Research in Transportation Economics, Volume 59, Issue November, 2016, pp. 185-195
DOI: 10.1016/j.retrec.2016.04.013

Improving the environmental performance of Airport Surface Access in the UK: the role of public transport.

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Abstract
Simultaneously increasing the share of airport surface access journeys that are made by public transport and reducing the environmental effects of airport access/egress trips while accommodating future demand for air and surface access travel are priority areas for the air transport industry and the UK Government. Given the urgent need to reconcile commitments to environmental responsibility with commercial and economic imperatives for growth, this paper analyses the surface access strategies of London's six busiest passenger airports to: identify the current challenges of airport surface access provision, examine opportunities for improvement within existing and future infrastructure and offer recommendations as to how increased public transport provision and patronage could improve the environmental performance of airport surface success in the UK.

Keywords: Airport surface access, passenger demand, public transport, UK.

1. Introduction

Commercial airports are not only sites of often intense aeronautical activity but are also significant generators of surface access journeys. Every year, over 3.3 billion passengers and over 50 million tonnes of airfreight are transported between the estimated 4,000 airports worldwide that support scheduled commercial flights (ATAG 2014). Both sustaining and accommodating increased volumes of air passengers and freight in the future is dependent not only on the provision of safe, reliable and cost effective air services but also on the ability of passengers, staff, visitors, freight, and mail to routinely, efficiently and reliably access airport terminals, cargo areas and maintenance facilities. Indeed, the provision of appropriate, affordable, accessible and reliable airport surface access options is a prerequisite of efficient airport operation and source of competitive advantage both for airport operators, on account of a wider catchment area and a strong reputation for surface access, and national economies who benefit from the enhanced speed and global connectivity access to air travel affords.

Airport surface access (also termed 'ground access' in the US) describes how people (including, but not limited to, passengers, employees, visitors and contractors), goods and vehicles access and egress airports by non-aeronautical based modes of transport. In the case of major airports, such as London Heathrow or New York JFK, which support a wide

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The final published version (version of record) is available online at 10.1016/j.retrec.2016.04.013. Please refer to any applicable publisher terms of use.

range of destinations and draw on a large and, in some cases, (inter)national catchment, the number of surface access trips can be considerable. Coogan (2008), for example, estimated that an airport handling 45 million passengers per year can generate up to 5 million vehicle miles of surface access travel per day (the equivalent of up to 1,825 million miles per year). The fact that this mobility is concentrated at one site has potentially serious implications for human health and wellbeing, traffic delays and congestion, energy use, noise, vibration, user safety and local air quality.

The surface transport modes that are used to access and egress commercial airports in developed economies can be classified into three groups. Although other modes of surface access transport, including tuck-tucks, horse and carts, snowmobiles and off-road four wheel drive (4WD) vehicles, are also used, such modes typically serve remote and/or smaller airports in less developed economies and, as such, are beyond the scope of the current paper. The three categories of surface access transport that can be identified in developed economies are: private motorised, individual active and public transport modes (see Table 1). These three groups exhibit different characteristics in terms of technology, provision and patronage and generate a diverse range of commercial, environmental and social challenges that require targeted management and informed intervention.

Table 1: Airport surface access modes in economically developed economies

1. **Private motorised** (mechanised forms of non-scheduled transport that are not available for public use)

- Private cars and motorcycles (whether as a driver or a passenger who parks the vehicle at the airport for the duration of their trip or someone who is being dropped-off or picked-up);
- Private taxis or minicabs (whether as exclusive hires or as part of a shared occupancy scheme);
- Airline or corporate chauffeur-driven services;
- Minibuses (including hotel shuttles and private transfers).

2. **Individual active** (modes requiring physical effort/activity by an individual)

- Walking;
- Cycling.

3. **Public transport** (shared surface transport modes which operate to a set timetable on fixed routes and which are available for public use)

- Long distance service coaches;
- Local service buses and on-site shuttle buses to other terminals or local railway stations;
- High-speed inter/national rail services;
- Heavy national, regional and local rail services;
- Light rail, automated rail or people mover/monorail services;
- Underground or metro;
- Tram, trolleybus or guided bus services;
- Water ferries, water buses or water taxis (as used at coastal or estuarine airports such as Venice Marco Polo, Toronto City and Boston Logan).

Of these three categories, public transport offers the greatest potential to reduce emissions,

lessen congestion and stimulate a modal shift towards more sustainable forms of surface access travel. Public transport is defined here as a shared surface transport mode which operates to a set timetable on fixed routes and which is available for public use. However, there are a number of significant challenges associated with procuring, planning, promoting and sustaining public transport services to airports, not least in terms of ensuring surface access options meet changing consumer needs and preferences with respect to accessibility, affordability and attractiveness while accommodating predicted increases in demand and operating in environmentally sensitive yet cost efficient manner.

In the UK, as in many developed economies, private motorised modes dominate the airport surface access split. At some UK regional airports, as many as 95% of surface access journeys are made by private vehicles. The reasons for this are complex and involve site specific-interactions between the physical location of the airport, its proximity to major population centres, interfaces with existing road and rail networks, local topography, public awareness of different transport options and knowledge of how, when and where they can be accessed, the relative cost, convenience and reliability of different public transport modes, the airport's passenger demographics and the type of air services it supports, the volume and seasonality of demand, the nature of competition with neighbouring airports, the regulatory position, and the political relationships that exist between an individual airport operator, public transport providers, local authorities and national Government.

One of the consequences of growing levels of motorisation and car ownership during the latter half of the twentieth and early twenty-first centuries was that road access to airports developed in an ad-hoc way to accommodate the mobility needs of growing volumes of private vehicles. Indeed, in an age of the automobile and few environmental concerns during the 1950s and 1960s, many UK airports were intentionally developed or expanded to facilitate easy access by road. The location of East Midlands Airport in central England, for example, a facility which opened to commercial air traffic in 1965 to serve the cities of Leicester, Derby and Nottingham, was selected on account of its proximity to the newly constructed north-south M1 motorway which linked the major UK conurbations of London and Leeds.

The legacy of this and other similar planning decisions that privileged vehicular access by road has meant that the built environment around many airports is dominated by multilane motorway and complex road interchanges that are hostile or totally inaccessible to pedestrians and cyclists and which generate a multitude of adverse environmental impacts including visual, acoustic and atmospheric pollution and road traffic congestion. These problems are compounded by the fact that many UK airports do not have a dedicated railway station, despite their geographic proximity to main railway lines. An exception to this is London Gatwick Airport which opened in 1958 and which had a dedicated integral railway station from its inception. Other UK airports, including London Luton, Liverpool John Lennon and East Midlands, have subsequently been (albeit remotely) connected to the rail network through new 'Parkway' stations, with varying degrees of success. Elsewhere, both the Piccadilly Line of the London Underground and the Tyne and Wear Metro have been extended to serve London Heathrow and Newcastle Airports respectively.

The need to address both the operational efficiency and the environmental implications of airport and aircraft operations is becoming increasingly acute and approvals for airport

expansion are now dependent on airport operators demonstrating a real commitment to improving public transport. In the UK, improving the environmental performance of airport surface access reducing car use and promoting public transport have been identified at a national level both by the British Government's appointed independent Airports Commission and the House of Commons Transport Select Committee as a key mechanism through which air transport's environmental impact may be reduced. Consequently this paper examines the current provision of public transport to UK airports, identifies opportunities for improvement and offers recommendations as to how a modal shift from private cars to public transport could be effected.

The next section of this paper reviews the salient literature on airport surface access and alights on key considerations surrounding the characteristics of different users and the challenges of public transport provision to and from airports. Section three interrogates data contained within the surface access strategies of the six London airports on their current public transport provision and patronage. The final section makes a number of recommendations to airports, public transport providers and policy makers as to how the environmental performance and sustainability of airport surface access provision might be secured.

2. Airport surface access and public transport provision

Surface access is a vitally important element of any airport's infrastructure. It materially affects investment in the local transport network, may generate congestion, almost inevitably degrades local air quality and creates visual pollution. Surface access also directly impacts on an airport's operational efficiency and commercial performance as airside activities rely on a continuous, unimpeded and timely flow of passengers, staff and goods accessing and egressing the site. For example, if employees arrive late for a shift owing to congestion or delays on the surrounding road or rail network, flights might be delayed or cancelled, passengers inconvenienced and the reputation of the airline and airport may be damaged. If passengers are delayed and miss their flights they may be disinclined to use the airport again and airlines examine an airport's surface access provision when evaluating whether to commence services from a particular site. Airports must, therefore, be able to offer a reliable, robust, safe, secure, affordable, integrated and attractive portfolio of surface access options to grow their business on the one hand while simultaneously minimising their environmental footprint on the other. This section of the paper reviews the different characteristics of surface access users and the environmental implications of different access modes.

Surface access affects passengers, airport employees, airport visitors, contractors and commercial vehicles supplying the site with everything from food and beverages for the retail outlets, to fresh linen for the hotels, in-flight catering, air cargo and mail. The surface access requirements and temporal, spatial and behavioural characteristics of these different user groups varies considerably and mode choice decisions are based on a range of both commercial and personal decisions and often highly subjective factors relating to considerations of time, cost, comfort, convenience, personal safety, security and reliability. Mode choice decisions have important implications for airport planning, operations and management but also for neighbouring local authorities who have to manage the effects of surface access traffic on their district, for public transport operators who provide surface access connections, and local residents who may simultaneously benefit and suffer from surface access provision in complex and unexpected ways.

2.1 Passengers

Research has shown that gender, age (and by association physical ability), trip purpose, journey time and cost, distance, convenience, personal safety and ease of baggage handling are key factors determining passenger mode choice. Frequent business travellers, for example, typically place a higher value on time than leisure passengers (Pels et al., 2003) but a lower value on the cost of their trip and so are more likely to use more expensive fast modes to access an airport (Coogan, 2000). Leisure passengers, in contrast, may be less familiar with local transportation networks, may be anxious and unfamiliar with the local language and are more likely to be encumbered with heavy/bulky luggage which makes public transport an unattractive option (Brilha, 2008).

2.2 Employees

Around one third of all access journeys to airports are made by employees but this figure may be higher at airports which act as airline headquarters or major aircraft MRO (maintenance, repair and overhaul) facilities (Humphreys and Ison, 2005). Unlike passenger traffic, which typically peaks in the early morning and evening to coincide with the 8 hour working day, airport employees often need to access the site 24 hours a day and at times outside the normal operating hours of public transport networks. At hub airports, as many as 75% of staff work shifts meaning they may start work as early as 4am local time or finish after midnight (Humphreys and Ison, 2002). For reasons of personal safety, convenience and expediency (staff may live in a wide catchment that is not adequately served by public transport), employees may feel that they have little choice other than to commute to work by car.

2.3 Visitors and commercial traffic

The third category of surface access users, airport visitors, includes people dropping off friends or relatives, people using the airport's retail or catering facilities and people attending meetings at tenant companies on site. Airports can also generate significant traffic from supply, delivery and other commercial vehicles. This traffic is often compounded by the high density of business parks, offices and light industrial units that are developed in the immediate hinterland of airports. At airports with major cargo facilities, heavy goods vehicles (HGVs) and other service trucks will need to access the site 24 hours a day.

2.4 The challenges of public transport

Private car use by passengers, employees and visitors is typically high as the car is perceived to offer greater comfort, convenience, personal security and reliability than other modes. While cars offer individual users a number of benefits, road-based trips (especially those undertaken by private car) generate the greatest share of surface access emissions and thus impose the greatest environmental footprint. In 2005, road-based journeys accounted for 91% of UK airport access emissions (DfT, 2009). Airports are under pressure to reduce the share of private vehicle journeys and increase public transport use.

The dominance of the private car also has implications for airports in terms of car parking provision as the number of surface access trips that are performed by car is affected by the price, availability and perceived personal utility of car parking. Car parking is a vital source of airport revenue and may represent an airport’s largest source of non-aeronautical income (Jacobs Consultancy et al., 2010). Land use constraints and high land values around many airports mean that the scope for increasing car parking supply is limited and sophisticated revenue management techniques are employed to maximise the economic utility of this

increasingly scarce resource (Ison et al., 2008).

Problematically, commercial pressures to maximise the revenue potential of airport parking are largely at odds with growing pressure to reduce the share of private car journeys to and from airports (Ison et al., 2008). Although restricting the supply of car park spaces may appear to be a logical step towards reducing private car journeys, evidence suggests that this approach may lead to increased numbers of passengers being picked-up and dropped-off rather than promoting the use of public transport. In addition, Budd *et al* (2013) reported on the relatively recent phenomenon of residential driveways being rented out by their owners through online parking marketplaces to airport employees and passengers.

From a customer service perspective it is important that the airport access experience is as easy and convenient as possible and ease of access has become a key determinant of UK airport choice for both airlines and passengers. The availability and use of a range of surface access modes increases the perceived accessibility of an airport and so may place it at a competitive advantage (Gosling, 2008). Similarly, an airport with poor surface access (either perceived or real) may place the airport at a competitive disadvantage. It is therefore important that airport managers build productive working relationships with a wide variety of stakeholders, including Local Authorities, public transport operators and owners of key transport infrastructure, to ensure that passengers are able to access the airport easily and conveniently. This is a key challenge for airports, since the commercial interests of these different stakeholders may not always align with those of the airport.

As well as directly affecting airport users and employees, surface access also directly affects local airport communities in complex and sometime contradictory ways. Local communities may benefit from the provision of improved local public transport infrastructure and more frequent services. However, negative impacts of increased traffic include more noise, congestion, a heightened risk of accidents and air pollution.

Following the publication of the 1998 *'A New Deal for Transport'* White Paper and the 2003 *'The Future of Air Transport'* White Paper, UK airports have been tasked with setting targets for increasing public transport ridership at the expense of private motorised modes and promoting surface access options that minimise negative externality effects. However, strategies for increasing the share of public transport trips remain largely at odds with commercial imperatives to maximise the revenue potential of passenger car parking. Airport managers subsequently face the challenge of aligning these apparently incompatible environmental and commercial objectives (Budd *et al*., 2011).

The challenges of increasing public transport patronage to UK airports fall into five key areas. The first of these concerns financial and/or economic issues. In the case of airports with limited passenger demand and relatively low levels of public transport use, public transport will often require a level of subsidy to make it viable. Subsidies aim to reduce congestion, encourage mode shift to increase patronage and frequencies and ultimately make the service financially self-supporting then profitable. With supported services, the operator receives a payment from the local transport authority for running a service which is considered socially desirable but which is otherwise commercially unviable. These subsidies can be used to upgrade vehicles, help meet social objectives to connect the airport with areas of high unemployment and low car ownership as well as connect areas that are otherwise un(der)served by public transport. The

level of the subsidy (whether it is working to full or partial cost recovery), the duration for which it is provided, and the level of service are key considerations for airports, Local Authorities and transport providers. It is important to note that subsidies are not always successful and if they are publically funded they will need to demonstrate that they are offering value for money. In February 2014, for example, it was reported that the bus service from Cardiff city centre to the airport was averaging fewer than four passengers per trip despite receiving a £500,000 annual subsidy (BBC News 2014).

The second area relates to geography as the physical location of some airports may not be conducive to public transport provision. Heavy rail, for example, cannot tolerate severe gradients and this may restrict the type of public transport mode that is available. Certainly, the capital expenditure associated with developing a new heavy rail line, a rail spur, or even a new chord from an existing line to an airport is considerable and will need to demonstrate a return on investment. For smaller airports with limited passenger demand, buses often represent the most attractive option but decisions need to be taken about the operator, the route that is followed, the frequency of services and the fare structure. The third area concerns the seasonal and/or temporal nature of demand. Many airport staff work shifts and need to access the airport at anti-social hours. Passenger demand, on the other hand, may not only peak at certain times of the day that correspond with the arrivals and departures of flights but also may be highly seasonal in nature which makes the provision of a year-round public transport service expensive.

The fourth area is user acceptance. Numerous studies have shown that people exhibit habitual behaviour with respect to their transport mode choice. Passengers and staff may hold negative perceptions of public transport due to a previous bad experience and/or perceptions of lack of cleanliness, unreliability, expense, concerns about personal safety or security, and perceived incompatibility with their personal lifestyle or professional status. The final area relates to issues of regulation and governance. In an era of public transport deregulation, Local Authorities and airport operators may only have limited control over the provision of public transport services and routes. They are rarely able to compel private operators to offer services and often only have a limited range of interventions available to them to incentivise public transport provision.

Given the complexities and interrelationships involved, it is vital that airports develop a coherent surface access strategy that can accommodate both present and predicted future levels of demand while encouraging users to access and egress airports by public transport. This challenge has become more acute given the potential environmental benefits that can be derived from increased public transport use. The importance of surface access to airports has arguably never been higher and it forms a core component of both national strategic and local planning decisions in the UK relating to airport development. The challenges of providing public transport to/from different airports is exemplified by the situation in London, a city of 8.6 million people that is served by six commercial airports which handle over 146.3 million passengers a year, over 61% of the UK passenger total of almost 238.4 million (CAA, 2015).

3. Airport surface access – the situation in London

London is an example of a multi airport region that is served by six commercial airports. Each facility has evolved to serve the aerial mobility needs of a particular market and as a consequence each airport supports a distinctive portfolio of airlines, destinations and

passengers. Each airport also has unique surface access infrastructure and characteristics, details of which have been obtained from a detailed content review of each airport's most recent Surface Access Strategy and related official documentation.

3.1 London Heathrow

The busiest of the six airports, and the UK's only true hub, London Heathrow is located approximately 15 miles west of central London. It is served by 80 predominately full service network or legacy airlines that collectively fly to 185 destinations worldwide. 73.3 million passengers used the airport in 2014 of which 45 million started or ended their journeys at the Heathrow and so accessed the site by surface transport (Heathrow, 2014). 50% of all passengers travel to or from central London and so historically the airport's surface access links were oriented along this corridor.

Heathrow is also a major public transport interchange. It is the location of the country's busiest long distance passenger coach station and it supports an extensive network of local bus services which have priority access to the central terminal along a camera-enforced bus lane. Heathrow also operates a free travel zone on local buses around the airport that can be used by passengers, employees, visitors and the general public. The airport is served by the Piccadilly Line of the London Underground, by local Heathrow Connect rail services and the premium Heathrow Express rail service that runs directly to London Paddington. Additional rail connectivity is planned through the delivery of the multi million pound Crossrail project and improved Western rail access.

Despite extensive public transport provision, tens of thousands of private vehicles access the airport every day and surrounding roads frequently suffer from congestion. In 2012, 18 million passenger access and egress journeys were made using public transport and the airport's public transport mode share was 40.6% (up from 32.5% in 1998), with 18% using the London Underground, 13% travelling on bus and coaches and 10% using heavy rail services (Heathrow, 2014). The equivalent public transport mode split for airport staff was 35% (Heathrow, 2014). A proposal to construct a third runway, which was supported by the British Government's independent Airports Commission in their recommendation of July 2015, will place additional pressure on surface access infrastructure and require millions of pounds of additional investment and upgrading to cope with the predicted number of users.

3.2 London Gatwick

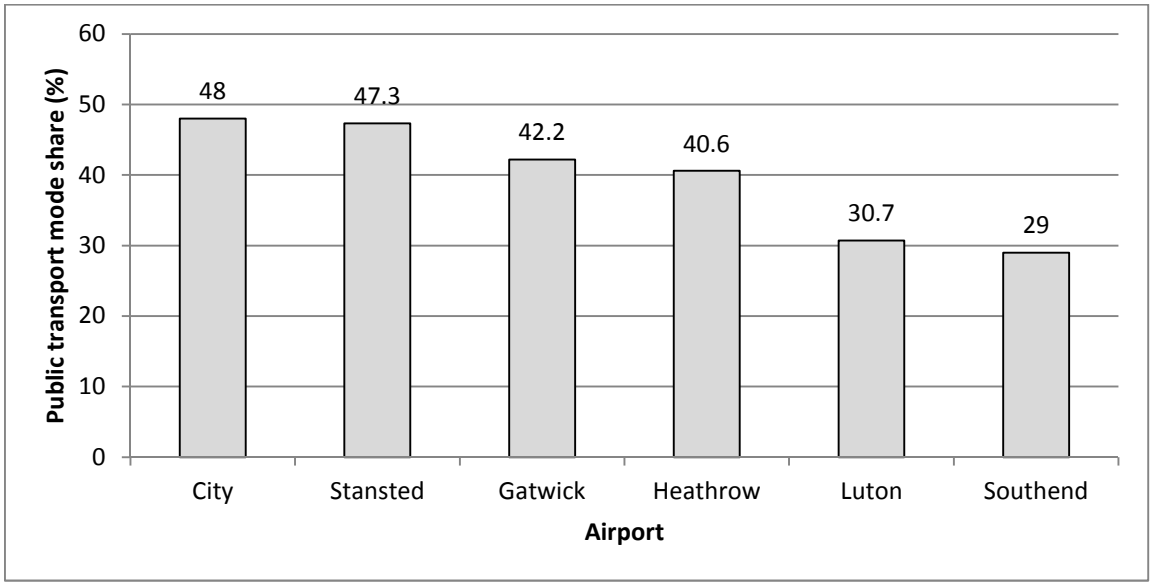
London's second busiest passenger airport, at Gatwick, is located 28 miles south of central London. Gatwick is the world's busiest single runway airport, handling over 38 million passengers a year. Gatwick is served by a dedicated railway station on the Brighton to London Victoria main line as well as an extensive network of long distance coach services and local buses. In 2011, 42.2% of passengers travelling to and from Gatwick used public transport modes, up from 30.7% in 1998 (London Gatwick Airport, 2012). 35.5% of passengers used the rail service while 6.7% used buses and coaches (Ibid, 2012).

3.3 London Stansted

Stansted is located 40 miles north east of central London and handled 19.9 million passengers in 2014. It is a major base for low cost carriers, including Ryanair and easyJet. Stansted is located adjacent to the M11 motorway and has a dedicated railway station under the passenger terminal from where trains serve both London Liverpool Street and cross country

routes to Birmingham via Cambridge and Leicester. Long distance coach services link the airport with London and other major cities while dedicated low cost coach and minibuses transfer passengers to central London. Despite its distance from central London and other major conurbations, Stansted has the highest public transport mode spilt of the 6 London airports (Figure 1). In 2009, 47.2% of passengers accessing and egressing the site used public transport (up from 34% in 2000) (London Stansted Airport, 2010).

Figure 1: Public transport mode share of surface access journeys at London Airports



Note: Data describes public transport mode share in 2009 (Luton, Stansted), 2011 (City and Gatwick), 2012 (Heathrow) and 2014 (Southend).

3.4 London Luton

The fourth busiest passenger airport, London Luton, is located around 32 miles north of central London. It is a base for low cost and charter operators and handled 10.4 million passengers in 2014. It is connected to the Midland Mainline railway at Luton Airport Parkway station which is located approximately one mile away from the terminal building at the bottom of a steep hill. A regular service shuttle bus links the two sites and takes around 10 minutes to complete the journey between the terminal and the railway station. Central London can be accessed by rail from Luton Airport Parkway station in around 20 minutes and takes passengers directly to London St Pancras International railway station. National Express coaches run to central London 60 times a day and 13 other long distance coach and bus services serve the airport. London Luton is also served by the Luton-Dunstable busway that provides fast and frequent services to local destinations. Furthermore a dedicated 'easyBus' service offers shared high frequency low cost minibus connections to central London with fares starting from £2 one way. In 2009 (the latest published figures) over 30% of surface access journeys were made using public transport. Of the public transport modes, rail had a mode spilt of 16.6% and bus and coaches 14.1% (London Luton Airport, 2012).

3.5 London City

London City (LCY), the capital's fifth busiest airport, opened in 1987 10 miles to the east of central London adjacent to Canary Wharf and the London Docklands financial district. It has a short single runway and is predominately used by business travellers flying on domestic and European services. The only long-haul destination is a business-class only service to New

York. LCY can be accessed by road and via a dedicated station on the Docklands Light Railway (DLR), an automated light railway line that connects stations in the east of the capital to Bank station in Central London. The DLR represents the greatest mode share of surface access trips at 47% (London City Airport, 2011). As the airport is located in a business and residential area, LCY arguably offers the greatest potential for passengers and staff to walk or cycle to the airport. Two local bus routes serve the airport.

3.6 London Southend

The sixth airport, London Southend, is located approximately 40 miles east of central London. The airport handled 1.1 million passengers in 2014 and is a growing low cost hub. A dedicated railway station links the airport to London Liverpool Street in 53 minutes for onward London Underground connections with as many as 8 trains an hour. The airport's location means that the majority of passengers currently access the site by car with public transport accounting for 29% of the total mode split (London Southend Airport, 2014).

Although all six airports are located within a 40 mile radius of central London share some common elements, the site and situation of each individual airport makes them unique in terms of surface access and public transport provision. The airports are owned and operated by different public or private consortia and are located in different Local Authority areas. They also have a different mix of public transport options (see Table 2). Unique public transport provision includes Luton (busway), London City (DLR) and Heathrow (London Underground).

Table 2: Public transport modes to London Airports, 2015

Airport	Long distance coach	Local bus	Busway	Mainline rail	Local rail	Light rail	Underground
Heathrow	✓	✓		✓	✓		✓
Gatwick	✓	✓		✓	✓		
Stansted	✓	✓		✓	✓		
Luton	✓	✓	✓	✓	✓		
City		✓				✓	
Southend		✓		✓	✓		

4. Encouraging public transport use

The six London airports' Surface Access Strategies commit them to reducing private vehicle journeys among both passengers and staff and supporting mode shift towards more environmentally sustainable public transport modes. A number of policies for achieving such targets have been identified in the UK and internationally. These can be split between strategic and operational policies. Strategic policies are generally longer-term organisational goals that help to implement a particular vision or mission statement into specific plans and projects. These set the benchmarks for progress and are designed to be measureable for the purpose of performance monitoring and to help guide decision-making. Operational (or tactical) level policies generally operate in the shorter-term, and are the means by which broader policies are met. Operational policies are also designed to be measurable and specific although they are generally narrower in focus.

A clearer delineation between strategic and operational policies may enable decision makers to disentangle the numerous complexities associated with airport surface access and help identify the prevailing challenges and possible opportunities for intervention measures. With this in mind, three key strategic surface access policies and their associated operational objectives were identified from the six London airports' Surface Access Strategies and presented in Table 3. In each case, building on Budd et al's (2011) previous empirical research, the operational policies that were identified were assigned one of five categories ranging from strong positive effect (++) to strong negative effect (--).

Table 3: Strategic and Operational Surface Access Policies for encouraging public transport use

Strategic / Operational	Increasing service provision and attractiveness of public transport relative to private car use	Improving accessibility and information provision to travellers	Optimising existing assets and infrastructure
Marketing and promotions/incentives	+ +	+/-	+
Smart/integrated ticketing	+ +	+	+
Simplified fare and ticketing regimes	+ +	+	+
New technologies and alternative fuels	+/-	+/-	+ +
Upgrade infrastructure and increase capacity	+	++	- -
Improve frequency of services	+ +	++	+ +
24 hour operations	+ +	+ +	++
Public transport hubs	+	+ +	+
Security and visibility of staff	+	+/-	+/-
Female only service provision	+	+/-	-
Discourage private cars	+ +	-	+
HOV lanes	+	+/-	- -
Real time information	+	+ +	+/-
Direct services	+ +	+/-	+/-
Dedicated services	+ +	+	+/-
Shared-ride vans	+	-	+ +
Wi-Fi and mobile broadband	+ +	+/-	+/-
Free travel zones	+	++	+ +
Free hotel shuttles	+	+/-	+ +

+ + strong positive effect, + positive effect, +/- neutral, - negative effect, - - strong negative effect

4.1 Strategic policies

The specific policy goals of surface access planning provision at an airport will be determined largely by the their market position and strategic business priorities, as well as the catchment area and configuration of the surrounding transport network. With regards to encouraging public transport use, such policies generally fall within three broad categories.

A fundamental component of encouraging more environmentally sustainable surface access behaviour by airport users involves simultaneously increasing service provision and the perceived attractiveness of public transport and alternative modes, whilst maintaining (or even reducing) those for the private car. The means by which these goals can be achieved relate predominantly to the various operational measures discussed in in the following section. Needless to say, it goes without saying that successful outcomes are most commonly accrued via the application of tailored ‘packages’ of measures applied in a coherent, sustained and site specific fashion.

Additionally, airports must also provide travellers with various types of surface access information, relating both to airport related services but also information about the regional transportation system in general. This information may relate to real-time public transport service timetables, ticketing arrangements, flight and check-in information for departing passengers, car parking availability, as well as way finding provision and other issues. In some cases the providers of these services will lie beyond the airports area of responsibility and control, and as such the coordination and delivery of this information in a timely and actionable fashion is a key challenge for airport operators. This may be especially challenging in a privatised transport market, such as the UK, where a number of different actors and service providers are responsible for the operation and maintenance of key services and infrastructure. Regardless, the surface access system must be designed so as to remain accessible and responsive to the varying needs and requirements of a broad range of users. Essentially, the system must ensure safe and efficient travel to all users, all of the time. To this end, a key trend in improving accessibility and information provision to travellers involves the integration of ‘traditional’ systems and those relating to the rapid growth in personal mobile and Internet enabled ‘smart’ technologies which can, amongst other things, create personalised real-time information schedules for travellers.

Concurrently, it is important that airports optimise existing assets and critical infrastructure such as car parking facilities, access roads, and public transport infrastructure to ensure safe, convenient and efficient access to airport facilities in a manner that is consistent with other goals and objectives of the airport and its community. This may include reconfiguration of queuing space on access roads and car parks to reduce vehicle dwell times, refurbishment of public transport waiting areas to improve perception and journey experience, or provision of self service ticketing machines at public transport terminals.

4.2 Operational policies

Operational policies generally operate at the tactical level, and are the means by which broader strategic policies are met. Operational policies are often designed so as to be measurable and specific to facilitate evaluative and performance benchmarking regimes, and will typically be applied in combination with other policies as a 'package' of measures. As illustrated in Table 3, these may have varying effects (both positive and negative) on different strategic areas of surface access provision. From a management perspective it is important that such effects are more a reflection of the airports strategic priorities, than unintended consequences of ill judged or poorly implemented policies.

Marketing and promotions schemes are used to inform and incentivise users about the services available to them. In some cases, especially for people who do not fly regularly or those unfamiliar with a particular airport or region, there may be a basic lack of understanding of the services on offer. Often marketing campaigns will be targeted towards certain users or passenger segments. For example, marketing for dedicated airport express rail services such as the Heathrow Express typically focuses on the speed, comfort and convenience afforded to business travellers. Alternatively, promotional schemes such as discontented fares for those travelling as a family or in groups (i.e. characteristics commonly associated with leisure passengers), may also be used. For airport employees promotional activities may take the form of tax free loans to purchase public transport season tickets or bicycle equipment, preferential car parking spaces for employees who car share or discount shopping vouchers for employees who leave their cars at home.

Ensuring that public transport options are easy and intuitive to use is a key factor in encouraging their uptake. Smart and integrated ticketing, and simplified fare and ticketing regimes have an important role to play in this. Examples of smart ticketing in the UK include the Oyster pre-payment scheme, which can be used to pay for travel on the London Underground, Docklands Light Railway, some over ground rail services, and London buses. However, this is not available to/from all London airports which can lead to frustration and inconvenience. Arguably a more convenient system is the ability to swipe in and out of the system using a credit card as this negates the need to queue for a ticket, worry about the price, not having enough cash to pay for a fare or losing the ticket. Potential obstacles to the implementation of these include cost, the fact that not all travellers will own the brand of credit card required, and user reluctance to trust the new technology for fear of being over charged or charged twice. Fare structures should be clear and simple and explain in multiple languages how the system operates. This is especially important for encouraging passengers who are non-native speakers of the region.

An alternative option, albeit one requiring considerable capital outlay, is for airports to implement new 'green' technology and vehicles powered using alternative fuel sources. For example, Amsterdam Schiphol Airport operate a fleet of fully electric vehicles, whereas on smaller scale, East Midlands Airport recently introduced bio-methane powered buses on the airfield to reduce emissions. These are necessarily longer-term initiatives that seek to secure long-term emissions savings.

Similarly, upgrading existing public transport infrastructure to increase capacity and improve

service levels is important to encourage (and then sustain) modal shift towards more sustainable modes. For example, at Heathrow Airport the London Underground's Piccadilly Line currently serves Terminals 1, 2 and 3; Terminal 4; and Terminal 5 with 1970s-era rolling stock that have a passenger capacity of 684 people per unit. During the weekday morning peak (8am-9am), 12 trains per hour serve Terminals 1, 2 and 3. The hourly passenger capacity of these services is 8,208. Proposals to upgrade trains and signalling will increase the line capacity by 60% and enable a peak service of 33 trains per hour by 2025. While clearly not on the same scale as Heathrow, at regional and secondary airports increasing the frequency of services, especially during peak periods, can improve public transport use significantly.

Equally, where possible the provision of 24-hour public transport operations can improve ridership. For employees at Heathrow for example, at present the first westbound Piccadilly Line service on the London Underground arrives at Heathrow Terminals 1, 2 and 3 at 05:11 hours. Given that check-in staff often need to be on the airport site to start work at 04:00hours, the Piccadilly Line does not offer a viable travel option and there is scope for considering the cost benefits of extended running.

Alternatively, some airports have developed so-called park-and-ride schemes, where vehicles are parked at a remote location offsite and bus shuttles are provided to transport people to/from the terminal. They are designed to reduce the number of vehicles accessing and egressing the terminal area at any time, but they may also add travel time and inconvenience for passengers who would necessarily need to change modes. Generally speaking such schemes have been more widely adopted in the US than in Europe. Although not traditional park-and-ride schemes, the growth of lower cost parking products, where cheaper parking is offered (often by third parties) at sites some way away from the airport have in fact many elements of the park-and-ride model. However, these may be difficult for an airport operator to regulate or influence, and in some respects may simply displace the problem elsewhere.

For larger airports, there may be advantages for developing as public transport' 'hubs' or interchanges. Indeed, while much has been made of the hub and spoke networks offered by airlines at major hubs there is arguably potential for creating similar hub and spoke networks for public transport. To an extent this is already happening at Heathrow, which is one of the busiest coach stations in the UK in terms of passenger numbers, while Manchester Airport has recently been connected to the city's Metro system and is purposefully developing as an 'airport city'. However, while public transport hubs may lead to an increase in the *share* of airport journeys by public transport they also necessarily increase the *total* number of journey to and from the airport site. Given that airline passengers may be put off using public transport when having to share with commuters and other 'everyday' traffic, the rationale for this approach is questionable.

While provision of self-service ticketing and automated systems are now commonplace on public transport systems, there is still an important role for airport staff in terms of providing help and assistance to users, and in some cases improve perceived security. It is something that can have significant benefits in terms of improving the passenger experience, and has been widely adopted by airports in the US and elsewhere. At Heathrow Airport, for example, staff providing assistance are located at the key 'touch points' throughout the passenger journeys and are easily identifiable by their purple branded jackets.

Personal safety and security also plays an important role in surface access provision, especially for people travelling alone and/or at anti-social hours. Some airports have sought to reassure female passengers by introducing female only rail carriages on trains, women only parking areas and regular patrols to reassure women passengers where it is culturally appropriate to do so. This use of women only carriages is already widespread in Japan while Salzburg airport in Austria has introduced a dedicated women only parking zone in the multi-storey car park that is well lit and close to the terminal.

Policies for increasing the share of public transport journeys are most likely to succeed when they are enacted in combination with measures discouraging private car use. These may include financial measures such as revenue management of passenger car parking, reduction of employee parking allocation, or charges levied on passengers being dropped-off or picked-up outside the airport terminal. Collectively, policies such as this seek to make choosing public transport a more attractive financial proposition than travelling by private vehicle. Additionally, airports may attempt to prioritise access by public transport and shared modes by enforcing dedicated bus and high occupancy vehicle lanes. These seek to improve the journey time and journey time reliability for passengers using these modes, although such measures often necessarily require the reduction in capacity of surrounding road networks, which may lead to increased congestion and offset any potential environmental benefits.

As a minimum, airport operators need to provide users with real time information to keep them informed of service updates and disruption. This should be delivered through both online and offline channels – this should include both the use of smartphones and communication technology, but also traditional information provision such as arrivals and departures boards at key points in the journey (for example, airports are increasingly placing real-time rail and bus information in baggage reclaim areas).

As already noted, the need to change modes or services is a key factor in discouraging users from using public and shared means of surface access. Consequently, wherever possible airport must seek to provide direct services by rail and bus. These will typically focus on key areas within the airports catchment area, such as a major town or city. However, in some instances there may be value in exploring seemingly more niche markets, especially with regards to employee travel where regular journeys are made and the origin and destination of users is well known. It should be noted that direct services alone do not guarantee patronage, factors including door-to-door journey time, the quality of the connection at the airport and non-airport location, and the market it seeks to serve are also significant.

At larger airports, dedicated rail services can offer fast, reliable (often non-stop) connections to and from the main urban area served by the airport. Although fares are typically more expensive than traditional services, dedicated services benefit from being designed specifically with the needs of airport users in mind, perhaps most notably suitable space for travelling with luggage. The Oslo Airport Express represents a good example where a rail service has been designed with an explicit passenger focus in this regard. For example, the rail carriages incorporate a seating layout whereby each seat faces a large central baggage storage area, meaning that there is normally ample space to store luggage and passengers can see their luggage during their trip. Some also include value added services such as included wi-fi and mobile broadband connectivity to help improve service quality perception and the passenger

experience.

An example of a dedicated service in the UK is the The Heathrow Express, which carries 16,000 passengers a day between London Paddington and the airport and recorded 93% overall satisfaction in the 2010 National Passenger Survey (Heathrow Express, 2014). The service targets time poor travellers who need to use a fast service to the airport. Dedicated services such as these can be relative expensive for passengers. Heathrow Express is currently one of the most expensive rail services in the UK in terms of cost per mile travelled. In July 2015, an adult single walk-up fare from Paddington to Heathrow was £21.50 while a return ticket was £35. The majority of passengers (69%) are business passengers (Heathrow Express, 2014). The service is less attractive to leisure passengers (especially those travelling in groups) and almost entirely unrealistic for employees.

For employees, the adoption of shared ride vans may become more common. These generally involve a small bus or minivan providing a door-to-door service for small groups. They can also operate on an 'on-demand' service, where users pre-book their travel online or by telephone. In some respects shared-ride vans provide a similar service to taxi or drop-off/pick-up but with the environmental benefits of higher occupancy public transport modes. Shared-ride vans may be particularly well suited to employee travel given the regularity of trips, familiarity with the service and fellow travellers, and the fact that the user may need to travel at times not served by public transport.

Hotels, offices, conference centres and other sites in an airports immediate hinterland can create a significant share of additional trips. To this end, some airports have developed free travel zones in the immediate vicinity of the airport. Shuttle buses to/from local hotels are also have an important role to play here, as they negate the need for passengers to use taxis or require the navigation of local bus services. Currently, the main hotel shuttle service at Heathrow is provided by National Express Hoppa. Single adult tickets are currently priced from £4.50, which inevitably provides a disincentive for passengers to use these services (especially given the comparatively short distances involved). This is especially the case if the passenger is travelling as part of a group, where it would likely be comparatively cheaper and more convenient to travel by taxi. Provision of free travel to/from airport hotels would likely reduce congestion on roads and at the terminal kerbside, and yield air quality benefits. There are numerous examples of similar services currently in operation at airports around the world. The shuttle bus service at Amsterdam's Schiphol Airport is arguably one of the best examples. The shuttle connects the airport with around 10 airport hotels and guests of the respective hotels travel for free.

5. Conclusions and Recommendations

The numerous challenges and complexities associated with environmentally sustainable surface access provision are self-evident. These include, but are not limited to, financial and economic constraints, geographical hurdles, the temporal/seasonal nature of demand, the difficulty of getting users to accept alternatives to the private car, and prevailing regulatory and governance issues. The challenges faced by decision makers in this regard are perhaps exemplified no better than in the UK and the southeast in particular.

With this in mind, decision makers must enact robust, coherent surface access policies that, as a minimum, fulfil three key strategic policy objectives as outlined in Section 4; increasing the

service provision and attractiveness of public transport relative to the private car, improving accessibility and information provision to travellers, and optimising existing assets and infrastructure. Within this, various operational (or tactical) policies can be put in place as part of this process. It is considered that clearer delineation between strategic and operational policies may enable decision makers to disentangle the numerous complexities associated with airport surface access and help identify the prevailing challenges and possible opportunities for intervention measures in each case. However, as shown, these policies can have varying effects on planning and service provision in terms of their ability to help, or, conversely, hinder, broader strategic policy directions. Balancing operational policy decisions to align competing pressures and considerations, while simultaneously reconciling the often-competing priorities of different stakeholders and practitioners, represents a key challenge.

These challenges notwithstanding, a number of recommendations can be offered to increase public transport access to airports. Long franchises should be awarded to public transport operators to incentivise investment, but strict performance criteria should be imposed on operators to ensure that they deliver an attractive and affordable product for users. This should include develop direct premium services for passengers and local stopping services for staff, with a focus on customer satisfaction and customer utility and offering a variety of tailored services to suit various passenger segments.

At an airport level, it is important that they develop dedicated and distinctive branding for their public transport services and promote them sufficiently. Airport staff need to be aware of the public transport options available to passengers, and they need to be empowered to assist passengers with questions and queries. A focus on the journey experience is also important, and as a minimum waiting areas must be visible, attractive, secure and well lit.

The problems of encouraging employee mode shift will likely remain, given the often-considerable barriers to behavioural change. Airports should continue to offer tangible incentives for car sharing and public transport use, either in the form of form of parking privileges, cheaper permits, vouchers, or parking spaces nearer to the building for car sharers. The number of employee spaces may also be reduced to help facilitate this change. Where possible, the use of shared ride vans may become more common for employee travel, particularly to try and attract users who need to access the airport at anti-social hours and/or where public transport services are limited.

Given the trip generation of surrounding sites around airports, airports operators should seek to introduce free travel zones in their immediate vicinity, such as the one currently in operation around London Heathrow. These and similar schemes could be funded via the implementation of a Public Transport Levy, which in turn may be funded through the proceeds from passenger and employee car parking revenues, to facilitate the introduction of new services. In the longer term there is merit in investing in new technologies, both in terms of purchasing of ‘greener’ vehicles but also new communication technology and software that may help create personalised travel planning information, for example, or systems for matching passengers with taxis or shared ride vans to avoid empty ‘wasted’ trips.

The growth in aviation is set to continue for the foreseeable future and as such airport surface access will form an increasingly important consideration for airport operators, airport users and local and national authorities. It is clear that public transport has a major issue to play in both

minimising the environmental impacts of surface access journeys while addressing the challenges inherent in increasingly congested road networks.

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Improving the environmental performance of airport surface access in the UK: The role of public transport

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2016-10-11
Elsevier
http://dx.doi.org/10.1016/j.retrec.2016.04.013
Lucy Budd, Stephen Ison, Thomas Budd, Improving the environmental performance of airport surface access in the UK: The role of public transport, Research in Transportation Economics, Volume 59, Issue November, 2016, pp. 185-195

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