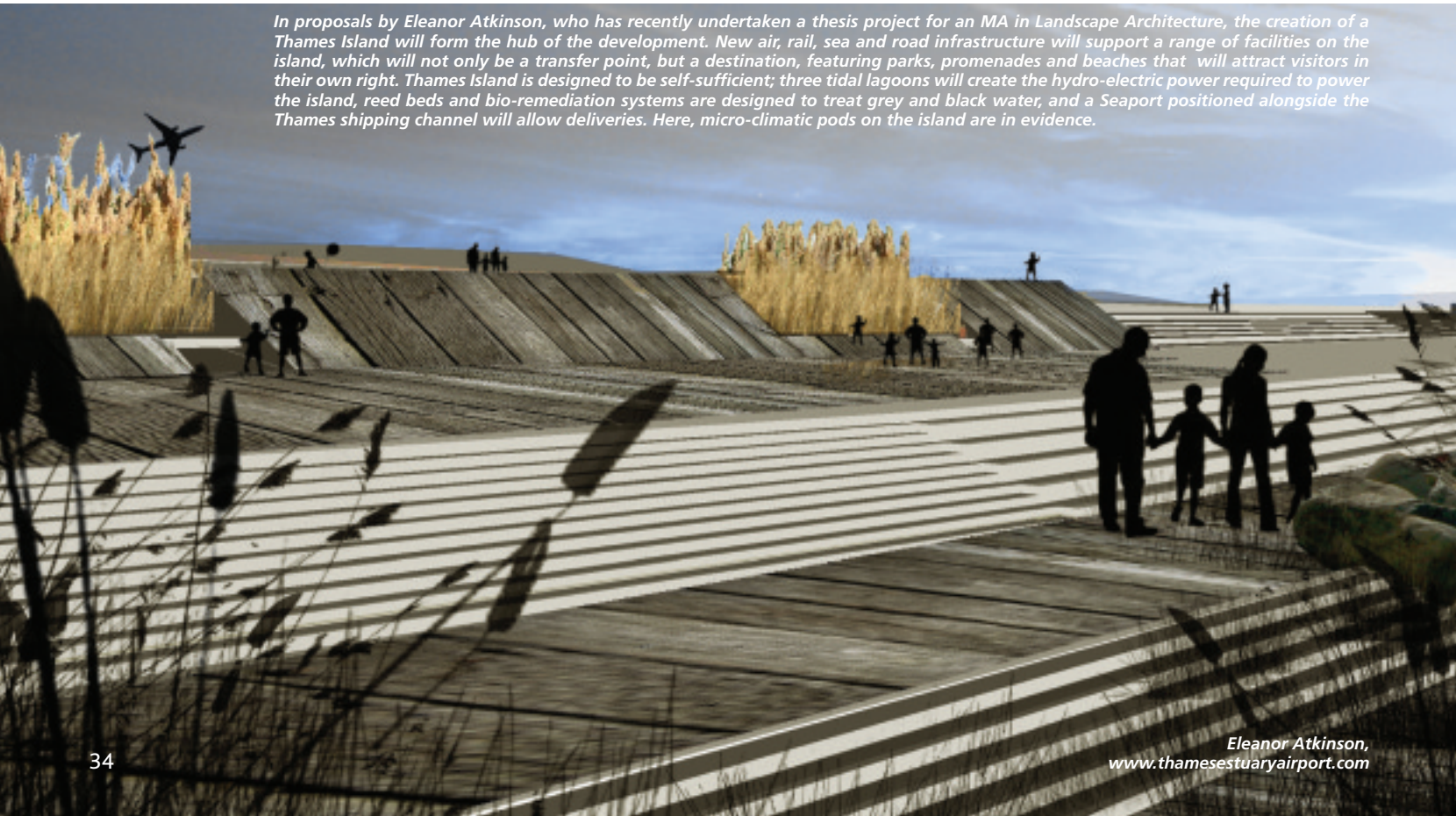
In the UK, as in much of the world, the issue of airport expansion is controversial. Heathrow, the country's major international airport, is running at 99 per cent of its total capacity – and while plans for a third runway currently have the go-ahead, environmental and political concerns mean that the expansion is in serious doubt. In business terms, there are fears the country could be left behind. However, alternatives have been suggested – including building a new airport in the Thames Estuary. Could such an endeavour really be possible, and indeed, beneficial? Professor Sir David King, Dr Oliver Inderwildi **and** Dr Chris Carey **of the Smith School of Enterprise and the Environment produced the following report.**

Airport focus: Is a Thames Estuary airport feasible?

In 2008, prospective Conservative Party candidate for London Mayor, Boris Johnson, suggested building a major new international airport in the Thames Estuary to replace the 'planning error' that is Heathrow [1]. Once elected, Johnson commissioned a serious study, headed by civil engineer Douglas Oakervee, into the potential for construction of an airport in the Thames Estuary [2]. Oakervee, who oversaw the successful construction of the Hong Kong International Airport Chek Lap Kok, which was built on reclaimed land, has recently published a report stating that the scheme is technically feasible. This has been taken forward by the creation of a board of inquiry, to be chaired by one of the authors of this article, to further investigate the feasibility of this proposal.



In proposals by Eleanor Atkinson, who has recently undertaken a thesis project for an MA in Landscape Architecture, the creation of a Thames Island will form the hub of the development. New air, rail, sea and road infrastructure will support a range of facilities on the island, which will not only be a transfer point, but a destination, featuring parks, promenades and beaches that will attract visitors in their own right. Thames Island is designed to be self-sufficient; three tidal lagoons will create the hydro-electric power required to power the island, reed beds and bio-remediation systems are designed to treat grey and black water, and a Seaport positioned alongside the Thames shipping channel will allow deliveries. Here, micro-climatic pods on the island are in evidence.

Eleanor Atkinson, www.thamesestuaryairport.com

But what is the demand for the expansion of aviation, particularly in the south east of England? In 2000, the Department of the Environment released forecasts for the growth of air traffic in the UK for the next 30 years. These indicated a huge growth in passenger numbers – 4.25 per cent per annum – and were accompanied by the caveat that past forecasts have often underestimated demand. Were this demand to be met, five new runways – three in the south-east – would be required. As a major aviation hub, Heathrow was chosen for the site of one of these runways, as announced by transport secretary Geoff Hoon in January 2009. The importance of Heathrow to the south-east and to Great Britain as a whole cannot be underestimated. It plays a vital role in the economy and employs at least 100,000 people directly, and is part of a sector contributing £11bn a year to the economy. Heathrow annually handles some 68 million passengers, on 477,000 flights, running at 99 per cent of its total capacity [3]. Heathrow's European competitors – Frankfurt am Main, Paris Charles de Gaulle and Amsterdam Schiphol – are running at 75 per cent capacity [3]. This is reflected in the number of routes flown regularly from Heathrow: 133 destinations are served at least once a week, 20 per cent fewer than competitors [4].

Expansion constraints

There are a number of issues that constrain the expansion of Heathrow. The airport's operational capacity is limited by several factors, including airspace, the number and length of runways, the area available for use as taxiways and aprons, the number and size of terminals and landside facilities, and access [5,6]. While infrastructure issues – the need to provide space and access for new facilities to be built – are obvious for the expansion of any airport, a number of environmental aspects must also be considered.

Of the environmental issues, probably the single most important impact of an airport on its local environment is noise. The frequency of aircraft movements, the sound level of the individual aircraft, and the relative proximity of the airport's arrival and departures routes to local communities are the main factors affecting noise levels, and therefore operational constraints.

A number of technological advances have been made, such as shielding landing gear and faired slats (high lift devices on a wing leading edge), that reduce the noise generated by aircraft. But these have been offset by the increased growth in air travel to such an extent that most major airports have operational constraints or capacity limits based upon aircraft noise. These can be operational restrictions on noisier aircraft, night curfews, limits based on noise budgets or the extent of a noise exposure contour.

At Heathrow, a quota count (QC) system is used where each aircraft type is classified and awarded a QC value depending on the amount of noise it generates under controlled certification conditions. Heathrow has a fixed QC

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A view from the cockpit of one of the suggested developments. Eleanor Atkinson proposes a scheme that responds to the sensitive character and nature of the Thames Estuary.

depending on the season (summer/-winter), which is gradually reduced year on year to reduce overall airport noise. Further constrains are placed on night flights, with Heathrow preventing the use of aircraft with a QC greater than 2 (95.9EPNdB) such as the arrival and the departure of a 747-100/-200/-300 [7, 8]. The UK government uses a 57 dB sound level exposure to determine whether communities are significantly affected by aircraft noise, which equated to 264,000 people at Heathrow in 2003. Any expansion of capacity will increase the number of individuals that fall under this limit, increasing the number of operational constraints on the airport.

The quality of air near an airport is also a major contributor to capacity constraints. Local air pollution is not only generated from aircraft movements, but apron activities and ground transport related to the airport's function are also significant factors in air quality. This has caused several airports to introduce stringent emission controls, particularly in relation to nitrous oxides and volatile organic compounds. To reduce these emissions, a reduction in ground transport by greater use of public transport, together with improvements in aircraft technology and apron activity procedures are required.

However, as Heathrow is surrounded on three sides by housing and by the London orbital motorway (M25) on the fourth, the potential for expanding public transport is limited.

Similarly, the risk to surrounding communities also rises with airport expansion as accident rates on approach and departure paths also rise. While aviation accident rates are falling, the increasing growth in air traffic has offset this benefit [9]. In the UK and the Netherlands, a risk contour measuring approach is used which predicts the area within which it is unacceptable to live or work due to the increased level of risk. A 1997 NATS report indicated that 2,222 people lived within an area where there was a 1:100,000 annual risk of death due to an aviation accident because of operations at Heathrow [9]. As a result, airports can be obliged to purchase and demolish properties to remove people from the areas of highest risk.

A lesser issue with Heathrow is the effect airport expansion has on biodiversity. Airports cover large areas of land with either inhospitable areas (built environment) or ecological monocultures (mown grass land) and therefore represent a challenge to the biodiversity of an area. This is particularly so where airports are built on greenbelt land surrounding major conurbations, which can restrict airport expansion.

All these issues could be involved with the expansion of any of the current airports in the south-east of the UK. Land is required for construction and it is inevitably communities that will be affected by increased air and ground traffic. One possibility for re-ducing these impacts is to locate air-ports away from communities, such as on reclaimed land in the Thames Estuary.

Building on the Thames Estuary

The possibility of an expansion of airport capacity by construction in or around the Thames Estuary was initially suggested prior to Heathrow accepting civilian traffic. In 1943, a combined airstrip and flying boat port was proposed at Gravesend by a Mr FG Miles. The project was expected to handle eight million passengers a year and 'great quantities of freight' but received no government backing [10]. A Thames site was again proposed during the selection of a secondary site for a new London airport, with a site at Cliffe Marshes being rejected in favour of developing Gatwick [11]. The site was dismissed due to air traffic control (ATC) issues, limited transport infrastructure, construction cost and poor weather.

Thames sites where again considered when the site for the third London airport, which eventually became Stansted, was under investigation [12]. A number of on-shore and off-shore sites were considered, including Cliffe Marshes and Gunfleet Sands (eight kilometres off-shore from Clacton-on-Sea) [13]. The advantages of the Thames sites were the low value of the land and proximity to London, but again they suffered from poor communication links to London, ATC issues, flood risk, secondary uses such as firing ranges, weather and the high construction costs of reclaimed land when compared to a dry inland site.

The choice of Stansted was a controversial one with a government enquiry and commission (the Roskill Commission Inquiry) as well as a number of local government and in-dependent groups producing reports [14]. When the Roskill Commission reported in 1970, after nearly two years of research, it recommended Cublington, in Buckinghamshire, which Edward Heath's Conservative government then over-turned in favour of Foulness (or Maplin Sands) as the site for London's third airport, opposing the earlier choice of Stansted [15,16]. This finding was backed by an earlier report, published on behalf of the Noise Abatement Society, which concluded that Foulness was preferable to Stansted [14].

The Maplin Sands project was then considered for the next nine years until it was finally dropped under Margaret Thatcher's Conservative government in 1980, on the grounds of environmental damage, cost and development time. The idea for a Thames Estuary international airport resurfaced as the Marinair proposal. Located five kilometres north east of Minster, on the Isle of Sheppey, the scheme was not the 'son of Maplin' as discussed in newspapers of the day, but a true offshore island, with more in common with the Gunfleet sands proposal from the 1960s.

The original scheme was estimated at £20bn and was based on a two-centre model with terminals at East Tilbury and runways on an artificial island 35 kilometres away. High speed trains running in tunnels would link the passenger terminals to the aircraft waiting on the offshore island. The scheme was not shortlisted by the government following the South East Regional Air Services Study (SERAS) and was dismissed in the White Paper *The future of air transport* due to insufficient information and the prohibitive cost of road and rail links (even with support from then Mayor of London Ken Livingstone [17]).

The Thames Estuary airport masterplan, as devised by Eleanor Atkinson, with a tidal surge barrier linking Kent to Essex, including new rail station, marina, sea-port, airport and road infrastructure.

The future of air transport White Paper also considered a number of alternative Thames Estuary proposals such as Thames Reach (on the Hoo peninsular) which were also discounted due to cost, environmental impact and an over-reliance on rail access [18]. Sahara Group has recently proposed a multi modal scheme which includes a container port and an airport with four parallel runways on an 18 by 2 kilometre reclaimed island off the Isle of Sheppey. It is linked to the southern shore by overland road and rail and the north shore by a tunnel. It also includes plans for a level of flood protection but not a lower Thames barrier. A more holistic approach is offered by Eleanor Atkinson, who proposes an off-shore location linked to both shores by road and rail and incorporating tidal lagoons for energy generation, a tidal barrier, as well as shipping and leisure facilities [19].

The pros and cons

The reason for such a high number proposals is the considerable advantages of locating an airport in the Thames. With few human neighbours, the airport could operate around the clock because noise levels would be less significant. There would be less pollution because a new airport would be much 'greener', and there would be better public transport than is possible at Heathrow. The third party risk is also removed to a significant extent with approach and departure over water. The possibilities of expansion of the airport at a later date and no requirement for compulsory purchase of property or the demolition of historic buildings, due to the nature of the site, are also significant benefits. The regeneration effects in the Thames area are also of note. Additionally, and perhaps surprisingly, an offshore airport would have better visibility than Heathrow.

But there are also disadvantages with this approach, not least the £40-50bn cost of constructing an airport on reclaimed land, and improving transport links with central London. This compares to the £10-13bn for a third runway at Heathrow. The technical challenge of reclamation has been achieved at a number of locations including Hong Kong's Chek Lap Kok and Haneda Airport in Tokyo Bay, and less successfully at Kansai International airport, Osaka, which has suffered from high rates of settlement; it has sank nearly 3m in the 14 years since it opened, so successful construction is not a forgone conclusion [20-22]. However, the geology in the Thames Estuary, clay overlying chalk, is well suited to this sort of scheme.

Another challenge is the airlines themselves. When legislation changed in 1991 and 2000, there was a desire for the big international airlines to leave Gatwick for Heathrow, so to attract them away from Heathrow will require some thought. Also, while the development of a new airport east of London will financially benefit the people there, there is a corresponding deficit for the west of London. An extra airport would considerably complicate air traffic control in the south-east, requiring wholesale changes to its structure. The proximity of the eastern airspace boundary of the UK's ATC zone and the busiest airspace in Europe increases the difficulties for air traffic management.

The location also presents a number of physical challenges, such as wind

Expansion at Heathrow, which is currently operating at 99 per cent capacity, is severely constrained by a number of factors.


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turbines at the London Array and Kentish Flats, but these would have served their working life by the time an airport opened in 30 years' time, and could be re-located on renewal. The estuary has features dating back to the Second World War; the wreck of the SS Richard Montgomery and a number of forts collectively known as the Maunsell Sea Forts. The SS Richard Montgomery was a liberty ship which sank carrying ammunition. While most of it has been removed, the equivalent of 1,500 tonnes of TNT remains, and is a hazard to local shipping and is protected by an exclusion zone [23]. The Maunsell Forts are anti-aircraft and anti-shipping platforms in a poor state of repair, some of which have already collapsed into the sea.

It is not just an airport that has a claim on the Thames Estuary; the site is a busy shipping area with some 53 million tonnes of freight being carried to the various Port of London locations [24]. There is also the new London Gateway Port, scheduled to open in 2011, which is expected to handle 3.5 million containers a year, making it the busiest container port in the UK. This will have an impact on any significant construction in the area. Leisure and fishing industries on the North Kent coast and in South Essex will have to be considered as well as there is a significant bird population. The Thames Estuary is an important area for birdlife and the increased noise and pollution, as well as potential habitat loss due to the construction of the airport, would be detrimental [25]. The risk of bird strike and related incidents could also increase, but an off-shore site would be several miles from the mudflats where they feed. Other uses for the Thames Estuary are as a flood defence for London and the surrounding area, and energy generation. Several power plants both on and offshore are already in operation with others planned.

A realistic possibility?

So while there are a number of benefits that are only possible in a Thames Estuary location, such as 24-hour airport operation, there are also issues to be considered. Not least of these is the huge cost and difficulty of construction with off-shore sites. Increasing capacity may be possible in other ways and should be considered. Freeing up capacity by shifting domestic flights to a renewed rail system, improving links between central London and Gatwick, Stansted and Luton or reviewing landing charge control to increase competition between airports should all be considered. However, if Heathrow is, as claimed by Johnson, a 'planning error of the 60s', is it not time to put this right?

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