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VANTAGE PHASE 1 – THE USE OF KEY PERFORMANCE INDICATORS AT BELFAST CITY AIRPORT

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ABSTRACT

George Best Belfast City Airport (BCA) plays a key role in providing almost direct access to the city of Belfast and the Province beyond. The airport operates under a planning agreement between itself and the Department for the Environment for Northern Ireland which dates from January 1997 and which sets out a series of obligations and restrictions on airport operations. In addition it is one of only four airports in the EU which are designated as a 'city airport' which means that it can be subject to the imposition of more stringent noise-related operating restrictions than other airports in the EU, if so desired. In response to these constraints, BCA has developed a noise complaints procedure which was reviewed in 2005. At present BCA's key environmental performance indictors (KPIs) relate directly to the planning agreement stipulations and the 2005 noise complaints procedure review.

This paper describes and considers the effectiveness of the current environmental performance indicators and suggests new key performance indicators (KPIs), which could be used to assess the environmental consequences arising from aviation growth , which influence the development of air traffic management technologies and procedures and demonstrate progress towards more sustainable air transport at BCA.

Keywords
Airport , key environmental performance indicators, KPIs, noise, air quality

INTRODUCTION

This work has been undertaken as part of VANTAGE Phase 1, which is a DTI funded project designed to enhance the environmental efficiency of the landing and take-off (LTO) cycle of aircraft at regional airports. This is enabled by the introduction of various technological solutions which together provide the integrated 'VANTAGE System'. The System is being deployed at Belfast City Airport (BCA), Northern Ireland and will be assessed in terms of its likely impact on operations and the key environmental outputs arising from it.

Belfast City Airport provides almost direct access to the city of Belfast and the Province beyond. It opened as 'Belfast Harbour Airport' in 1938 and became a military base during the Second World War. In 1983 it re-opened for commercial traffic, and in 1984 handled 177,000 passengers, via 11,000 air traffic movements (ATMs). The airport became Belfast City Airport (BCA) in 1989 and was renamed George Best Belfast City Airport in 2006. It currently handles around 2 million passengers per annum via short haul, mostly scheduled traffic (BCA, 2005). The site benefits from the proximity of the open water of Belfast Lough, the docks, industrial and other commercial areas, the major road that passes along its south western perimeter and surrounding parkland, such that any disturbance from ground operations is localised. The noise of aircraft approaching and departing from BCA does, however, affect large numbers of residents in the City of Belfast itself, and in communities along the southern shore of Belfast Lough. The level of noise disturbance at BCA is only in part a function of the frequency and sound generated by aircraft movements and the geographical distribution of built up areas. It is also affected by people's expectation of quality of life, their understanding of the benefits arising from the airport existence and by related concerns such as a fear of air accidents.

BCA is one of only four airports in the EU designated as a 'city airport', and, as such can be subject to the imposition of more stringent noise-related operating restrictions than other airports in the EU, if so desired (EU Directive 2002/30/EC). In addition the airport operates under a planning agreement between itself and the Department for the Environment for Northern Ireland that dates from January 1997 and sets out a series of obligations and restrictions on airport operations.

As part of their role in the VANTAGE Phase 1 project, staff from the Centre for Air Transport and the Environment at MMU were asked to assess current environmental indicators and provide suggestions for new environmental KPIs which could be used to assess the impact of air transport and environmental performance at BCA.

THE USE OF ENVIRONMENTAL KPI'S AT BELFAST CITY AIRPORT

The Present Situation

The present environmental performance indicators at BCA are limited and relate directly to the planning constraints on the airport. These are summarized in Table 1.

Table 1. BCA Planning Obligations and Restrictions
BCA (2005)

• Scheduled aircraft may only be scheduled to operate between 0630 and 2130hrs (there is provision for this to be extended between 2131 and 2359hrs to facilitate delayed aircraft);

- Not more than 45,000 air traffic movements shall be accepted in any twelve month period;
- Operators shall not offer for sale more than 1,500,000 outgoing seats in any twelve month period;
- Only aircraft types which meet the standards adopted by ICAO, Annex 16, Chapter 3, shall be accepted;
- A bias shall be maintained of approaches and climb outs over Belfast Lough; and
- The company shall produce an annual Noise Contour and compare it with the indicative noise contours prepared by the Department for the Environment for Northern Ireland.

In July 2004 BCA submitted an application for a review of the Planning Agreement, with particular reference to the removal of the limit on the number of seats that operators may offer for sale in a given twelve month period. The outcome of this review is imminent and it is expected that the 'seats for sale' limit will be removed.

The present environmental performance indicators at BCA provide a useful but limited indication of the level of impact operations have on the surrounding environment. They are summarised in Table 2.

Table 2. Present environmental performance indicators at BCA

- % aircraft movements over the Lough;
- Number of flight extensions allowed after 21.30hrs; and
- Total number of ATMs.

Aircraft Movements over the Lough

The determination of the % of aircraft movements over the Lough provides evidence that BCA are delivering on their commitment to prioritise LTOs over the Lough and thereby ensure that arriving and departing aircraft fly over the minimum number of people. In practice this can be difficult to achieve, particularly for take-off and climb-out as pilots, as well as air traffic control tend to make a decision on which runway direction to use on an *ad hoc* basis, dependent on weather conditions, prevailing wind and pilot preference. From an airline's point of view the preferred route is south over the city, as it results in less fuel burn, as the end of climb is closer to the likely destination. The airport has a preferred noise route which is a departure to the north east over the Lough, followed by a right turn to the south at a suitable height. Thus a trade-off exists between the reduction of noise nuisance for residents to the south of the airport and the reduction of fuel burn; as noise reduction is achieved at the cost of greater track distances resulting in higher fuel burn and subsequent greenhouse gas emissions. Although noise nuisance is currently the limiting environmental constraint at BCA – and this is likely to tighten as increasingly affluent and noise-sensitive communities become less tolerant of aircraft noise – other aviation environmental impacts are also increasing and at some point may become limiting factors in their own right. For example, the significance of greenhouse gas emissions is increasingly acknowledged, and

growing awareness of the potential impacts of climate change is shifting the balance of concern in favour of reducing fuel burn rather than reducing noise nuisance. Such a shift in emphasis is likely to be more welcome to the aviation industry since it would potentially be accompanied by fuel savings,

Number of Flight Extensions Allowed After 21.30hrs

The arrival and departure of aircraft after 21.30hrs and before 06.30hrs is prohibited under BCA's planning agreement except where absolutely necessary and where an extension has been agreed. In addition engine testing is also prohibited between 21.30hrs and 06.30hrs. Some 60% of noise complaints relate to aircraft operating after 21.30hrs and approximately 65% of late aircraft arrive over the Lough (BCA data). Additionally, in terms of noise, aircraft type is also considered an influencing factor for complaints with a larger Airbus arriving at 22.00hrs causing more impact than smaller aircraft.

Flight extensions after 21.30hrs represent the most sensitive environmental issue for operations at BCA. Local residents have expressed concerns that the airport has permitted flight extensions in contradiction to its planning agreement and these concerns have motivated noise complaints to the airport. In an audit of the BCA approach to noise management, Thomas [2005] found that the airport set a target to achieve a 10% reduction in the number of aircraft delayed past 21.31hrs by 2004; in fact, the airport exceeded this target and achieved a 20% reduction. Nevertheless, some local residents expressed uncertainty about whether the airport was genuinely active in managing aircraft noise [Thomas, 2005]. As a result, BCA has been urged to report more effectively to its stakeholders the improvements in environmental performance that have been secured.

The approval or refusal of flight extensions by air traffic control, nonetheless, remains a critical influence on the environmental performance of the airport. The sensitivities here are well illustrated by the case of aircraft which transit the area to or from another airfield (such as Belfast International Airport): those aircraft are sometimes mistakenly assumed to be BCA traffic and the airport receives complaints about their (legitimate) operation, over which it has no control.

In addition to the influence of aircraft type (mentioned above), the extent of the delay past 21.30hrs is a factor in determining the level of annoyance caused: aircraft arriving soon after 21.30hrs generally cause much less aggravation than those arriving later in the night.

Options for reducing the number of flight extensions allowed after 21.30hrs are affected by complex sequences of events that can begin before the departure of the inbound aircraft and that may be beyond the control of BCA.

Total Number of ATMs

The total number of ATMs at BCA is capped at 45,000 per annum by the planning agreement currently in place. This translates to a maximum of 1,500,000 outbound seats per annum with the current fleet mix. The relationship between total number of ATMs at BCA and environmental performance is complex. Absolute improvements in environmental performance are achieved most directly by reducing or limiting aviation growth. However, the UK Government has made a commitment to encourage aviation growth over the period 2003-2030 as part of a balanced approach to the future of air transport, including the necessary infrastructure to meet the expected demand for air transport by region [DfT, 2003]. Therefore, opportunities to secure improvements in environmental performance at airports are limited to improvements in eco-efficiency, by which means the environmental impacts of

air transport are reduced through improved use of resources and management of waste per ATM. Furthermore, from a sustainable development perspective, environmental impacts may be justified if they are balanced in a reasonable way with social and economic benefits arising from aviation growth. In terms of environmental performance, an increase in the total number of ATMs generally represents an increase in absolute environmental impacts, but may also be accompanied by an increase in the eco-efficiency of the industry, which in turn would reduce any absolute increases in impacts. Ideally such eco-efficiency improvements would be sufficient to fully compensate for growth (i.e. maintain or even reduce the level of absolute impacts); however, in reality, technological improvements are struggling to keep pace with the rate of growth in this sector. Thus, the social and economic benefits derived from an increase in ATMs are usually associated with increasing absolute environmental impacts that might ultimately become limiting factors on the airport's growth.

The relationship between total number of ATMs at BCA and seats per year is also complex. An increase in the total number of passengers per movement may be achieved by using larger aircraft with greater capacity and greater operating take-off masses but these require greater absolute fuel burn and produce more greenhouse gas emissions. However, as larger aircraft offer improved fuel efficiencies per available seat, greater utility is achieved by the use of larger aircraft and these can be justified from a sustainability perspective if social and economic benefits are maximised per unit of fuel burned or pollutant generated. Overall, the logic of eco-efficiency suggests that the largest aircraft possible should be operated from BCA whilst maintaining load factors so that the most utility can be derived from the permitted number of ATMs. However, as each movement of larger aircraft generates more sound than their smaller counterparts; this may result in an increase in perceived noise impact, even where average sound energy levels over a given period (i.e. dBA Leq) are shown to be reducing.

PROPOSED ENVIRONMENTAL PERFORMANCE INDICATORS AND KEY PERFORMANCE INDICATORS AT BELFAST CITY AIRPORT

One objective of the VANTAGE project was to propose a small number of environmental KPIs for use at BCA. These may be drawn from a wider range of environmental performance indicators which could be put into place at the airport and which relate to the two issues of noise and air quality. Noise is considered to be the key issue at BCA, particularly because of its close proximity to the city and its designation as a 'city airport'. A number of noise related performance indictors have been proposed by VANTAGE and these are presented in Table 3. It is anticipated that noise monitoring at the airport will become more readily available when the scheduled secondary radar system (SSR) becomes available in approximately 18 months time, hence not all the performance indicators and KPIs proposed may be implemented initially, rather they represent potential KPIs for the short to medium term, when more comprehensive monitoring data are available.

At present there are no local air quality issues currently identified at BCA. However, given the importance of this issue at many other regional airports it would be impertinent to ignore issues of local air quality, particularly should the airport wish to expand operations in the future. To this end it is important that the airport maintains links with the Local Authority who assess local air quality against the standards and objectives set out in the Air Quality Strategy for the UK [DETR, 2000]. It is also important to consider the global aspects of air quality, and in particular emissions of the greenhouse gas carbon dioxide (CO_2), in

order to meet the challenges of a more sustainable aviation industry. Air quality performance indicators and KPIs have therefore been proposed as part of the VANTAGE project. These shown in Table 3 and relate specifically to carbon dioxide (CO_2). In addition, should local air quality become a particular issue for the airport in the future, similar KPIs relating to nitrogen oxides (NO_x) and particulate matter (PM_{10}) could be employed.

It is worth noting that given the need for the sector to demonstrate that it is doing all that is reasonable to minimise any increase in the absolute environmental impacts arising from growth through the delivery of improvements in eco-efficiencies , a further refinement of these indicators may be to illustrate performance per passenger carried. This would capture any improvement in the relative efficiency of the LTO system derived from changes in fleet mix and operational improvements and indeed highlight a core sustainability concern; namely the environmental consequences associated with the delivery of a unit of utility. Nevertheless, such efficiency indicators should always be used in conjunction with absolute indicators to ensure they are not used to mask any absolute increases in environmental impact; hence the KPIs identified in Table 3.

Table 3. Proposed environmental performance indicators and KPIs at BCA

Noise Related	Air Quality
Environmental Performance Indicators • % movements over the Lough; • % Number of deviations from preferred track; • % of aircraft applying noise abatement measures; • Number of departures after 21.30hrs; • Noise levels at specified locations around the airport; and • The % of movements operated by Chapter 4 compliant aircraft	**Environmental Performance Indicators** • Total mass of CO_2 (kg) per individual aircraft per phase of the LTO cycle; • Total mass of CO_2 (kg) per aircraft type per phase of the LTO cycle; and • Total mass of CO_2 (kg) per aircraft type per entire LTO cycle
Key Performance Indicators (KPIs) • **Area of the 57 dBA Leq 8 hour night noise contour and 16 hour day-time contour;** • **Population (resident) enclosed within the 57 dBA Leq 8 hour night noise contour and 16 hour day-time contour**.	**Key Performance Indicators (KPIs)** • **Total mass of CO_2 (kg) per phase of the LTO cycle per day; and** • **Total mass of CO_2 (kg) per day.**

BENCHMARKING

In order to determine the relative environmental performance at BCA, some degree of benchmarking should take place. Benchmarking offers the possibility of making comparisons of environmental performance across the airport sector – a practice that Hooper and Greenall [2005] have acknowledged (in relation to airlines) is an important tool for facilitating dialogue between airports and local community stakeholders. They state that:

'in order to optimise the reputational benefits of reporting, and thus enhance the "licence to operate", the information supplied in [environmental reports] should allow stakeholders an opportunity to compare the relative environmental and social performance of companies' [Hooper and Greenall, 2005].

It is also argued that attempts to benchmark environmental performance against that of competitors or against an industry average can enhance the credibility of the claims made in an organisation's environmental reports. Such comparisons, however, may require qualifying statements to explain that airports operate in different local circumstances and carry out different functions in their local and regional economies. Different airports have also experienced varying opportunities and constraints in their historical development, to which variations in environmental performance could be attributed. Hence it would be important to define similar airports in order that appropriate, 'like-with-like' comparisons can be made [Hooper and Greenall, 2005].

The variability in the circumstances of different airports – which makes appropriate benchmarking problematic – has also been acknowledged by Upham and Mills [2005], who state that much of the variability that may underlie environmental performance may be beyond the control of an airport; hence it is important that the reporting of environmental KPIs should be as explicit and transparent as possible, in order that stakeholders can assess that performance against what might reasonably be expected of an organisation. In common with Hooper and Greenall [2005], Upham and Mills [2005] acknowledge that sustainability benchmarking and reporting should take place in the context of a dialogue between the organisation and local stakeholders. The latter state:

'Inter-airport sustainability would enable both the airport and its critics to gain a more informed idea of an airport's performance, is a basis for discussion and demonstrates a willingness to take some accountability for environmental impacts' [Upham and Mills, 2005].

This debate could be facilitated by means of consultation and reporting initiatives (including more extensive use of the Internet), charters with stakeholders, or the inclusion of articles by stakeholders in environmental reports [Hooper and Mills, 2005]. It could also be informed by the approaches taken by the Global Reporting Initiatives, the Association of Chartered Certified Accountants (ACCA) and the International Standards Organisation (ISO).

Consideration of the potential issues involved in environmental benchmarking in the airport sector raises the question: 'is this what stakeholders really want?' [Hooper and Greenall, 2005]. As the interests and concerns of stakeholders affected by airport operations vary, and because of the complex nature of some aviation environmental impacts (and the trade-offs between those impacts), defining appropriate environmental KPIs – and deciding on appropriate forms of benchmarking – are problematic. For a related industrial sector (airlines), Hooper and Greenall [2005] argue that a re-think of the indicator framework is required, which should include a much wider debate to clarify the different priorities of each stakeholder group and the information sought by each group. In particular, those authors warned that information relating to *impacts*, rather than *outputs*, can be more relevant to some stakeholders. Furthermore, information about those impacts is sought in

the context of locally-determined planning agreements, legal requirements and political negotiations [Upham, 2005]. Therefore, Hooper and Greenall [2005] conclude that the selection and definition of environmental KPIs – and the benchmarking of a company's environmental performance – should ideally take place in the context of a transparent, wider debate with specific stakeholder groups, as a result of which the true nature of the information required can be understood

SUMMARY/CONCLUSIONS

This paper describes the current environmental performance indicators which are in place at BCA and has discussed some of the issues surrounding their use: in particular, some sensitivities relating to the percentage of aircraft movements over Belfast Lough, the number of flight extensions after 21.30 hours, and the total number of air traffic movements. Given some of the limitations of the current KPIs – and the fact that they were defined before the environmental issue of aviation-induced climate change came to prominence it is suggested that new KPIs could be used to assess more accurately the environmental impact of air transport at BCA. The importance of defining a suite of appropriate environmental KPIs is increasingly acknowledged; such KPIs offer a means of monitoring environmental impacts and demonstrating improvements in eco-efficiencies which, as illustrated in this paper, is particularly significant in the context of the absolute increases in environmental impacts currently associated with the growth in aviation. A further specific benefit of this more comprehensive and systematic suite of KPIs is that can be used to evaluate proposed changes to technologies and operations under the VANTAGE project and thereby ensure that the development and deployment of air traffic control technologies at BCA is undertaken in such a way as to optimise the possible environmental returns.

In general, it is likely that environmental pressures at airports will continue to increase and will constrain their growth to a greater extent in the future; thus it is incumbent upon key actors in the sector to ensure that this ultimately constrained resource is provided as efficiently as possible to maximise the utility offered.. Effective environmental management and long term planning are the keys to ensuring that the environmental capacity, and hence the operating capacity of an airport can be optimised.

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