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ADS Contribution to the Airport Commission
Call for Evidence on Airport Operating Procedures – Discussion Paper 04

About ADS

ADS is the premier trade association advancing the UK Aerospace, Defence, and Security industries, with Farnborough International Limited that runs the Farnborough International Airshow, a wholly-owned subsidiary. ADS comprises around 900 member companies within the industries it represents, with over 850 companies identified as SMEs. Together with its regional partners, ADS represents over 2,600 companies across the UK supply chain.

The UK is a world leader in the supply of Aerospace, Defence, Security and Space products and services with these sectors supporting one million UK jobs, exporting £22bn and investing £3bn in R&D annually. ADS welcomes the opportunity to contribute to the Airports Commission's discussion paper on Airport Operational Modules, in order to highlight the impact the UK aerospace industry can have on the overall study for greater UK airport capacity.

Executive Summary

Investment and innovation in new aircraft technology will have the greatest impact on the future of aviation and its environmental effect surrounding major airports.

- The aerospace industry will continue to develop new, innovative and more efficient aircraft technology designed to reduce both emissions and future noise output.
- There has been a 30% improvement in CO_2 emissions/RPK over the last two decades, saving over 400m tonnes of CO2 per annum at current fleet activity levels, relevant to fleet efficiency levels in 1990[1].
- Future improvements offer the potential for reductions in perceived noise from aircraft of 65% by 2050, and an improvement of average efficiency of airline fleets by almost 39% by 2050.

Significant reductions in noise and emissions around airports can also be achieved through improvement in operational procedures identified by industry

- Improvements in airport operational procedures may reduce noise by 1-5 decibels (SEL) along parts of the flightpath, by 2030 against a 2010 baseline, and improve overall fuel burn[2].
- Joined up Air Traffic Management (ATM) initiatives such as the Single European Sky programme will improve matters further, which is why it must be swiftly implemented.
- Steeper climbs and descents, alongside displaced thresholds could also add to improvements in noise impact close to an airport, requiring possible changes to the way UK airspace is managed.

ADS encourages the Airports Commission to ensure all is done to increase UK economic growth, access to new markets and capacity building for the short, medium and long term.

- It is vital that UK capacity is able to expand to improve access to emerging market and facilitate the significant growth in aviation which has been projected.
- A balanced approach is required and must include airlines, industry, airports and passengers in order to develop joined up and cost effective airport capacity strategy.
- Investment from government must continue in new technology which can improve noise and CO_2 reductions, and increase the efficiency of airframes, aircraft engines, and aircraft systems, to address key concerns surrounding airports and capacity building.

[1] Sustainable Aviation 'CO2 Road Map', Section 5.4.1, Page 27
[2] Sustainable Aviation 'Noise Road-Map', Section 4.1, Page 45

1. Innovations in technology will assist in reducing aircraft Noise and CO_2 Emissions

1.1. As discussed in Chapter 2 of the Commission's Discussion Paper 04, advances made in technology are likely to have a significant impact upon the future of civil aviation. Innovations in aerospace design and manufacturing over the last 50 years have continually reduced the impact new aircraft have had on the environment, through both reductions in noise and CO_2 as well as other emissions. Since the invention of the jet engine, the noise output from modern aircraft has been reduced by 97% on departure (a 15dB reduction) and 94% on arrival (a 12dB reduction)[3]. There has also been a 30% reduction in CO_2 emissions since 1990, at current levels[4].

1.2. Such innovation and improvement is set to continue over the next 20-30 years, as the demand for air travel and new aircraft increases significantly to around 27,000 new commercial aircraft globally, by 2031[5]. The Aerospace industry, of which the UK holds a 17% global market share, is committed to ensuring that the next generation of aircraft are able to operate on a quieter scale and emit less CO_2 and other emissions throughout their operational life. Both government and industry have recognised how the importance of technological breakthrough, by forming Aerospace Growth Partnership (AGP) which provides a £2bn investment for 7 years, investing in new R&D and the creation of the Aerospace Technology Institute (ATI). Such a partnership is vital not only in order to sustain the UK's global market share in aerospace, but also to reduce environmental impacts of aviation and improve overall efficiency of use for airlines and air operators. Alongside the AGP, the creation of 'Sustainable Aviation' in 2005, a group that stretches across the aviation industry, continues to promote "cleaner, quieter, smarter" aviation, and has produced Noise and CO_2 Road-Maps - projecting how significant reductions in both can be made through new technology and other factors such as improved airport operational procedures.

1.3. Aircraft Technology Development – Reductions in Emissions and CO_2

The CO_2 Road-Map outlined by Sustainable Aviation includes a variety of measures which could help reduce CO_2 emissions from aviation, of which a significant proportion is based upon the new technology that will be attached to the introduction of both 'imminent' and 'next generation' aircraft. New aircraft types such as the Airbus A350XWB, A380, A320Neo, the Boeing 737MAX and 787 Dreamliner and the Bombardier C Series, are set to improve the average fuel efficiency of airline fleets by some 17% through measures related to engine, airframe and composite material technology. Targets set by the Advisory Council for Aeronautics Research in Europe (ACARE) mean that by 2020, engine and airframe technologies should allow for a fuel-efficiency improvement of around 45% on those aircraft where such technology has been implemented. In addition, ACI, CANSO, IATA and ICCAIA projected in 2009 that an on-going improvement rate in fleet-average fuel efficiency of 1.5% per annum (reflecting recent trends) by 2020 can be envisaged, alongside the deployment across the fleet of radically new technologies developed in the intervening period, with a reduction of net carbon emissions (relative to 2005 levels) by 50% by 2050[6].

1.4. In addition to ACARE compliant technologies being implemented, further year-on-year improvement in fleet-average fuel-efficiency will arise from technology insertion and further developments in lightweight materials and turbomachinery efficiencies, amounting to some 0.5% per annum from 2021 onwards. It is also anticipated that new technologies such as blended-wing-body aircraft configurations could have a major impact of up to 20% less future CO_2 emissions through reduced fuel burn.

[3] Sustainable Aviation 'Noise Road-Map', Section 3.3.1, Page 22
[4] Sustainable Aviation 'CO2 Road Map', Section 5.4.1, Page 27
[5] HMG and AGP, Lifting off: Implementing the strategic vision for UK Aerospace, 2013
[6] Sustainable Aviation 'CO2 Road Map', Section 1.6, Page 7

1.5. Whilst such figures are based upon industry projections, the economic drivers and historical improvements made in the reduction of carbon emissions, indicate that the aerospace industry through new technology can contribute significantly to reducing emissions further. Such considerations should be taken into account when studying the environmental impact CO_2 and other emissions from aviation will have on the various airport capacity options available to the Airport Commission.

1.6. Aircraft Technology Development – Reductions in Noise

Noise impact on communities that surround airports is one of the most significant issues facing the future of UK airport capacity strategy. Whilst the effect different airport operational models can have on noise will be discussed later in ADS's contribution, significant technological improvements are also set to ensure that noise is reduced from aircraft arrival, taxiing, ground and departing operations. The industry partnership established through Sustainable Aviation, has produced a Noise Road-Map which highlights how provisions for future technology mean that overall noise output from aircraft operations can be reduced, inclusive of the projected rise in forecasted (DfT) passenger demand over the next 40 years.

1.7. Historically, engines have been seen as the most significant focus area for technology improvement in reducing source noise output. Early turbojets and turbofan engines were dominated by high jet exhaust noise, however modern very-high-bypass-ratio turbofans, such as recent members of the Rolls-Royce Trent family of engines, have significantly reduced jet velocities for the same thrust, and consequently make substantially less noise. Advances in materials and manufacturing technology have allowed these very-high-bypass-ratio engines to avoid incurring unacceptable weight and drag penalties on the aircraft, and delivered reduced aircraft noise whilst simultaneously reducing fuel burn. Various other improvements including promoting faster mixing of the jet exhaust with the atmosphere (whilst minimising the turbulence created in the mixing process) and new nozzle lip treatments, such as the serrations featured in the flight testing of the Rolls-Royce/Boeing Quiet Technology Demonstrator and the Rolls-Royce/Airbus 'low interior noise fan nozzle' research programme, are now close to or currently entering commercial service with aircraft such as the Boeing 787, etc.

1.8. With the reduction in jet noise, fan noise is becoming the dominant source of aircraft noise disruption, particularly in and around airports. New design features of the engine fan system for minimum noise include choice in the number of rotating blades and static vanes, the distance between these two rows of blades/vanes, detailed geometries of the rotor blades and stator vanes (including sweep) and the rotor rotational speed. Recent aircraft such as the Airbus A380 powered by the Rolls-Royce Trent 900 and the Boeing 787 powered by the Rolls-Royce Trent 1000 have demonstrated significant noise reductions compared with their predecessors as these aircraft feature technologies which include increased engine bypass ratios, nacelles with zero-splice intake liners and advances in new component design. These aircraft are typical of the 'imminent' aircraft entering service over the next few years and deliver significantly reduced noise footprints than the aircraft they replace.

1.9. ADS believes that previous experience and on-going innovation has demonstrated how aerospace manufacturers, particularly those in the UK, can deliver results and have a significant impact on the aviation industry. For example, during the initial development of the A380 (then the A3XX), Airbus predicted that arrival noise levels of the aircraft would meet the QC1 criterion, significantly under the level QC2 Quota Count System for arrivals noise set by London Heathrow Airport. However, on introduction into service in 2007, the A380 actually achieved noise levels that allowed it to be classified into the lower QC0.5 group, demonstrating the ability for the aerospace industry to achieve substantial results at least as good as provisionally predicted. A

similar story outlining the development of the noise performance of the Boeing 777, was presented to the Heathrow Terminal 5 Inquiry, demonstrating that this is not just a one-off example but the norm within the aviation industry. Such examples should give the Airports commission confidence in the ability of the aerospace industry to deliver tangible improvements and in the predictions for the performance of future aircraft programmes, many of which are currently under development.

1.10. ADS would encourage the commission to recognise the benefits and expertise the UK aerospace industry can bring when discussing the impact of carbon emissions and noise output, both of which rank highly on the background to decision making on future airport capacity. However, ADS notes that actual noise and CO_2 performance will vary significantly by airport, depending on the fleet mix, route structure, number of runways, operational requirements and the scope for adopting new noise mitigation measures.

1.11. The measures taken and demonstrated above mean that the aerospace industry has recognised and responded to the demand from airlines and airports alike for greener and quieter aircraft. More recently, new technology developments have focused on increasing an aircraft's passenger capacity, as well as it fuel efficiency and noise reduction. For example, more fuel-efficient, smaller aircraft that are capable of flying to mid- and long-haul destinations by both Airbus (A350) and Boeing (Boeing 787) could have an impact on future decisions made by airlines on developing new routes and connections for their customers. This signifies a direct correlation between new technological improvement in aircraft by industry, decision making by airlines on their route structures and ultimately, the future fleet mix and operational models of UK airports.

2. Improvements in Airport Operational Models and Procedures

2.1. Whilst noise levels and disruption will vary between airports depending on the structure of routes, meteorological conditions and fleet of aircraft, there remains the potential for additional improvements to be made of reductions by 2030, through the use of various aircraft operating techniques. However, it should be noted the exact noise benefit will also vary for different locations along the flight-path depending on the current noise exposure and the local scope for developing and adopting new noise mitigation procedures. Potential operational improvements however, still present an opportunity to influence noise both close in to and further away from a given airport.

2.2. For arriving aircraft, use of such methods as continuous descent operations (CDOs) have been implemented for a number of years, requiring less engine thrust than level flight and also providing additional noise attenuation by keeping the aircraft higher for longer. However, there may still remain scope for better performance. A study by ERCD for the London Airports suggests that CDOs from 7,000ft may offer between 1-5 dBA SEL noise reduction at between 10 to 25nm from touchdown[7] relative to the 'traditional' stepped approach. The upper end of this range relates to benefits identified for some larger aircraft types, with benefits towards the lower end expected for small to medium aircraft types. Whilst issues such as the nature of 'stacks' and the way that airspace is managed in the UK for arriving aircraft by NATS, have to be taken into account on new potential procedural changes, both airlines and airports are working together with NATS for continuous improvements, with the potential for new airspace design and the uptake of performance based navigation techniques.

[7] CAA ERCD, BAA, CDA Briefing Paper, "Noise benefits associated with Continuous Descent Approach Procedures at London Heathrow"; and DTLR (1999), "Noise from arriving aircraft: Final Report of the ANMAC Technical Working Group," Departments for Transport Local Government and the Regions, December 1999.

2.3. In addition, slightly steeper approaches of up to 3.2 degrees, versus a standard 3.0 degree approach, may be able offer scope for additional noise reductions of up to 1dBA SEL, and displaced runway thresholds would move the noise footprint of arriving aircraft closer to the airport by the same distance as the displacement. For departing aircraft, measures such as greater use of continuous climb operations through airspace redesign and revised procedures to eliminate stepped climb, offers significant fuel and emissions savings and could also offer a small noise benefit beneath some parts of the departure flight-paths.

2.4. It should be noted however, that in many cases it is necessary to achieve a balance between the need to mitigate between noise and other effects, such as fuel burn (emissions) and airport capacity, etc. For example, whilst the use of the noise preferential routes (NPRs) can reduce the number of people affected surrounding an airport in absolute terms, the additional track distance required to adhere to the NPR means that extra fuel-burn, and associated emissions, will probably be required. Operational noise mitigation should, where possible, be tailored to the specific desired outcomes of communities around individual airports and within the legal and safety constraints of what is allowable. No one solution can fit all airports and, additionally, decisions on noise concentration or dispersal, can only be answered by agreeing the desired outcome for each airport community[8]. However, ADS would note that we have only limited information on this subject and would point to the more informed responses provided by the airports, airlines and local community bodies engaged in these discussions.

2.5. Alongside changes in airport operational models and procedures as highlighted above, the integration of new Air Traffic Control Technology and initiatives such as the Single European Sky project will also help reduce noise, fuel-burn, and emissions from aircraft operations and can allow the achievement of the greater use and capacity of UK airports and reduce delays. ADS supports the Single European Sky programme and SESAR research programme, as not only would increasing the cohesion of Europe's air traffic management bring benefits for a reduction in fuel burn and the ability to undertake operational procedures which reduce overall noise output as listed above, but SESAR would also benefit the European economy by around €419bn (UK's share = €84bn) from 2013 to 2030, creating 328,000 jobs and saving 50 million tonnes of CO_2.

2.6. In addition, new technology such as Performance Based navigation (PBN), consisting of RNAV (Required Navigational Performance) and RNAV1 (known as Precision-Area Navigation (P-RNAV) in the UK) is an example of aircraft navigation systems which the aerospace industry has developed to assist in the improvement of airport operational models. P-RNAV is the European terminal airspace RNAV which allows for track keeping accuracy of aircraft. In addition to a significant technology breakthrough that adds a substantial dimension to future airspace management, P-RNAV allows greater noise optimisation after initial aircraft power cut-back, alongside the opportunity to ensure better efficiencies and noise performance through more accurate positioning of flight-tracks, though it's use is currently limited for operators in UK airspace.

3. Ensuring decisions on future UK airport capacity allow access to emerging global markets

3.1. ADS believes that it is vital that the Airports Commission's findings identify the outcome which most facilitates the expansion of UK economic growth. For the UK aerospace industry's ability to continue to grow and meet demand for the projected increase in 27,000 new commercial aircraft required by 2031, greater UK airport capacity must be used to maximise the UK's ability to reach emerging markets in Asia, Latin America and the Middle East. According to the CBI, a new daily

[8] See Stansted NPR case study in appendix 7, annex F.

flight to the eight largest high-growth economies could generate as much as £1bn of additional trade a year, with a 'symbiotic relationship' between air links and trade flows[9].

3.2. In addition to greater capacity which can deliver access these new markets, ADS believes it is essential that investment from government in collaboration with industry continues. The UK is a global leader in aerospace innovation, and continued investment will allow the industry to develop the next generation of quieter, more fuel efficient and cleaner energy technology that will have an impact on the future strategy and development of increased UK airport capacity, and meet the increasing demand across the world for air transport.

[9] CBI, 'Trading Places: Unlocking export opportunities through better air links to new markets', February 2013.