ capacity ratio	1.411889227	0.524740633	2.69064208	0.043265434
Proportion of connecting passengers	-1.332153695	0.739228626	-1.802086184	0.131404196
Number of airlines	0.006904296	0.006095093	1.132762966	0.308692366
Proportion of network carriers	1.646482067	1.071296297	1.536906336	0.184920706

Number of destinations	-0.003193494	0.001056319	-3.023227698	0.029307783
Proportion of long haul destinations	-0.29227582	0.43083958	-0.678386651	0.52764704

[1] Colour coding: green – most relevant drivers with p-value below 0.1, orange – relevant drivers with p-value between 0.1 and 0.2, yellow – semi-relevant drivers with p-value between 0.2 and 0.3, white – drivers not significantly relevant with p-value above 0.3

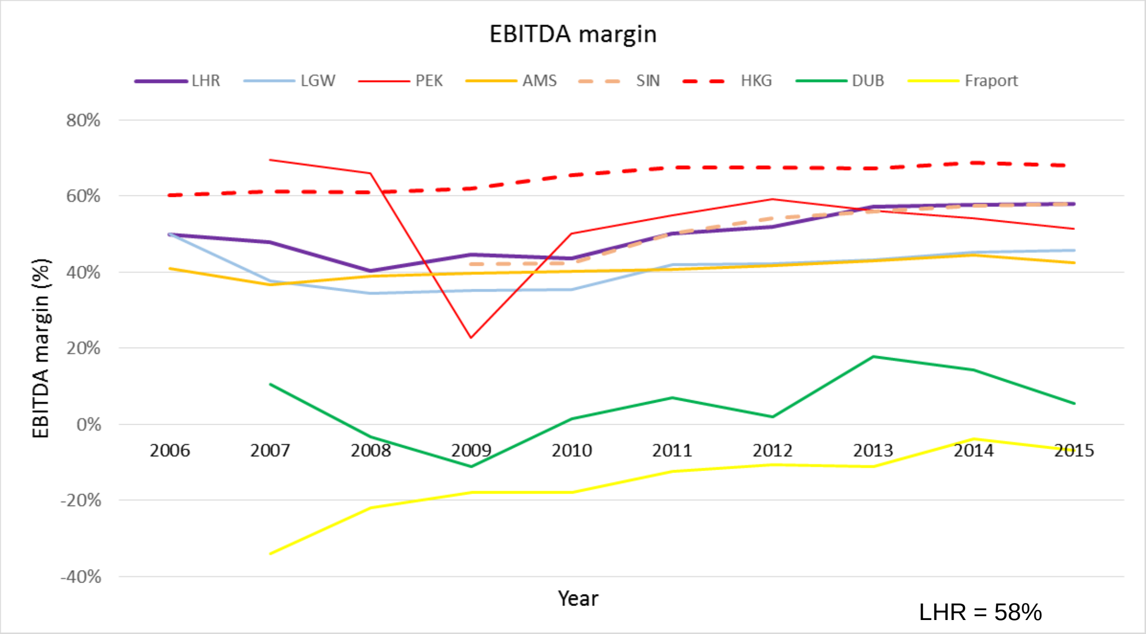
In the 2014 data illustrated in Figure 30 below, Heathrow's EBITDA margin is fifth highest of all the airports in the long-list of comparators but second highest when considering those that are the most relevant peer group identified by the regression analysis (coloured green and amber).

Figure 30: EBITDA Margin, 2014



The time series shown in on page 49 illustrates a wide variation in margins reported by airport operating companies from negative performances reported for Fraport (which we are using as a proxy for Frankfurt airport (FRA)), to margins consistently higher than 60% at Hong Kong (HKG). Over the period considered, Heathrow's margin has steadily increased year on year and, in 2015 was 30% higher than the margin it achieved in 2008. Similar trends in increasing margins are observed at Hong Kong (HKG), Singapore (SIN) and Gatwick (LGW), albeit from a lower base in the case of Gatwick.

Figure 31: EBITDA Margin, 2006 – 2015



7.3 Earnings before interest and tax (EBIT)

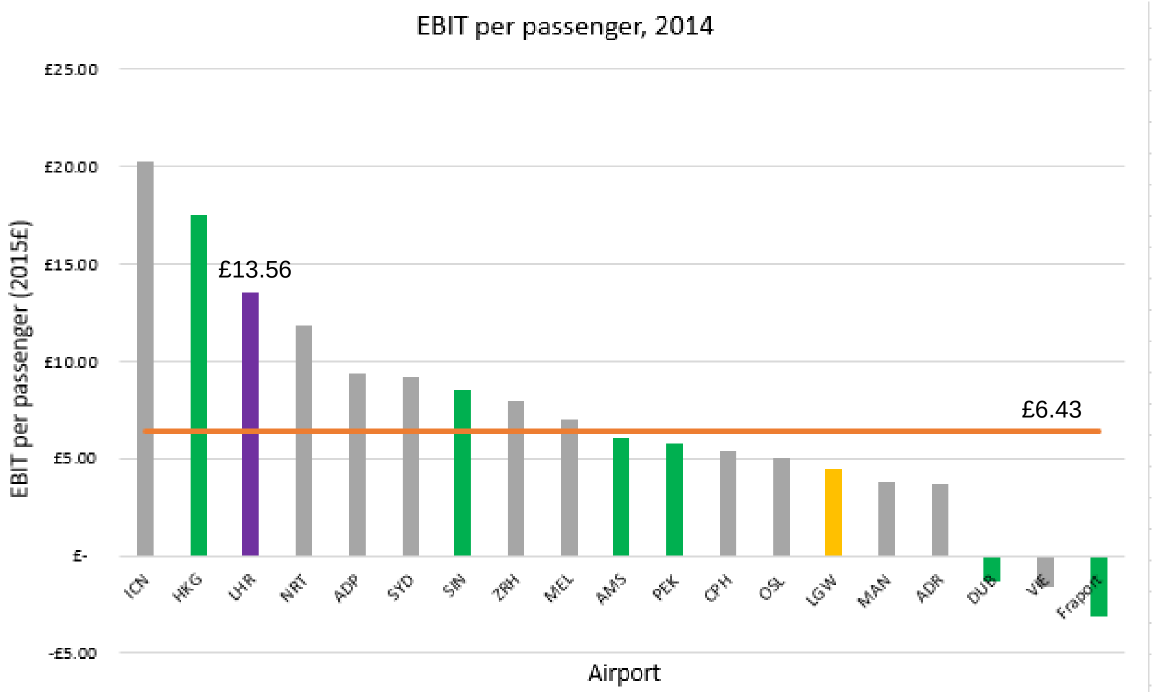
For comparison with the EBITDA-based metrics, we have also considered Earnings before Interest and Tax (EBIT) as a means of including financial costs following the impact of the depreciation effects described above.

For this metric we only present charts for EBIT per passenger but similar results are obtained when EBIT is normalised by work load units or movements.

7.3.1 EBIT per passenger

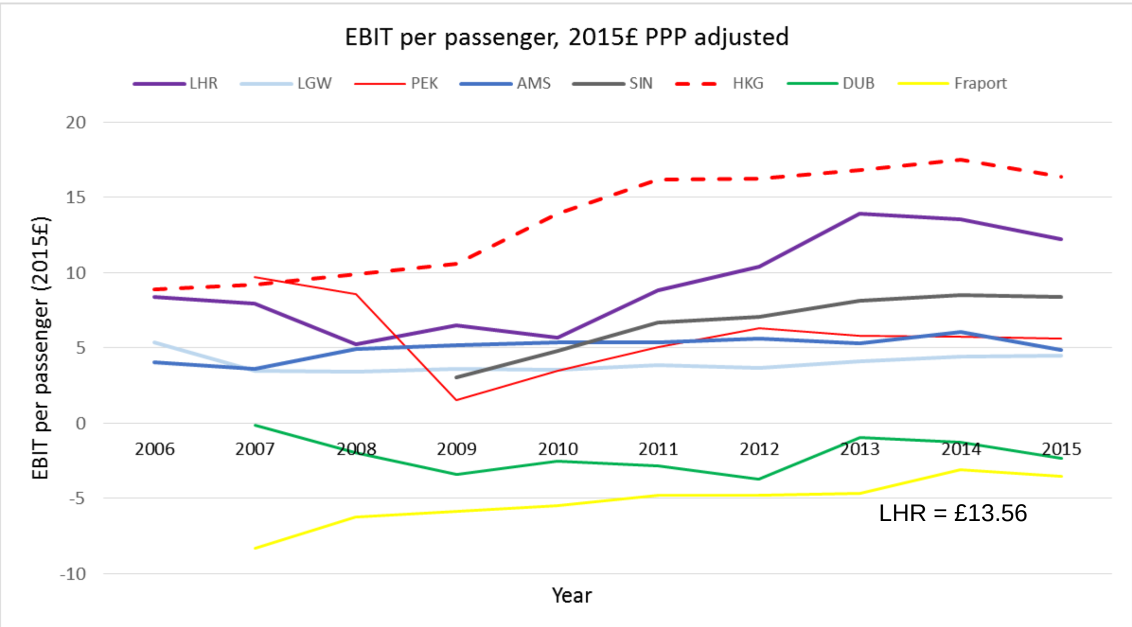
Normalising EBIT by passenger numbers in shows that Heathrow has the second highest EBIT per passenger in the peer group of most relevant comparator airports (see **Error! Reference source not ound.** on page 49).

Figure 32: EBIT per passenger, 2014



Heathrow's EBIT per passenger has increased since 2010 with a fall from 2013 onwards consistent with the depreciation impact of the opening of Terminal 2 in 2014, as shown in Figure 33 below. Over this period, Heathrow has been consistently second highest in the peer group of comparator airports behind Hong Kong (HKG).

Figure 33: EBIT per passenger, 2006 – 2015



8 SUMMARY

As the purpose of this benchmarking study is to inform the CAA and support them in making their H7 regulatory determination for Heathrow Airport, we have considered the historical performance of Heathrow against a range of KPIs considered to be relevant to the building blocks model. For each KPI, we have used a combination of techniques, including multi-variable regression analysis, to identify those airports considered to be most relevant comparators.

8.1 Summary of benchmarking results

The relative rank of Heathrow against its most relevant peer group comparator airports in 2014 for each of the KPIs is summarised in Table 13 below. In this table, the notation 1st illustrates that Heathrow has the highest value for that metric for any of the sample airports considered most relevant. Where Heathrow is not highest, those airports with higher values are indicated in brackets after Heathrow's ranking.

Table 13: Heathrow ranking for each KPI (with airports ranked above Heathrow shown in brackets):

Category	Metric	Per passenger	Per workload unit (WLU)	Per air transport movement (ATM)	Other normalisation
Operating Costs	Total Opex	2nd (NRT)	2nd (NRT)	2nd (NRT)	-
	Staff costs per employee (£)	-	-	-	6th (ADP, ZRH, LGW, ADR, VIE)
	Staff per m passengers	-	-	-	2nd (DUB)
	Depreciation	2nd (NRT)	1st	2nd (NRT)	-
Revenues	Aeronautical revenue	3rd (ICN, NRT)	1st	3rd (ICN, NRT)	-
	Commercial revenue	3rd (NRT, HKG)	1st	3rd (NRT, HKG)	-
Overall operating performance	EBITDA	2nd (HKG)	1st	2nd (HKG)	-
	EBITDA margin (%)	-	-	-	2nd (HKG)
	EBIT	2nd (HKG)	1st	1st	-

The directional trend of Heathrow's performance against each of the KPIs over the years 2011 to 2015 is summarised in Table 14 below:

Table 14 Heathrow trend in absolute values of each KPI over the years 2011 – 2015 in 2015£:

Category	Metric	Per passenger	Per workload unit (WLU)	Per air transport movement (ATM)	Other normalisation
Operating Costs	Total Opex	Decreasing	Decreasing	Decreasing	-
	Staff costs per employee (£)	-	-	-	Increasing
	Staff per m passengers	-	-	-	Level
	Depreciation	Increasing	Increasing	Increasing	-
Revenues	Aeronautical revenue	Increasing	Increasing	Increasing	-
	Commercial revenue	Level	Level	Increasing	-
Overall operating performance	EBITDA	Increasing	Increasing	Increasing	-
	EBITDA margin	-	-	-	Increasing
	EBIT	Increasing	Increasing	Increasing	-

8.2 Observations

8.2.1 Operational efficiency

Despite Heathrow's position in the higher region of the peer group (2nd in 2014), the directional trend of decreasing opex when normalised against any of the output measures could be an indicator of improving efficiency. However, this should be seen in the light of increasing passenger numbers, WLUs and ATMs at Heathrow over the same period. The analysis in Section 5 above also notes that other airports have made similar improvements in these metrics over this period.

Our high level benchmarking of opex should be considered in conjunction with the results of the parallel CEPA study to gain a deeper understanding of the subject of opex.

Also, as significant operational changes have occurred at Heathrow during this period, including the opening of Terminal 2 in 2014 and the closure of Terminal 1 in 2015, the impact of changes in the operational asset base on opex need to be considered carefully.

When assessing the element of operating efficiency that relates to staff, we observed that unit staff costs were mid-range in the peer group of airports but on an increasing trend through the years 2011 – 2015. Although direct comparisons of staff costs across airports is not appropriate because of different outsourcing policies, we also note that the trend in the number of staff per million passengers processed at Heathrow is increasing being 7% higher in 2015 than in 2011. The combination of these two factors indicates that efficient utilisation of staff and market-based pay and benefits packages are areas that warrant continuing study.

The Heathrow data analysed clearly shows that considerable capital investment has taken place over the period studied and the impacts of the RAB based building blocks model of regulation flow through in the increases seen in aeronautical revenues. It is less easy to draw insights from the comparison with other airports as they have a range of different regulatory models and are necessarily all at different points in their investment cycles.

However, the observation that Heathrow is consistently in the upper region of the peer group when depreciation is considered against any of the output measures, indicates that the airport is not under-invested when compared to its peers.

8.2.2 Revenues

In terms of aeronautical revenue Heathrow is positioned at the higher end of this range with an increase that is 42% higher than the comparator mean. This has been sufficient to move the airport from a mid-range position in the peer group within a ten year period, and compares to real term reductions in aeronautical revenue per passenger seen at other airports. This may be attributed to the fact that LHR has the 3rd highest ATM value amongst the comparators (471k movements per annum) and only exceeded by AMS (484k movements) and PEK (568k movements); this is made more interesting by the fact that LHR has two runways versus the three at AMS and PEK who therefore have correspondingly lower runway demand/capacity ratios.

The data analysed indicates that Heathrow's performance in terms of commercial revenues remain consistently in the upper region of the peer group. However, the time series analysis indicates a plateau-effect over recent years when these revenues are normalised by passengers and workload units. Rather than being an indicator of improved commercial efficiency, the increasing trend of commercial revenues per ATM, reflects a corresponding increase in passengers carried per air transport movement over the same period.

8.2.3 Profitability

As a combined effect of the factors discussed in the preceding sections, Heathrow's profitability is at the upper end of the peer group in terms of all of the KPIs related to EBITDA (as a measure of operating profit), EBITDA margin and EBIT. All of these KPIs are increasing over the years 2011 to 2015 on a like-for-like basis in 2015£.

9 RECOMMENDATIONS

This report highlights some useful directional trends and indicates aspects of Heathrow's financial performance that would warrant further investigation as part of the H7 preparation process. Our study should only be used as one of a range of reference points in support of that process but will become most useful when used in conjunction with the results of the other works in the initial suite of consultancy studies referred to in Section 1.

9.1 Extent of this study

The study has used the data available in the public domain to its fullest extent. These data sets have shortcomings and are often not transparent concerning the basket of activities included in each cost or revenue category. Furthermore, it is not clear that the definitions of cost and revenue categories are directly comparable across different airports, particularly where different accounting standards might be used. Therefore, we believe that to draw further inferences at this stages would introduce risks in validity and credibility of assumptions.

9.2 Updates to this study

However, as more complete 2016 financial performance is reported by airport operating companies and beyond, it may be appropriate to update the analysis used in this study and confirm that the observations made about Heathrow in respect of its peer group still hold.

Updates should also be made if data becomes available from some of the airports who were discounted due to a lack of reliable data or if greater transparency can be gained on individual airport performance from any of the Group figures we have used, for example for Fraport, ADP and ADR.

9.3 Future airport benchmarking studies

To enable more detailed benchmarking of operational performance, greater access and participation from the airport operators would be required to understand better the comparability of financial reports, definition of cost and revenue categories and to increase the granularity of, and to validate, the data used.

In our experience for any subsequent benchmarking studies it is possible to engage on a bilateral basis with specific airports to enable access to more useful benchmarking data not in the public domain. The conditions usually associated with this exchange are: (i) confidentiality or at least anonymity in any published report and (ii) a reciprocal arrangement such that the comparator airport gains some visibility of and insights from the benchmarking results and hence benefits from providing its data. It may also be possible for the CAA to engage other aviation regulators or competition authorities to obtain suitable data for airport benchmarking.

There are also precedents to operators in the aviation value chain participating jointly in benchmarking exercises and sharing performance data measured using common definitions. One such example is the annual ACE benchmarking report[12] which compares the cost effectiveness and efficiency of participating air navigation service providers (ANSPs). This was started as a voluntary activity driven

[12] ATM Cost-Effectiveness (ACE) 2014 Benchmarking Report Prepared by Eurocontrol for the EC

by the Eurocontrol Performance Review Commission but now forms the basis of the mandatory Performance Scheme for European ATM applied within the Single European Sky framework within the member states of the Single European Sky area. In parallel to this the Civil Air Navigation Services Organisation (CANSO) runs a global air navigation services benchmarking exercise.

We believe that both the bilateral engagement with specific airports and the formation of a wider benchmarking ‘club’ as a longer term objective would provide beneficial insight for the CAA in this and future determination processes.

APPENDIX: STAKEHOLDER ENGAGEMENT

A number of workshops and briefing sessions have been held during the course of this study. The primary purpose at each has been to describe the scope and outline methodology of our study and elicit feedback on the techniques, metrics and comparators proposed.

Table 15 below summarises these sessions:

Table 15 Stakeholder sessions held during the top-down benchmarking study

Date	Forum	Attendees from:
01/12/16	Heathrow Briefing Meeting	HAL, CAA, PA Consulting
07/12/16	CAA Seminar	CAA, PA Consulting
12/01/17	Stakeholder workshop	AOC, IATA, British Airways, South African Airways (SAA), CAA, HAL, PA Consulting
20/01/17	Supplementary stakeholder meeting with additional IATA representatives	AOC, IATA, CAA, PA Consulting, Cambridge Economics Policy Associates (CEPA)

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