



**BAA OPERATIONAL FREEDOMS TRIAL AT HEATHROW AIRPORT
THE CIVIL AVIATION AUTHORITY'S SUPPLEMENTARY VIEWS ON
BAA'S PHASE ONE REPORT FOR THE MINISTER OF STATE**

Contents

1. Trial oversight and reporting	1
2. Engagement.....	5
3. Data, use of the freedoms and effects of the trial.....	8
4. Summary of recommendations for Phase 2 of the trial	18

Chapter 1. Trial oversight and reporting

Chapter summary

- The BAA report attached is the first of two reports on the impacts of the Heathrow Airport Operational Freedoms trial. This report relates to Phase 1. The CAA is making supplementary reports in each case. BAA has also published daily and monthly reports during the trial. BAA has commissioned Cambridge University to audit its methodologies and processes.
- The CAA is ensuring that the trial is run safely and within the broad parameters agreed by Government, and that the data produced by the trial are sufficient to generate a robust information base to inform future decisions by Government.
- Phase 1 included measures being applied reactively or as part of proactive tests. Heathrow already had some flexibility before the trial began, for example in the early morning or when on easterly operations.
- The trial did not increase the cap on overall movements, the scheduled hourly capacity, or scheduled night flights, and it did not involve 'mixed-mode' operations.

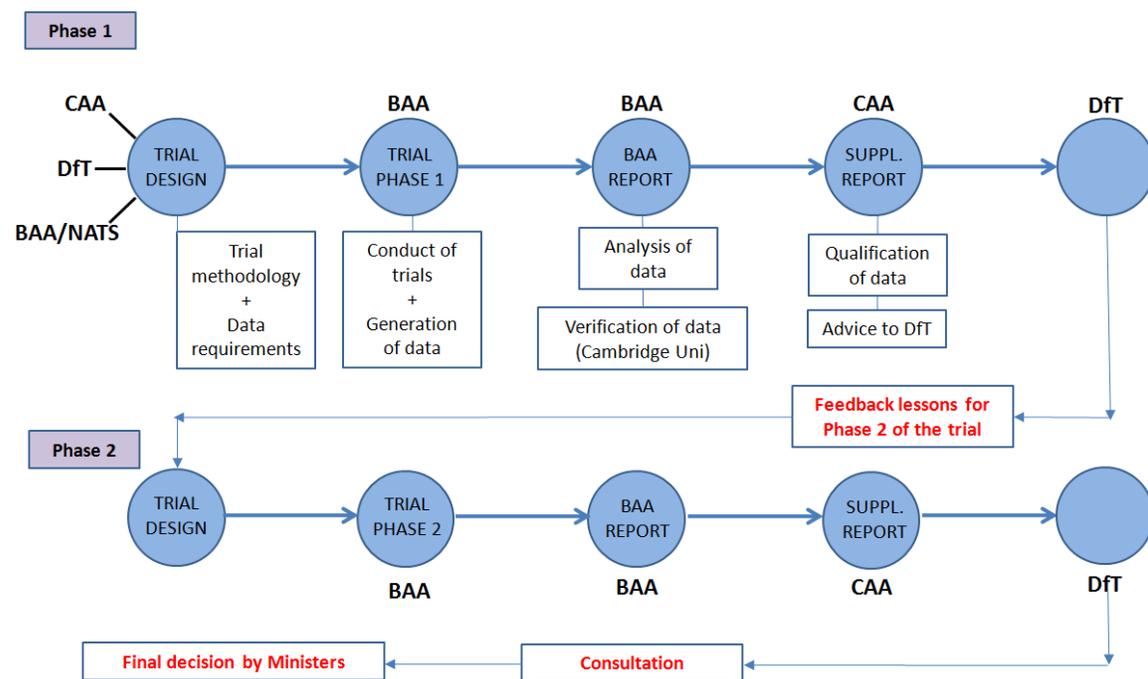
The purpose of this document

- 1.1 This document sets out the CAA's views on the first of two reports by BAA on the Operational Freedoms trial at Heathrow Airport. BAA's report covers Phase 1 of the trial which ran from 1 November 2011 to 29 February 2012¹.
- 1.2 The BAA report on the first phase of the trial provides significant levels of detail on the background, design, use and effects of the Operational Freedoms used, accompanied by independent reports from Cambridge University's Institute for Manufacturing (UCIEU) and the CAA's own Environmental Research and Consultancy Department (ERCD) in Appendix 14. BAA has also published daily and monthly factual data reports highlighting key performance parameters.
- 1.3 In order to avoid duplicating the significant quantities of information made available by BAA in its main report, this document only offers a brief summary of the detail provided, cross-referring to BAA's main report and appendices as appropriate.

¹ This report is available on BAA's website www.heathrowairport.com/noise.

1.4 The oversight and reporting process is set out in Figure 1 below. As illustrated, this report is intended to supplement BAA's report by providing an independent view on the conduct and effects of the first phase of the trial, as well as providing a number of recommendations to influence thinking on the design of the second phase which is intended to begin on 1 July 2012. The recommendations made in this supplementary report build on those made in the CAA's interim report on Phase 1 of the trial for the Minister of State for Transport².

Figure 1: Reporting on the trials: generation of data and production of reports



Background to the trial

1.5 The report of the South East Airports Taskforce (SEAT), published on 14 July 2011, recommended a package of proposals to address punctuality, delay and

² The earlier interim report to the Minister found that BAA's conduct of the trial had generally been good, with thought and resources committed to addressing the principal issues faced by the trial. Areas where improvements could be made covered: trial design and methodology; data production, capture and validation; and engagement with communities. The CAA's interim report is available at: www.caa.co.uk/default.aspx?catid=589&pagetype=90&pageid=13041.

resilience issues, to be taken forward at an airport level, but overseen by the CAA. The report recommended exploring the scope for establishing a set of Operational Freedoms at Heathrow. These freedoms would enable the greater use of tactical measures to prevent or mitigate disruption and to facilitate recovery, in defined and limited circumstances.

- 1.6 The Minister of State for Aviation announced a two-phase trial of Operational Freedoms by BAA to generate evidence on the impacts and benefits and to provide a basis for consultation with local communities. This would inform the Government's decision on whether these measures should be adopted on a permanent basis, and what safeguards should apply in relation to their use, given that the anticipated operational benefits would be offset by some redistribution of aircraft noise among local communities. BAA was required to engage fully and transparently with relevant local authorities, communities and other stakeholders throughout the process, particularly on the monitoring of noise impacts.
- 1.7 The CAA was asked to oversee the trial consistent with its statutory duties of enhancing aviation safety and advising Government. The CAA's powers do not allow it to direct changes to the design or conduct of the trial (except where affecting safety), so its focus has been on ensuring that the trial is run within the broad parameters agreed by Government, and that the data produced by the trial are sufficient to generate a robust information-base on which Government can ultimately take decisions. This will inform both the design of Phase 2 and, ultimately, whether the freedoms are deployed in the longer term.

Design of Phase 1 of the trial³

- 1.8 Phase 1 of the trial investigated the impacts of the following measures after 07.00 hours:
 - Tactically Enhanced Arrivals Measures: arriving aircraft using the runway designated for departing aircraft – a dual-arrival runway operation (referred to as TEAM* to distinguish from existing freedoms known as TEAM);
 - Tactically Enhanced Departures measures: departing aircraft using the runway designated for arriving aircraft – a dual-departure runway operation (TED).

³ Section 5 of BAA's report summarises the design of the trial. Information is also published on BAA's website including a video animation of the trial.

[www.heathrowairport.com/portal/page/Heathrow+noise%5EGeneral%5ENoise+in+your+area%5EOperational+trial/1d532f25264b2310VgnVCM10000036821c0a_____/448c6a4c7f1b0010VgnVCM200000357e120a_____/](http://www.heathrowairport.com/portal/page/Heathrow+noise%5EGeneral%5ENoise+in+your+area%5EOperational+trial/1d532f25264b2310VgnVCM10000036821c0a_____/448c6a4c7f1b0010VgnVCM200000357e120a____/)

- 1.9 These measures could be applied reactively when, on the day, certain trigger criteria were met relating to anticipated poor punctuality or delay performance. These measures were also applied proactively to test different scenarios involving the arrivals of particularly large (A380) or small aircraft or the use of the southern runway for Terminal 4 movements.
- 1.10 Some freedoms already existed before the trial began⁴. Subject to certain criteria, these allow ‘dual arrivals’ when aircraft are arriving and departing towards the east⁵, in the early morning between 06.00 and 07.00, or when there is severe inbound congestion. Dual arrivals and departures are also permitted in exceptional circumstances, for example recovery from snowfall. Thus it has been necessary to untangle the existing freedoms – which are not an ‘Operational Freedom’ for the purposes of the trial – from those introduced by the trial. The trial did not increase the cap on overall movements, the scheduled hourly capacity, or scheduled night flights, and it did not involve ‘mixed-mode’ operations, i.e. the scheduling of the runway to operate arrivals and departures at the same time.

4 These are set out in Section 17 of the BAA report. During the trial BAA was receiving so many questions about these existing freedoms that it published an explanatory document in December 2011: http://noise.heathrowairport.com/assets/Internet/Heathrow_noise/Assets/Downloads/Statics/Runway_Operating_Procedures.pdf

5 Air traffic control selects the runway depending on wind direction, on the basis that aircraft have to land and take off into wind. Around 30 per cent of operations are ‘easterlies’ on average.

Chapter 2. Engagement

Chapter summary

- BAA acknowledged that it needed to engage fully and transparently with local communities throughout the trial. BAA generally appears to have offered and organised the right meetings and has committed considerable time and resources to the engagement process.
- The CAA's own channels of communication with stakeholders revealed some concern among local authorities about the relatively short engagement process (which was largely outside BAA's control), a wish to be more involved in the trial design, greater clarity around the monitoring of the trial and greater granularity of data. BAA has generally been responsive in accommodating these requests.
- Overall, the CAA sees BAA's engagement during Phase 1 as having been only partially successful. Very apparent was the lack of trust in BAA's statements and motivations, and the sensitivity to any change in operating procedures. There may be a limit to what improvements BAA can reasonably be expected to make for Phase 2, but local authority experts should be more involved in the detail of the data collection and analysis and at an earlier stage.

- 2.1 The first phase of the Operational Freedoms trial inevitably involved some redistribution of aircraft noise among local communities, affecting the respite periods created by runway alternation. BAA recognised that it was expected by the Government and the CAA to engage fully and transparently with relevant local authorities, communities and other stakeholders throughout the trial, particularly on the monitoring of noise impacts. BAA's communications and engagement strategy is set out in its report (Section 11).
- 2.2 The CAA appreciates the complexities associated with engaging with local communities, including the number of people and audiences involved, the recent history of Heathrow development, and the technical nature of some of the operational issues associated with the trial. BAA has committed considerable time and resources to the engagement process. In general, the company has been responsive to stakeholders' appetite to engage in the trial and has organised the right meetings – covering local communities and residents' associations, MPs, GLA members and local authorities – and produced considerable publicity through extensive leafleting, the BAA website, advertising in the local press, briefing local journalists, and participating in radio interviews, with an email and telephone enquiry hotline.

- 2.3 BAA also commissioned opinion polls and focus groups from Populus, and a social survey which is still underway. BAA's report assesses its engagement strategy on Phase 1 through the results of the Populus work. It concludes that most residents polled "were unaware of Heathrow's awareness campaign", which speaks for itself, and that the existing attitude of an individual to the airport was generally mirrored in their attitude to the trial.
- 2.4 The CAA has also initiated its own channels of communication with stakeholders through observing at BAA meetings and hosting bilateral meetings with local authorities, as well as producing a news release and providing briefings to local journalists. (More detail appears in the CAA's interim report.) Some local authorities expressed concern to Government and the CAA about the little notice they had been given to inform or respond to local residents before the trial – timescales which the CAA accepts were largely outside BAA's control – and expressed a wish to be more involved in the trial design. Local authorities also made numerous requests for clarification of the monitoring of the trial, including greater granularity of data, perhaps reflecting a greater public expectation for information to be disclosed than BAA was anticipating. The main forum for these requests has been Heathrow's pre-existing Noise and Track-Keeping Working Group which includes representatives from the main impacted local authorities. BAA has generally been responsive in accommodating these requests.

CAA Recommendation 1: That the technical discussions on the impact of the trial continue to be facilitated through Heathrow's existing Noise and Track-Keeping Working Group and that there is greater involvement of local authority experts in the detail of the data collection and analysis at an earlier stage for Phase 2. This should help to reduce the number of queries from various parties around different data sources and conflicting information, which it has taken considerable effort and time to resolve.

- 2.5 The CAA is overseeing the engagement process but is not driving it, and it has been difficult at times to judge whether the engagement process could have worked better or whether BAA has done all it could reasonably be expected to do. There are different audiences for engagement – for example, specialists requiring detailed data and residents needing plain-language explanation. It is possible that some problems may have stemmed from BAA initially underestimating the resourcing that responding to data requests would require.
- 2.6 The lack of trust in BAA's statements and motivations was very apparent in some of our engagement with local stakeholder groups (and reflected by the Populus findings) as was the sensitivity to any change in operating procedures affecting local residents. There is therefore a question as to how BAA could

improve the tone and effectiveness of its engagement and what success can reasonably be expected in circumstances where BAA faces distrust and hostility.

- 2.7 The CAA would agree with BAA's conclusion that engagement with the local community should be different for Phase 2 in certain respects; for example, there seems to be little case for door-to-door leafleting on as wide a scale as for Phase 1, judging by the Populus results which show poor levels of awareness of this activity.

CAA Recommendation 2: The CAA agrees with BAA that a different approach to awareness-raising should be adopted ahead of and during Phase 2. In particular, more effort should be given to informing local communities affected by the trial through appropriate local media (for example, radio, local newspapers).

Chapter 3. Data, use of the freedoms, and effects of the trial

Chapter summary

- The data collected by BAA was appropriate for the trial analysis, and BAA has shown transparency in the amount of data it has already published or is intending to publish, although more attention in Phase 2 should be paid to notifying or amending known errors in published data.
- Operational freedoms were used almost solely to de-alternate arrivals under westerly operations. On average, just over 3% of westerly arrivals were affected by Operational Freedoms.
- Cambridge University's Institute for Manufacturing ECS Unit concluded that data was extracted accurately from BAA systems, and that the statistical tests undertaken were correct, as were the conclusions drawn from statistical tests.
- BAA analysis suggested that the trial recorded improvements in ATFM arrival delay, stackholding (under specific circumstances), on-time arrival punctuality, and taxi-in times; a reduction in the average respite hours with no de-alternated flights; a small increase in the noise exposure during respite; a large increase in complaints; generally low awareness and, where explained, some support for the trial among the local community; no detriment to safety; and only very minor increases in airport/airline/ATC workload.
- There is scope for further analysis of the operational data (to separate more accurately the effects of the trial from those of other drivers of performance) and the complaints data (to estimate better those that could have been directly due to the use of the freedoms), which has the potential to alter the nature or strength of the conclusions drawn in BAA's report.

Data

- 3.1 BAA discussed the data to be collected for the trial with the CAA, DfT and other stakeholders in advance of the commencement of Phase 1. It published daily data on its website three days in arrears and more detailed, monthly reports about four weeks after month end⁶. It has committed to the Noise and Track-keeping Working Group that it will publish lower-level flight details on its website following the publication of its Phase 1 report. This commendable degree of

⁶ The February data report was in abeyance whilst BAA worked on its overall report on Phase 1 of the trial.

transparency will enable external scrutiny of BAA's analysis and operation of the trial.

- 3.2 BAA's Phase 1 report highlights the various data sources required to collate all the information used in the analysis of the trial. It also indicates that there are some inconsistencies in the data reported from these sources and the importance of using the appropriate data source for each data item. BAA has crystallised this knowledge through its experience of publishing data through the trial, and we are comfortable that the data BAA used in its analyses is robust to the level of accuracy required.
- 3.3 However, some of the data previously published still contains errors, and BAA is expected to issue corrections to the relevant reports.

CAA Recommendation 3: Fewer issues with data accuracy are expected in Phase 2, but we believe it would be of help to those with an interest in the operation of the trial if BAA can correct or at least notify users of inaccuracies in published information as soon as possible throughout the period of Phase 2.

Use of the Operational Freedoms

- 3.4 BAA has summarised the use of Operational Freedoms in Section 6.6 of its report on the trial. In periods when the airport was on easterly operations, the only new freedom which the trial provided was the use of dual departures (TED). However, on no easterly operations day was this freedom actually used, reflecting the fact that the overall incidence of use of TEDs throughout the trial period was extremely low (38 departures out of a total of over 55,000). The low use of TEDs in either departure direction is likely to be attributable to the operational difficulties associated with the operation of dual departures on Heathrow's non-independent runways made worse by existing airspace structures (i.e. established Noise Preferential Routes), meaning that the operator must apply the same level of time separation between departures from alternate runways as for departures from the same runway.
- 3.5 On virtually all days when the airport was on westerly operations, the trial freedoms were used for one or more movements. For the most part, this was the dual arrival freedom (TEAM*), used either reactively or proactively, which affected 1,802 westerly arrivals out of a total of over 56,000, or just over 3%. On days when TEAM* was used around 20 flights on average were affected.
- 3.6 Even during the periods of the proactive tests, the reactive TEAM* freedoms were used more frequently (in the two four-week periods, proactive tests affected 158 flights to reactive tests' 872). Of the three proactive tests, it appears that landing Terminal 4 arrivals out of alternation has been used more

intensively in the proactive tests than landing A380s or small aircraft. This is because A380s and small aircraft are often chosen for landing out of alternation during the reactive use of Operational Freedoms, and therefore there was little difference between the proactive and reactive periods for these types of arrival.

- 3.7 BAA reports that, of the four triggers available in Phase 1 of the trial, only that relating to an expected delay of over ten minutes was actually used. BAA does not state how often the trigger conditions were met, but the freedoms were not used.

CAA Recommendation 4: We would suggest that BAA seeks to establish a way of capturing how often the trigger conditions are being met but the freedoms are not being used. This would be useful information to add to that collected in Phase 2 of the trial.

Audit of the trial by Cambridge University Institute for Manufacturing ECS Unit (UCIEU)

- 3.8 Heathrow Airport employed UCIEU to provide independent assurance for the data and trial methodology. UCIEU's comments relate only to the statistical analysis and methodology described in the methodology section below. It did not cover the analysis of customer complaints or of noise and emissions.

- 3.9 UCIEU concluded that data was extracted accurately from BAA systems, and that the statistical tests undertaken were correct, as were the conclusions drawn from statistical tests. It also examined the nature of the experiments (which it characterised as simple comparatives between two treatments of landing / departure operations) and considered the analysis strategy was the correct one to be adopted.

- 3.10 However, UCIEU also noted that as expected from the initial lack of an experimental design, the analysis does not provide clear and explicit cause and effect links between Operational Freedom modes and most of the performance measures of interest. UCIEU recommends an experimental design be developed jointly by NATS and BAA (CAA to validate and UCIEU to support). The design will include a detailed definition of the approach to data analysis ahead of the start of Phase 2.

CAA Recommendation 5: We agree with the view expressed by Cambridge University that BAA should engage with them and the CAA to establish a more robust experimental design for Phase 2 ahead of commencement.

Effects of the trial

3.11 In order to assess the overall effects of the trial, five different aspects of the operation and its effect on the local community were examined by BAA. Below we examine the methodology which BAA has used for the majority of its analyses, followed by the results for each of the aspects⁷, and then consider the audit of the analyses undertaken by the Cambridge University's Institute for Manufacturing.

Analysis methodology

3.12 The application of reactive and proactive Operational Freedoms is hypothesised by BAA to have certain impacts on a number of operational key performance indicators (KPIs) such as punctuality, runway throughput, stackholding time and taxi-in time. In particular, the hypotheses to be tested for westerly operations for the reactive tests are summarised in Figure 5 of BAA's report.

3.13 The approach taken by BAA to test these hypotheses involved using data from an appropriate baseline period (the winter months of November–February 2008/09, 2009/10 and 2010/11), using regression analysis to test whether some external drivers (related to traffic volume and weather conditions) influence operational performance of each KPI, and then comparing the trial KPIs with the baseline KPIs – while controlling for each of the significant external drivers individually – by means of standard statistical tests.

3.14 These statistical tests can only give an indication of whether any differences in the average and variance of the KPIs between the trial and base periods are systemic⁸. If they are, the tests can also indicate to what level of statistical confidence the measures differ between the trial and base periods (with a confidence level of 95% or higher being taken as 'significant'). However, as BAA and UCIEU have also noted, this type of test cannot confirm any cause and effect between implementation of the Operational Freedoms and the observed operational performance during the trial. Rather, it must be inferred that Operational Freedoms have caused the change since the test assumes that the application of Operational Freedoms is the most significant driver of the difference between the baseline and trial periods.

3.15 However, there may be other factors which also affect the statistical tests that BAA has used. These tests only allow the control of one external factor at a time

⁷ A summary of the apparent effects of the trial and the confidence with which we can ascribe these results to the trial is contained in Table 1.

⁸ i.e. unlikely to be caused solely by random variations.

when looking at any KPI (for example, whether there is any observed improvement in arrival punctuality under high wind condition). In other words, these tests cannot take into full account the fact that some or all of these external factors may interact with each other and have a joint influence on operational performance⁹.

- 3.16 Controlling for all external factors rather than just one in the way used by BAA is likely to lead to a sample size insufficiently large to come to any statistically significant conclusion. For this reason, coupled with the danger that the Olympic period may not provide a representative reflection of the effects of the trial on normal Heathrow operations, the CAA believes Phase 2 of the trial should be extended.

CAA Recommendation 6: Given that operating conditions during Phase 2 of the trial are likely to be heavily affected by the Olympics and in light of the difficulties faced during Phase 1 in terms of drawing robust conclusions from the data generated, we recommend that the duration of Phase 2 be extended to encompass the 2012/13 winter scheduling season.

- 3.17 An analytical approach which can be used in parallel to (and in advance of) collecting more data is to refine the regression analysis which BAA has used to test for external drivers so as to also estimate the effect of these external drivers. In order to do this, more work is required to select the most appropriate form of regression model and form of transformation for any variables which are unsuited to the model¹⁰.

- 3.18 BAA acknowledges in Section 5.12 of its report that *'The analysis ... is the first attempt to understand the drivers ... [and] represents a learning exercise and work-in-progress'*, and also states that it 'has provided a good foundation for the further development needed and will be developed further in the future' using data from both Phase 1 and Phase 2 of the trial. Since more detailed regression analysis as suggested above is not always straightforward, it is quite reasonable for BAA not to have undertaken it at this stage. However, we would expect the shortcomings of the analysis to be addressed going forward.

CAA Recommendation 7: We would recommend that more detailed regression analysis is undertaken on the Phase 1 data as well as the future Phase 2 results

⁹ For example, one might find no significant improvement in performance when controlling for 'high wind' conditions. This may be because the trial has not been effective in 'high wind' conditions, but may also be because the 'high wind' periods in the trial saw higher demand volume than those in the baseline.

¹⁰ For example, the precipitation variable has many zero values, whereas the temperature variable has a mix of positive and negative values (making the standard log transformation of this variable impossible).

so as to provide a better foundation for any future decisions on the application of the Operational Freedoms tested.

Operational

- 3.19 BAA has examined a number of operational arrivals and departures KPIs, both overall and controlling for certain possible drivers, to test whether there has been any change between the trial and the control periods. The results are summarised in Table 1 below.
- 3.20 Overall, BAA observes statistically significant improvements in ATFM arrival delay, stackholding (under specific circumstances), on-time arrival punctuality, and taxi-in times, all of which align with pre-trial hypotheses. However, other significant results contradict the pre-trial hypotheses, including predictions of no change to easterly operations where no new freedoms were used. This suggests that not all external drivers have been successfully controlled for in the analysis and casts some doubt on the robustness of the conclusions.
- 3.21 As indicated above, further analysis of the data collected in Phase 1 (and the extra data due to be collected in Phase 2) is likely to provide more robust conclusions on the effects of the trial. However, Heathrow's operations are exceedingly complex and it may not ultimately be possible to fully isolate all of the effects of any trial. How to best collect and analyse trial data is a topic which is expected to be addressed in detail by BAA, CAA and UCIEU prior to the commencement of Phase 2.

Environment

- 3.22 Since the Operational Freedoms did not change the total number of arrivals and departures at Heathrow, and affected only a small proportion of the services at the airport, it is unsurprising that the noise contours show only small effects due to the trial, although these are focussed on particular communities underneath the westerly approach paths.
- 3.23 The CAA (ERCD) has also analysed the effect of the trial on the respite period. This shows that the average daily number of 'respite hours' (defined as an hour between 0700 and 2300 with no de-alternated westerly arrivals) fell from 9.5 in the baseline period to 5.7 during the trial period. On average, this equated to an extra 11 de-alternated flights in the 16 hour day, split evenly between the morning and afternoon/evening alternation periods, or an extra 0.5 to 2 minutes exposure to noise above 70dBA Lmax per eight-hour respite period. At present, there is no established method to capture the value which residents place on the

respite period, and whether this is best reflected by hours in which there is no de-alternation or time exposed to noise above a certain threshold.

CAA Recommendation 8: That BAA gives consideration to whether Phase 2 of the trial would benefit from further work to understand the value placed on respite by residents.

- 3.24 There was a significant reduction in departures after 2300 during the trial compared to the baseline period (in both easterly and westerly directions). It is plausible that some of this reduction may have occurred as a result of the Operational Freedoms trial, but, as with the operational KPIs, further analysis of the trial data would be required to confirm the existence and magnitude of any such effect.
- 3.25 Apparent improvements in both taxi-in time and stackholding (the latter only during certain stressed conditions) during the trial indicate that there was a saving in emissions over the trial period, which has been estimated, were the freedoms to be used through the year, at about 35,000 tonnes CO₂ per annum. However, as noted above, more analysis of the data could attempt to understand the mixed results observed for stackholding and the effect of other drivers on the taxi-in times.

Community

- 3.26 Complaints rose markedly during the trial, to two or three times that seen in the previous three winters, although it is not clear how much this was due to the actual effects of the trial, the raised awareness of noise due to the publicity surrounding the trial, or the increased frequency of easterly operations in the early weeks of the trial period.
- 3.27 BAA classifies complaints by the number of callers, the number of times they are contacted and the number of movements which are mentioned in each contact. These can be very different quantities, since it is not unknown for one caller to complain about a significant proportion of the flights on a single day.
- 3.28 BAA has attempted to isolate complaints caused directly by the Operational Freedoms trial by comparing the location of the complainant with plots of the noise change during the trial period. It has also analysed the times and details of complaints received about February operations. Whilst this analysis shows that many of the complaints received during the trial cannot have been due to movements that arrived or departed out of alternation as a result of utilising the Operational Freedoms, it also suggests that many may have arisen for this reason.

CAA Recommendation 9: As the findings from the analysis undertaken so far leave unanswered the question of how many of the complaints generated relate specifically to direct experience of nuisance generated by flights utilising Operational Freedoms, we recommend that further analysis of complaints data, from both Phase 1 and 2 of the trial, should be undertaken to clarify the nature of the relationship.

- 3.29 In advance of the trial starting, BAA commissioned an independent polling company – Populus Ltd – to undertake three waves of polling (before, during and after the trial) to explore residents’ attitudes to the trial, as well as to hold focus groups amongst residents. These indicated that, in general, knowledge of the trial was not common, although, once its aims were explained, 70-80% of respondents showed some support for the trial.

Safety

- 3.30 The CAA undertook monitoring of the trial progress with the cooperation of NATS (Heathrow and Terminal Control). BAA’s summary of safety outcomes accurately reflects what the CAA witnessed during the first phase of the trial, and describes the single safety-related incident (with associated response) appropriately.
- 3.31 Section 8.2 of BAA’s report also describes the preparatory period immediately before the implementation of Phase 1, and is factually correct. However, it does not acknowledge the comparatively late submission of the safety-related material described in the report. The review of safety assurance presented resource challenges for the CAA in giving the material due consideration without impacting on the trial implementation date. The CAA notes that lessons appear to have been learned from this issue of late submission of documentation, in that NATS is more closely engaged with the CAA on the safety implications of different options in the preparatory period for Phase 2 of the trial.

Resources

- 3.32 BAA has given no quantitative estimate of any extra resource required to maintain the Operational Freedoms, although qualitative estimates from BAA and NATS indicate that this is a very low figure. As yet, there has been no estimate (either qualitative or quantitative) from the key airlines at Heathrow as to the impact of the trial on their operations. However, there is no reason to believe that there should be any significant extra resource required from any of the parties at the airport as a result of using the Operational Freedoms.

CAA Recommendation 10: The report on Phase 2 of the trial should include greater consideration of the resource impact on the airport, NATS and airlines.

Summary

3.33 The effects of the trial described above are summarised in Table 1 below.

Table 1: Summary of effects of Phase 1 of the Operational Freedoms trial

Category	Effect reported by BAA	Degree of Confidence regarding causality	Further work / CAA comment
Operational	<p>Improvements in ATFM arrival delay, stackholding (in stressed conditions), on time arrival punctuality, and taxi-in times.</p> <p>Benefits to airlines (fuel and direct costs) and passengers (value of time) are estimated at around £15m and £20m pa respectively.</p>	<p>More detailed regression analysis may alter the list of statistically significant KPI changes observed in the trial period.</p> <p>Extent of benefit due to trial cannot be stated with confidence.</p>	<p>Further analysis of the data from Phase 1 and Phase 2 is likely to provide more robust conclusions on the effects of the trial. Details to be covered in future discussions between BAA, CAA and UCIEU.</p>
Environment	<p>Minor changes to noise contours.</p> <p>Average hours with no de-alternation fell from 9.5 to 5.7, although time in respite period exposed to noise above 70dBA increased only by 0.5–2 minutes.</p> <p>Emissions for taxi-in and stackholding reduced by an estimated 0.04mt CO₂ pa.</p>	<p>High.</p> <p>High.</p> <p>Extent of benefit due to trial cannot be stated with confidence.</p>	<p>Consider some work to understand value residents place on respite.</p> <p>See comment on regression analysis above.</p>
Community	<p>Complaints increased by 2 to 3 times.</p> <p>Polling suggested general awareness of the trial was low, but, when explained, the majority of residents showed some support.</p>	<p>Increase may be due to awareness of a trial rather than nuisance from de-alternated flights.</p> <p>Medium.</p>	<p>Further analysis of Phase 1 and Phase 2 data to isolate complaints which plausibly could be due to de-alternated flights.</p>
Safety	<p>No decrease in safety.</p>	<p>High.</p>	
Resources	<p>Very minor increase likely to manage new freedoms.</p>	<p>Medium/high.</p>	<p>Discussions with airlines to understand any resource implications on their operations.</p>

Chapter 4. Summary of recommendations for Phase 2 of the trial

Chapter summary

- This Chapter collates the recommendations made by the CAA in relation to the Operational Freedoms trial.
- A total of ten additional recommendations are made, relating to engagement, data, analysis methodology, use of the trial and examination of trial effects.
- These recommendations supplement the five recommendations made in the interim report, which are reproduced below for the sake of completeness.

4.1 This chapter summarises the recommendations arising from the Phase 1 Operational Freedoms trial, the majority of which have a direct bearing on the approach to be adopted in Phase 2. For ease of reference, we have grouped these according to theme, with the recommendations made in the earlier interim report brigaded under the appropriate theme for the sake of completeness.

Engagement

CAA interim recommendation: *Any adjustments to the trial design and trial methodology should be agreed between the DfT, CAA and BAA further in advance of the planned commencement of the second phase of the trial to enable better preparation and greater transparency.*

CAA interim recommendation: *We note that the timing of the first phase of the trial allowed only limited opportunity for prior engagement with local communities. We recommend that BAA considers how best to engage with communities about the trial ahead of the commencement of the second phase, including seeking agreement with the DfT and CAA on what successful engagement looks like.*

CAA interim recommendation: *Local authority technical experts should have more, and earlier, opportunity to be engaged in the data verification and analysis.*

CAA interim recommendation: *The publication of existing runway operating procedures in mid-December helped to answer a number of the questions raised about the distinction between pre-existing procedures and the Operational Freedoms in the trial. We recommend that the differences between existing flexibility and the freedoms being tested by the trial are clearly explained at an earlier stage for the second phase of the trial.*

CAA recommendation 1: That the technical discussions on the impact of the trial continue to be facilitated through Heathrow's existing Noise and Track-Keeping Working Group and that there is greater involvement of local authority experts in the detail of the data collection and analysis at an earlier stage for Phase 2. This should help to reduce the number of queries from various parties around different data sources and conflicting information, which it has taken considerable effort and time to resolve.

CAA recommendation 2: The CAA agrees with BAA that a different approach to awareness-raising should be adopted ahead of and during Phase 2. In particular, more effort should be given to informing local communities affected by the trial through appropriate local media (for example, radio, local newspapers).

Data

CAA interim recommendation: *A key step in the data validation process for the final report will be ensuring that the two principal sources of data used in measuring use of the trial freedoms (i.e. the Noise and Track-Keeping System and NATS operations logs) are reconciled accurately and consistently so as to provide a robust and reliable picture of the flights that have benefited from the application of the Operational Freedoms. We would recommend that Cambridge University look specifically at this aspect of data generation as part of their validation role.*

CAA recommendation 3: Fewer issues with data accuracy are expected in Phase 2, but we believe it would be of help to those with an interest in the operation of the trial if BAA can correct or at least notify users of inaccuracies in published information as soon as possible throughout the period of Phase 2.

Use of the Operational Freedoms

CAA recommendation 4: We would suggest that BAA seeks to establish a way of capturing how often the trigger conditions are being met but the freedoms are not being used. This would be useful information to add to that collected in Phase 2 of the trial.

CAA recommendation 5: We agree with the view expressed by Cambridge University that BAA should engage with them and the CAA to establish a more robust experimental design for Phase 2 ahead of commencement.

Effects of the trial – Analysis methodology

CAA recommendation 6: Given that operating conditions during Phase 2 of the trial are likely to be heavily affected by the Olympics and in light of the difficulties faced during Phase 1 in terms of drawing robust conclusions from the data generated, we recommend that the duration of Phase 2 be extended to encompass the 2012/13 winter scheduling season.

CAA recommendation 7: We would recommend that more detailed regression analysis is undertaken on the Phase 1 data as well as the future Phase 2 results so as to provide a better foundation for any future decisions on the application of the Operational Freedoms tested.

Effects of the trial – Environment

CAA recommendation 8: That BAA gives consideration to whether Phase 2 of the trial would benefit from further work to understand the value placed on respite by residents.

Effects of the trial – Community

CAA recommendation 9: As the findings from the analysis undertaken so far leave unanswered the question of how many of the complaints generated relate specifically to direct experience of nuisance generated by flights utilising Operational Freedoms, we recommend that further analysis of complaints data, from both Phase 1 and 2 of the trial, should be undertaken to clarify the nature of the relationship.

Effects of the trial – Resources

CAA recommendation 10: The report on Phase 2 of the trial should include greater consideration of the resource impact on the airport, NATS and airlines.

Annex: Hypotheses testing

- A.1 The application of reactive and proactive Operational Freedoms is hypothesised by BAA to have certain impact on a number of key performance indicators (KPIs) such as punctuality, runway throughput, stackholding delay, taxi-in time etc.¹¹
- A.2 The approach taken by BAA to test these hypotheses involved:
- (1) Selection of a baseline period (the winter months of November–February 2008/09, 2009/10, 2010/11)
 - (2) Selection of some external drivers (related to traffic volume and weather conditions) that are thought to influence operational performance based on regression of each KPI on these external factors using the baseline data
 - (3) Comparison of the average and variance of the trial KPIs with the baseline KPIs – while controlling for some of the identified (and significant) external drivers obtained from step (2) above – by means of the t-test and F-test
- A.3 It is important to point out that the hypothesis test results obtained from the t-test and F-test as described in step (3) above can only give an indication of whether the differences (if any) in the average and variance of the KPIs measured between the trial and the base periods are systemic or not; if they are, the tests can also indicate to what level of statistical confidence the measures are significantly different between the trial and base periods. However, as both BAA and Cambridge University have also noted, these tests cannot confirm any cause and effect between implementation of the Operational Freedoms and the observed operational performance during the trial. The main reason for this is because these statistical tests only allow the control of one external factor at a time when looking at any KPI (for example, whether there is any observed improvement in arrival punctuality under high wind condition). In other words, these tests cannot take into account the fact that some or all of these external factors may interact with each other and have a joint influence on the operational performance.

Robustness of results

- A.4 BAA has applied the t- and F-tests to a number of arrival/departure KPI measures under reactive and proactive Operational Freedoms. The analysis so far has shown some mixed results (see Table 3 below). Whilst the results cannot reject the hypothesis of performance improvement on westerly operations during the trial

¹¹ The hypotheses to be tested for westerly operations for the reactive tests were summarised in Figure 5 of BAA's report.

period for some of the KPIs (and in some cases the improvement is observed only under specific traffic volume or weather conditions), the analysis has also revealed some contradictory results in other cases (for example, stackholding performance on westerly operations has worsened during the trial or easterly operations have improved albeit they were expected to remain unchanged in the trial period).

- A.5 As explained above, whilst the t- and F-tests may not reject the hypothesis¹² that a KPI has improved during the trial period, however, no causal relationship between Operational Freedoms and the measured KPI can be concluded from such hypothesis testing. Hence, it is not possible to say how much of this apparent improvement is attributable to the application of Operational Freedoms and how much is associated with the other underlying factors. The observation of better performance for some KPIs when comparing easterly operations in the trial period with the baseline also suggests that there were other factors (other than the use of Operational Freedoms) that were also in play but had not been properly accounted for. BAA recognised this insufficiency and attempted to mitigate some of these external influence by comparing the KPIs on westerly operations during the trial with those observed under “similar” underlying conditions – factors identified in step (2) that have strong correlation with the measured KPI – by controlling for some of these factors one at a time. This approach appears to have led to some improvement in the qualitative results in certain cases. For example, Table 11 in the BAA Report indicates that stackholding performance appears to have improved during the trial under ‘high wind’ conditions although the overall average stackholding time for westerly operations during the trial period has increased compared with the baseline period (Table 10). However, conclusion from such simple comparison could be misleading. For example, a further disaggregation of the same data by CAA under ‘high wind’ conditions has revealed that, on average, the volume of traffic on westerly operations was lower and the visibility condition was better in the trial period than in the baseline period (see Table 2 below). However, this seems to contradict the results in Table 13 of the BAA Report which indicate that under ‘good visibility’ and ‘low volume’ conditions stackholding performance during the base period was better than during the trial. This highlights the pitfall in drawing any firm conclusion based on the control of only one factor at a time as in BAA’s analysis. Thus, in order to have a more robust assessment of the impact of Operational Freedoms whilst controlling for all other relevant underlying factors, it is the CAA’s view that a more appropriate approach is to regress the KPIs on both the number of de-alternations and other relevant external drivers that

¹² It should be noted that the proper interpretation of these tests when significant difference is found is that the null hypothesis under investigation ‘cannot be rejected’ rather than ‘the analysis supports the hypothesis’.

explicitly allows interactions amongst the various drivers and the usage of Operational Freedoms (as measured by the number of de-alternations)¹³.

Table 2: Average measures of external factors under different conditions on westerly operations

		TRIAL	BASE	TRIAL	BASE	TRIAL	BASE	TRIAL	BASE
CONDITIONS		Wind (°C)	Wind (°C)	Visibility (km)	Visibility (km)	Humidity (%)	Humidity (%)	Volume (no. flights)	Volume (no. flights)
Wind speed	High			17.86	12.40	75.63	78.27	635.56	637.17
	Medium			16.34	11.57	80.19	82.62	630.84	630.38
	Low			9.70	9.52	82.91	85.29	645.91	624.92
Visibility	Good	19.50	16.58			78.10	79.43	631.79	637.79
	Medium	12.13	16.60			87.29	82.24	645.57	631.75
	Low	9.36	9.90			87.86	89.46	641.14	612.00
Humidity	High	12.83	11.52	10.80	8.61			634.23	619.46
	Medium	17.78	15.06	15.42	11.72			630.92	633.03
	Low	20.48	20.47	18.20	12.62			636.91	635.02
Traffic volume	High	16.94	15.30	15.65	11.49	79.50	82.31		
	Medium	17.52	15.65	15.28	11.15	80.56	82.91		
	Low	21.54	14.55	16.76	10.24	78.82	83.38		

¹³ It is more appropriate to treat the number of de-alternations as an input or intervention variable which is thought to influence operational performance level rather than as one of the KPIs per se.

Table 3: Summary of BAA’s hypotheses-testing results

ARRIVALS				DEPARTURES (with limited TEDs)				
KPI	Condition	Hypothesis on KPI in the trial period	Test result on KPI	KPI	Condition	Hypothesis on KPI in the trial period	Test result on KPI	
Runway arrival rate	Westerly operations	improved	no difference	Runway dep rate	Westerly operations	no difference	no difference	
	- with 'high volume'	improved	worsened		Easterly operations	no difference	improved	
	- with 'low temp'	improved	improved	Start-up delay	Westerly operations	no difference	improved	
ATFM delay	Easterly operations	no difference	improved	Holding point delay	Easterly operations	no difference	improved	
	Westerly operations	improved	improved		Westerly operations	no difference	no difference	
Stackholding time	Easterly operations	no difference	improved	Taxi-out time	Easterly operations	no difference	worsened	
	Westerly operations	improved	worsened		Westerly operations	no difference	improved	
	- with 'high wind'	improved	improved	Punctuality	Easterly operations	no difference	improved	
	- with 'low visibility'	improved	improved		Westerly operations	no difference	improved	
	- with 'medium wind'	improved	improved		Easterly operations	no difference	improved	
	- with 'medium visibility'	improved	improved		Cancellations	All operations	no difference	no difference
	- with 'medium volume'	improved	worsened					
	- with 'medium humidity'	improved	worsened					
	- with 'low wind'	improved	worsened					
	- with 'good visibility'	improved	worsened					
	- with 'low volume'	improved	worsened					
	- with 'low humidity'	improved	improved					
	Easterly operations	no difference	no difference					
	Taxi-in time	Westerly operations	improved		improved			
		Easterly operations	no difference		improved			
Punctuality	Westerly operations	improved	improved					
	- with 'high wind'	improved	improved					
	- with 'low visibility'	improved	improved					
	- with 'high volume'	improved	improved					
	- with 'low temp'	improved	improved					
	- with 'medium wind'	improved	improved					
	- with 'medium visibility'	improved	improved					
	- with 'medium temp'	improved	improved					
	- with 'low wind'	improved	improved					
	- with good visibility'	improved	worsened					
	- with 'low volume'	improved	improved					
	- with high temp'	improved	improved					
	Easterly operations	no difference	improved					
Cancellations	All operations	no difference	no difference					
T4 taxi-in time	Proactive test	improved	improved					
A380 taxi-in time	Proactive test	improved	no difference					
Stackholding time	Proactive test for A380s arrivals	improved	no difference					
	Proactive test for small and light arrivals	improved	no difference					

Note: Test results are only considered 'improved' or 'worsened' when the test statistic has more than 95% level of statistical confidence, suggesting that there is a significant difference in the KPI measure between the trial and baseline periods. Otherwise, the test result is considered to be 'no difference'.