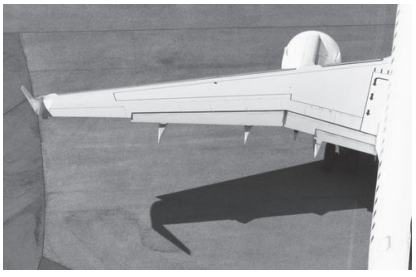
International Transport Forum

Airport Site Selection

Case-Specific Policy Analysis

OECD

Airport Site Selection



Case-Specific Policy Analysis

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Case-Specific Policy Analysis Reports

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Executive summary

Background

In 2015, the Korean Government's Ministry of Land, Infrastructure and Transport (MOLIT) launched a feasibility study for increasing airport capacity in the Youngnam Region of Korea, the southeast quarter of the country. The Ministry appointed a consortium formed by the Korea Transportation Institute (KOTI) and ADPI (Aéroport de Paris Ingénierie, member of the Aéroports de Paris Group) to develop the methodology for deciding at which site airport expansion should take place.

In the framework of that work, the Korean Government requested that an expert workshop be organised by the International Transport Forum to review the methodology developed for site selection and the criteria employed with a view to ensuring that the exercise undertaken for the Korean Government reflects current international best practice. The selection criteria developed by ADPI were presented and discussed at an expert workshop held in Paris in February 2016. The main conclusions from the expert workshop are provided in Chapter 1 of this report. A detailed review of the methodology developed by ADPI is provided in Chapter 2. The review is based on examination of methodologies used for selecting airport expansion sites in four different ITF member countries: Australia, Japan, Portugal and the United Kingdom. Each of these cases is presented in Chapters 3-6 of this report.

Findings

The approach taken by ADPI to developing an airport site selection methodology was discussed in depth at the expert workshop and found to be consistent with international best practice. The methodology was developed through a benchmarking exercise that compared airport site assessment methodologies established by ICAO, FAA and IATA, as well as previous site selection procedures for specific airports both in Korea and in other countries. This produced an integrated suite of assessments covering a broad range of environmental, economic and social impacts.

ADPI also employed an international benchmarking approach to develop their methodology for weighting assessment criteria in order to arrive at an objective recommendation on which site or sites to select for development. The discussions at the expert workshop established which of the procedures developed in other countries were most relevant for the decision to be taken in Youngnam. They also identified a number of ways in which the weighting of criteria could be improved and potential double-counting of impacts eliminated. These improvements are discussed in Chapter 2 of the report and were adopted by ADPI.

The quality of the site selection methodology developed was critical to the decision-making process adopted for selection of the site for airport expansion in the Youngnam region. Reopening of earlier decisions on the merits of expansion fragmented opinion among local and regional governments and exacerbated the polarisation of positions. The approach taken to unlocking the governance impasse was for the national government to convince stakeholders to commit in advance to abiding to the results of the technical evaluation of the competing sites. For this agreement to hold the methodology for site assessment had to be seen to be irreproachable. In the event it proved robust.

Policy insights

The experts discussed what constitutes best practices in devising assessment criteria and selecting sites for the location of new airport capacity, concluding that that the following points characterise best practice.

The process should start with an assessment of need for new infrastructure

The process of selecting the site for expanding airport capacity should begin with a thorough assessment of need for new airport capacity. This requires examining the entire network of airports to understand how they contribute to overall connectivity for the country and if there are any ways in which airport capacity can be increased without building new infrastructure, which is usually very costly and requires a lot of political investment.

Comparable assessments should be undertaken for a range of feasible options

As demonstrated by international experience, assessments should be undertaken for a wide range of options that meet the assessment of need for new airport capacity. The suite of different options should be comprehensive and not dictated by the focus of the discussion of the day. In particular, both expansion of the existing sites and building new airports should be considered.

Selection criteria need to examine all positive and negative impacts of airport capacity expansion

The suite of selection criteria to compare different possible expansion options needs to be complete and include all positive and negative impacts of airport expansion. Both direct impacts on the users of air transport as well as impacts on local communities and businesses need to be taken into account. The impacts need to be considered across the airport network and the regional economy as a whole, accounting for any possible displacement of economic activity. Such a comprehensive approach fosters the identification of winners and losers from the decision on airport expansion and is a good starting point for developing compensation measures.

Assessments need to incorporate considerations of risk and uncertainty

Building new airport capacity relies on long-term forecasts of aviation demand. But forecasting is a daunting task, particularly for the rapidly evolving air transport sector in which airlines constantly find new innovative ways of serving passengers. The selection process needs to incorporate considerations of risk and uncertainty; this will enable testing the resilience of all expansion options under different states of the world rather than just focusing on a business-as-usual trends. This can be done through, for example, a scenario-based approach.

The process needs to be clear, transparent, collaborative, and trade-offs need to be explicitly considered

Even the most robust process, if not communicated clearly to the stakeholders is unlikely to succeed. Collaborating with stakeholders and producing assessments in a clear, transparent manner not only maximises the chances of stakeholder buy-in but also ensures that all impacts are identified and the relationships between them are appropriately considered. A qualitative discussion of key trade-offs and social impacts should accompany the quantitative results of screening. Efforts should be directed at developing clear summary information and if a balance needs to be struck in meeting deadlines the emphasis should probably be here rather than on producing large volumes of exhaustive supporting analysis.

Chapter 1. Major airport investments challenges

Why are major airport investments often so contentious and controversial?

Decisions on major airport investments are often contentious and controversial. This is the case for two main reasons. First, there are usually fundamental trade-offs to consider between the national and local impacts of airport capacity expansion. Second, these trade-offs are often exacerbated by major risks and uncertainties.

Major airport investments have a host of significant social, economic and environmental impacts, which often put stakeholders on the opposing sides of the negotiating table. Airport capacity expansion creates, on the one hand, direct benefits of increased air connectivity to the users of aviation, passengers and the freight sector. While the local communities can benefit from the resulting increase in economic activity around the airport, they will also suffer from increased levels of noise and air pollution, as well as other adverse impacts on the surrounding natural environment. Such adverse impacts can trigger significant opposition to airport investment. On the other hand, airport capacity expansion benefits the wider economy through increasing and improving the movements of goods and services, workers and tourists, investment and ideas. Moreover, in a constrained airport system scarcity rents are created and the aviation stakeholders who benefit from these rents may also oppose expansion.

Major airport infrastructure usually takes a long time to build, is long lived and once the construction begins the process is difficult to reverse (at least inexpensively). This implies that the investment decisions need to be taken on a long-time horizon, with project appraisal periods stretching to 20-30 years or more. This is in turn implies that planning of infrastructure investment is inherently exposed to considerable risks and uncertainties with respect to how the project's impacts are likely to develop over the investment's lifetime.

All of this taken together means that major airport infrastructure investments will almost always be contentious and controversial. There is ample evidence of this in the various case studies discussed at the expert workshop (and also more generally, see for example OECD/ITF, 2014). Given the conflicting interests at play, the successful implementation of large airport infrastructure projects will require gaining support from a wide range of stakeholders with divergent positions in circumstances where evidence on impacts and their consequences will often be uncertain. A key ingredient for success will be securing acceptability for the decision from a wide range of stakeholders through a robust process of screening and consultation.

Economic objectives

Passenger air travel has rapidly grown over recent decades, with households and businesses becoming increasingly dependent on aviation for their activities. This trend is expected to continue: according to the International Civil Aviation Organization (ICAO), the global aviation sector carried around 3.5 billion passengers in 2015 and these numbers are expected to rise to over 6.4 billion passengers by 2030.

Airports and airlines have remained flexible and so far have adapted rather well to the rapid growth in air travel. At the same time, however, many major airports globally have become congested. According IATA, 39 out of 55 aviation mega-cities are served by airports where demand already exceeds

the available capacity. Capacity constraints create significant economic costs in the system, through increased risks of delays at airports, increased costs of aviation operations and suppressing economic activity.

This, in a nutshell, is the economic case for investment in additional airport infrastructure; it is about sustaining (or enhancing) levels of service as demand grows in order to realise the economic benefits afforded by air services to households and businesses.

Some of these benefits arise directly to passengers through more favourable air fares and services. Some arise through reduced costs to businesses and, via this, enhanced productivity. The evidence from the case studies at the expert workshop – and from the research evidence more generally (see Airports Commission, 2013, for a discussion) – suggests that these economic benefits can often be substantial.

Environmental objectives

Set against the often substantial economic benefits of airport expansion are negative environmental impacts. These include increased noise to local residents, degradations to local air quality (arising particularly from surface access traffic on the roads), increased greenhouse emissions and detriments to landscapes as well as plant and animal habitats.

The importance of each of these environmental impacts will vary according to the site, depending in particular on the natural and economic geography of the site under consideration, the characteristics of airline services provided and the priority for different environmental objectives in the country concerned.

This variability is illustrated in the cases discussed at the expert workshop. For example, noise has been a very important consideration in the airport expansion debate in Japan (a "knock-out issue"), and is also relevant in London and Sydney. In Lisbon natural habitats have been particularly relevant (preserving cork oak stands turned out to be the knock-out issue at one site) whilst in London local air quality and greenhouse gas emissions have both been very important.

An important consideration for noise and air quality impacts is that they will usually have a less serious impact at airports which are at a greater distance from urban centres. This is in direct contrast to the economic objectives which will usually be better served by proximity to major urban areas, to provide favourable surface access to the main markets and residences served by the airport often at a lower cost. This geographic conflict exacerbates the tension between economic and environmental impacts.

Local impacts – NIMBY and PIMBY issues

Proximity effects tend to polarise attitudes to airport expansion as follows:

- Negative: "Not in my backyard" or NIMBY, for example in relation to increased disturbance from aircraft noise

- Positive: "Please in my backyard" or PIMBY, for example, in relation to the increased economic opportunities which arise in the local community from the construction and operation of a major new airport facility.

In some settings both attitudes are present, according to stakeholder group and scale of local constituency. These local impacts can often be very important to the individual households or businesses concerned but at the same time the numbers of households in the local area concerned, or value of businesses, will be relatively small when set in the wider regional or national context. And in

consequence, the aggregate size of these local impacts will also often look relatively small when seen from a regional or national perspective.

In contrast, when we look at the wider catchment community, the average individual impacts at the level of the household or business will be of much smaller magnitude. However, because the overall numbers of households and businesses are much larger in total then so will be the overall aggregate impact of the new facility upon the national economy.

In the particular case of impacts upon the local economy, this conclusion is reinforced by a second consideration. The benefits to the local economy from the construction and operation of a new airport facility – which are often real and important benefits to the businesses and to the community concerned – will nevertheless often be gained at the expense of a transfer of activities from other local communities elsewhere in the region or country. The consequence of this displacement is that the overall benefit of this when seen from a regional or national perspective is usually far smaller than when seen from a local perspective.

The upshot of this discussion on local issues – NIMBY and PIMBY – is that whilst the impacts of airport expansion on the local communities concerned are often very significant, nevertheless the policy maker will have to consider these impacts also from a wider national perspective, from which the impacts will look smaller. This potential disjuncture between the local and the national creates important questions about fairness and acceptability which can stretch support or opposition to a proposed new airport facility well beyond the local community concerned. Resolving this divergence – where it arises – can be a major obstacle to securing acceptability. And perhaps unsurprisingly the expert workshop discussion concluded that this is one of the biggest challenges to the process of airport site selection.

What are the biggest challenges to the process of airport site selection?

The discussions at the expert workshop raised a wide range of questions, suggestions and issues on the challenges to the process of airport site selection. The expert workshop participants agreed that the biggest challenges were the following:

- accounting for risks and uncertainties in demand forecasting and the implications for the specification of investment options
- comparing different airport capacity expansion options on a range of different social, economic and environmental criteria, and communicating conclusions to facilitate consensus
- resolving local issues of NIMBY and PIMBY.

Risks and uncertainties

As noted, risk and uncertainty frequently plays a very significant role in deciding on major airport infrastructure investment. This is because the time scales are often long (in development, construction, and operating life of the facility) and the investment is often irreversible (that is, it is impossible or very costly to secure an alternative use once construction is completed). All of these considerations necessitate a long-term infrastructure planning horizon which will have to be based on long-term forecasts of demand for aviation. But the aviation outlook is inherently uncertain. On the one hand, the demand for aviation has been growing strongly (over the medium term) driven by increasing trade, tourism and other business activities. On the other hand, there are global efforts to constrain the greenhouse gas emissions

from aviation, but their impact on aviation is uncertain. This is just one case in point demonstrating that the future of the aviation sector is fraught with risk and uncertainty.

While there is an extensive body of research evidence and practical experience shedding light on how to address risk and uncertainty in demand forecasting, in practice forecasts have often been problematic to the process of airport site selection with many stakeholders not subscribing to the results they would yield(for examples see OECD/ITF, 2016, and ACRP, 2012).

The uncertainty about the future demand for aviation is exacerbated by the constantly changing aviation industry, with airlines constantly pursuing new business models with respect to serving their passengers. Unforeseen changes to airline business models caused some major unexpected changes in airport demand in the past (ACRP, 2012, provides some illustrations), but the research capability to predict such developments is still a developing science.

The participants at the expert workshop suggested that robust demand forecasts will need to account for a host of different risks and uncertainties, also with respect to policy uncertainly, for example with respect to the importance of environmental impacts, where the discussion showed, for example, emergence of local air quality as a constraining factor in some settings.

There are two immediate consequences of risks and uncertainty for the airport expansion debate. First, there can and often are genuine differences of expert view about the best project to choose. The second consequence is that the local stakeholders concerned that they may face significant adverse impacts will, given the significant uncertainties, tend to be (sensibly) risk averse in responding to proposals to increase airport capacity.

Developing high quality demand forecasts in terms of using state of the art methodology, quality assurance and stakeholder engagement (see OECD/ITF, 2016 for a discussion of different demand forecasting methodologies in aviation) can help bring stakeholders on-board. Risk and uncertainty have to be accounted for in the forecasts. This can be done accomplished through developing scenarios of how the aviation sector may develop in the future. The scenarios can then be used to test the assessment of the proposed investment options to explore whether or not an expansion option is materially weakened (or strengthened) under some of the scenarios.[1] Scenarios should play an important role in testing the robustness of all expansion options under different states of the world.

Different strategies can also be applied to reduce risk and uncertainty. For example, where the major source of risk is likely to arise from airline network developments, then some form of vertical linkage between the airport and some of the airlines, providing for joint investment or some other form of risk sharing might provide a solution (Starkie, 2012). An assessment of a wide range of project options, including some which are either incremental in nature or introduce flexibility in relation to the scale, timing or re-usability of the project. Such solutions, if possible, can reduce some of the characteristics of airport infrastructure (large, long lived, and irreversible) which might otherwise raise costs if adverse risks come to fruition.

At the same time, flexible or incremental project options will usually carry some additional costs in relation to (some or all of) construction, operation or service quality. The key question then is whether this is a price worth paying. Some examples of incremental or flexible infrastructure projects which have been used successfully in North America are provided in ACRP (2012), while Burghouwt (2007) provides a discussion of experience in Europe.

Comparing the benefits and costs of different airport expansion options

Approaches to developing a comparative analysis of different airport expansion options are outlined in Chapters 3-6 of this report. They can be divided into two broad groups:

- multi-criteria analysis (MCA) – illustrated by for example by the case studies of Osaka and Lisbon
- cost-benefit analysis (CBA) – illustrated for example by the case studies of Sydney and London

The expert workshop discussed the essential features of each method, recognising that each can be seen as "family groups" containing several variants. The discussion highlighted some familiar strengths and weaknesses of each of the methods. The wide range of views expressed on the merits of each approach are summarised below.

The MCA framework is constructed around a set of key objectives or criteria. The aim is for these criteria to reflect the key issues to policy makers and stakeholders with respect to choosing between different investment options or locations. The assessments in an MCA provide qualitative assessments rather than quantitative valuations of the proposed projects. The criteria are usually developed and applied to each of the expansion options by a panel of experts. The advantage of an MCA is that it provides a set of results which is relatively straightforward to understand and interpret, and which directly links to the issues that policymakers and stakeholders are most concerned with.

There always is, however, a risk that assessments by experts may be distorted by cognitive bias. Such a bias can be both unintentional and unrecognised (see Kahneman, 2011 for a general discussion and Mackie, Worsley and Eliasson, 2014 for a discussion of the implications for transport appraisal). There is also a risk that the experts may fail to make the most effective use of research evidence and practical experience when comparing different key objectives or criteria to come up with a recommendation.

The CBA framework is applied to answer a fundamental policy question on the merits of a proposed project: what it the project's value to the society? In other words, does the project provide positive impacts upon the economy and the community which together outweigh the overall costs of provision, including construction, maintenance and operation of the infrastructure plus any associated negative social or environmental impacts.

A CBA relies on a well-established framework, developed over a considerable track record, which ensures that impacts are considered in a systematic, consistent and inclusive manner. Best practice regarding CBA can be readily assured, as can consistency with similar results from other projects. The framework helps inhibit the possibilities of biases and inconsistencies which are otherwise a risk when assessment is built on a boarder measure of expert judgement.

The CBA framework, however, cannot answer all important questions relevant to investment decisions. It is better at answering questions of efficiency – "how far do the overall benefits of a project exceed its costs?" – than those of equity – "who gains and who loses?" Whilst the first of these questions is of critical public policy importance – and CBA's greatest strength is in providing insight on this front – there will often also be a public policy interest in other considerations. This is particularly likely in cases where some particular groups of individuals might be expected to lose substantially (or equally some to benefit), with associated concerns about fairness and acceptability (examples of the former might include noise; of the latter, impacts on the local economy).

The CBA framework cannot account for all impacts of airport capacity expansion. Examples may include greenhouse gas emissions, impacts on bio-diversity, the health consequences of adverse air quality impacts and the wider productivity benefits of improved transport links (over and above the reduced costs to business travellers and the freight sector). In some cases, this knowledge gap might be adequately addressed by scenarios and sensitivity analyses (see for example, the analysis of greenhouse gas emissions in the London case study). Importantly, CBA does not usually provide insights into deliverability issues – i.e. whether a proposed project has the necessary financial and managerial arrangements in place to materialise without delay and cost over-runs. Complementary approaches will usually be required to provide this assurance.

The CBA framework can be technically complex, resource intensive and difficult for non-specialists to engage with. This can make CBA a less effective tool in building stakeholder acceptability, unless efforts are made to summarise the results of CBA (alongside other assessments) in a clear and concise manner.

In summary, there was a wide range of views at the expert workshop on the merits of the different methods of assessment – with some participants placing more weight on some of the pros and cons discussed above while other participants gave more weight to others, with only piecemeal consensus overall.

The discussion suggested that some degree of complementarity between the two approaches. Using a mix of the two may balance the pros and cons of the two approaches (in other words, using elements of MCA to resolve some of the weaknesses of CBA, and vice versa). This is often what happens in practice. For example, a recent survey of transport assessment in seven countries (four in Europe, one each in the USA, Australia and New Zealand) found that in all of the countries considered CBA plays a formalised role in decision making. But the study also found that all of the countries place the CBA results within a comprehensive assessment framework that also includes various types of non-monetised benefits or costs (see Mackie, Worsley and Eliasson, 2014).

Exactly what type of blending works best can be expected to be shaped by the needs of a particular study. For example, in the sifting through a long list options MCA has the advantage of being both straightforward to interpret and (potentially) relatively inexpensive (although the workshop discussion noted that a reduced version of CBA has also worked successfully for sifting sites). Once a shortlist has been selected – probably containing the winning member from different "family groups" of options – this will often be the stage where CBA can be helpful in choosing between the short listed options. But as noted (by Mackie, Worsley and Eliasson, 2014), the CBA findings will need to be set in a comprehensive assessment framework covering the ground that CBA cannot cover (in particular with respect to the non-monetised impacts, identification of the winners and losers, and deliverability considerations). A focus of blending different assessment approaches should be on how to make the best use of available evidence and expert opinion, to facilitate .political choices built around an informed discussion of different trade-offs.

Resolving local issues – NIMBY and PIMBY

The discussion at the expert workshop reflected a diverse range of views on the most effective methods of factoring local issues into the assessment of major airport infrastructure investment. For example, there was a discussion on how to account for the fact that noise impacts of airport expansion on local communities often do not constitute significant monetised costs in a CBA. Some experts concluded that such results implied that the noise issues should be addressed at a local level only once the strategic decisions on the preferred infrastructure option had been taken. At the other end of the spectrum was a view that these issues can be of fundamental importance to infrastructure decisions – as they pose

unsurmountable obstacles to the project delivery – and that they hence have to be considered at the outset of the decision-making process.

In practice, the relevance of these various local issues will most likely vary strongly between different cases. Thus each of the (apparently) contradictory views set out above are probably right in some circumstances but not in others – for example, sometimes noise will be a knock-out issue but sometimes it will be relatively unimportant. This suggests an approach in which initial scanning aims to identify which local issues are likely to be significant at an early stage. The issues, and the ways forward, are likely to differ between the PIMBY cases and the NIMBY cases, the sections below consider each in turn.

PIMBY – benefits to the local economy around the airport

Most of the benefits of airport expansion to the local economy stem from the construction and operation of the infrastructure, together with the associated support services provided. For local stakeholders these are important benefits to their community. However, from a national perspective these benefits to the local economy will most often reflect the displacement of activities from elsewhere (either from other sectors in the local area or from other areas of the country). This means that the advantage to the entire national economy from the construction and operation of the facility needs to take into account the displacement of economic activity in other areas in the country.

Airport expansion also benefits the wider national economy through improving air services by increasing the number of frequencies, destinations, improving accessibility and lowering ticket prices. These benefits will spill over directly into reduced business costs and improved productivity, which in turn can lead to wider productivity gains. The majority of these benefits are likely to be realised across the wider catchment (national or regional) which the airport serves, and only part of these benefits will be realised across the local area in which the airport is located.

The participants of the expert workshop discussed how to best reflect these two very different considerations - the impact of the infrastructure investment on the local economy and the impact upon the national and regional economy – in the overall assessment of the merits of the proposed investment. All participants agreed that the assessments need to account for economic displacement. Otherwise the project's benefits to the economy are likely to be overestimated, which may lead to inefficient over-investment. There are many examples of how the use of input-output tables which do not account for economic displacement (among other shortcomings of this methodology) contributed to the inefficient over-provision of capacity at regional airports in many European countries (see Niemeier, 2013 for evidence on German airports).

An assessment of all benefits to the local community is very important as quantifying these benefits can help secure acceptability for airport expansion with the community. Local economic benefits may also be relevant to the strategic case for investment. This may be the case if the local area is economically depressed, and where nationally funded regeneration activities may be desirable. In these circumstances, an infrastructure project may help ameliorate the need for regeneration activities in a particular location.

An example of handling the effects of displacement can be found in the United States, where the Federal Aviation Administration (FAA) provides funds major airport infrastructure projects. The FAA uses CBA as its main assessment tool. The impacts are considered from a national perspective, consistent with FAA's role as a national government agency. However, the local benefits of airport expansion are acknowledged, but not included in the CBA. This is the case because the methodology recognises that much of the local benefits reflects displacement from other sectors or localities, and thus will not reflect a

net benefit to the economy at national level. The FAA does, however, include a qualitative assessment alongside the CBA of whether a proposed airport investment may contribute to the regeneration of an economically depressed area. In practice, however, this part of the assessment seems rarely to have been material to any project approval. A review of the FAA's approach to CBA (see Landau, Weisbrod, and Alstadt, 2009) suggests that this approach has been reasonably successful in marrying together different impacts of airport infrastructure on economic development at the local and national level, and has perhaps helped constrain PIMBY lobbying. Experience at the expert workshop suggested that, in a similar way, the increased use of CBA in Japan had helped to constrain PIMBY lobbying.

NIMBY – negative impacts upon the local community around the airport

The impacts likely to be most significant in prompting NIMBY responses are to do with adverse impacts of airport expansion on environment; impacts include increasing noise levels, loss of wildlife habitats, landscape or deteriorating air quality. The importance of these factors will vary from case to case, with one, or several, of the impacts mentioned above leading to a significant NIMBY response..

As already discussed earlier, the reaction to any potential adverse impacts of expansion can often be more than proportional to the estimated magnitude of these impacts, particularly when the affected individuals face a lot of risk with respect to how severe the impacts may actually be in the future. Indeed, the evidence on these impacts is sometimes uncertain or contentious. Moreover, NIMBY responses are also more likely to command broader public support – beyond those immediately affected – when the imposition of these material losses on individuals is perceived as unfair.

Since usually the number of people in the local community who lose from infrastructure investment will typically be much smaller than the number of people who gain across the wider catchment from improved air connectivity, the CBA will deem the project "efficient". The CBA, however, does not account for equity or fairness considerations, which stresses the importance of using other complementary approaches to CBA. It is also important to investigate any measures that can reduce negative impacts of air transport, which should then form part of final site selection. Securing acceptability will usually involve some combination of mitigation measures to reduce the scale of the negative impacts (e.g. double glazing to reduce noise) and compensation measures to counterweight negative impacts which cannot be mitigated in a cost effective manner (for example, purchasing of severely blighted properties).

An example of a combined package of measures is shown in relation to noise in the case study of London. More generally, a recent study in the United States looked at approaches to building acceptability in local communities for airport capacity development (ACRP, 2013). The report concluded that both an optimal capacity solution and a compromise solution which balances project needs with mitigating community impacts should be considered. The report outlines a number of major projects in the US which have successfully used this approach.

But while mitigation or compensation measures can be successful in securing acceptability from local communities, there is clearly a choice to be made on whether or not it is worth foregoing the benefits of the optimal capacity solution in favour of the acceptability of the compromise solution. Setting out both solutions in the assessment helps policy makers to develop an informed choice.

Note

[1] See, for example, Airports Commission (2013, 2015) for a discussion of different aviation scenarios for the London airport system and how they were used to test the shortlisted expansion options.

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Chapter 2. Airport site selection criteria developed by ADPI for the Youngnam Region- A summary of expert workshop recommendations

The policy challenge at hand

As discussed in Chapter 1, expanding airport capacity in densely populated areas is characterised by a fundamental trade-off between economic and environmental goals. Good transport infrastructure is of key importance for productivity and economic growth but airport capacity that is highly accessible to users means larger numbers of people exposed to noise and air pollution.

Expanding airport capacity at sites further away from urban centres may mitigate these environmental impacts but can undermine economic viability, increasing the risk that the new capacity is underutilised and that economic benefits fail to materialise. The higher the cost of development of the site the larger the negative consequences if this happens. These trade-offs characterise the Youngnam region, where the main existing airport faces capacity constraints in its existing configuration and where noise is one issue that leads to some much higher cost alternative sites for potential expansion being considered.

Background and objectives

The Youngnam Region of Korea is home to 13 million people. It is divided administratively into two provinces and three municipalities: Busan (3.7 M) Daegu (2.6 M) and Ulsan (1.0 M), the smallest but wealthiest district. The region has five civil airports, all of which host military operations, except for the airport in Ulsan. Busan and Daegu serve international as well as domestic routes. Busan Gimhae airport handled 12.4 M passengers in 2015 and Daegu 2 M. Rapid growth at Gimhae airport (13% pa recently) has been driven by the emergence of low cost carriers and most recently increasing numbers of visitors from China.

A site is being sought for a new airport to be developed with the following objectives:

1. accommodating growth of traffic
2. facilitating development of direct long-haul routes, by out-competing services with transfer at Incheon or other hubs
3. improving safety
4. providing better access for the region's population in all major population centres to international flights
5. providing jobs for the region, both long-term jobs resulting from new business development opportunities and short-term construction jobs
6. containing noise exposure.

Providing jobs has two largely separate aspects – with quite different implications:

a) Providing better job opportunities (much of the economic benefit is likely to be realised through more productive jobs rather than a net addition in employment) in the immediate local area as a result of employment in the construction and then the operation of the new infrastructure.

b) Providing better job opportunities across the wider region/country as a result of the increased connectivity provided by improved air services, which can be expected to raise the overall national productivity and growth levels.

Providing job opportunities locally will be very important to the populations living close to the future development and to gathering political support for the development. The local benefits from the construction and operation of the new infrastructure should, however, be considered against the nation-wide impacts on employment. The positive job creation impacts locally may be to a large extent offset by the loss of employment elsewhere due to the shortages in labour force. This is particularly relevant to Korea, as the country enjoys the lowest unemployment levels among all OECD member states.[1]

Improved aviation connectivity can positively impact the overall productivity levels and, in turn, the country's economic growth. These impacts, however, are very difficult to measure, given the problems of causality and the complexity of the benefit transmission mechanism in the economy.

The new airport will be developed with central government funds, and airside charges will probably not have a direct link to the cost of development. Central government funding naturally means that competition between local governments to attract the investment associated with the airport is intense, a phenomenon that has been termed PIMBY (please in my back yard) in contrast to the more common NIMBY (not in my back yard) reaction to local nuisance including noise and air pollution. PIMBYism characterises transport infrastructure development whenever it is funded entirely by central government and is not unique to Korea. In Japan the tendency has been mitigated to a degree with the introduction of project evaluations based on cost-benefit analysis (CBA) and greater public involvement in decision making, following a December 2002 report of the Aviation Subcommittee for the Transportation Policy Council of the Ministry of Land, Infrastructure and Transport (MLIT).

PIMBYism can exist in parallel with NIMBYism and is not confined to Korea, as reflected in attitudes to operations at Hamburg's airport in Germany. In face of opposition to expansion because of noise impacts, the local chamber of commerce commissioned a survey of business community views in the early 1990s that proposed moving leisure flights to neighbouring Hanover airport while retaining business flights from Hamburg. Even when it comes to the highly contested expansion of Heathrow airport in London there is quite a lot of support for expansion of the site, mostly among those residents who rely on the airport for jobs. [2] The Back Heathrow campaign was supported by over 100 000 residents who live in the neighbourhood of the airport.[3]

Airport site options

In the Youngnam region, topography and/or sharing runway capacity with military aviation limits the potential for expansion at most of the existing airports. The availability of potential new sites is limited by the mountainous terrain and urbanisation of most of the flat areas. Two potential new sites were identified in the 2000s: one at Gadeok next to the shore in the sea 34 km by road southwest of Busan, and the other between Busan (45 km) and Daegu (65 km) at Baeksan Ri village next to the town of Hanam Eup in Miryang County. Both would involve major civil engineering works to remove

obstacles (mountain tops) and provide infill. Cost-benefit analysis rejected both options in 2011 as too costly for the expected traffic.[4] A third option is redevelopment of the existing Busan Gimhae site (14 km from downtown Busan).

Renewed passenger growth after the economic crisis and renewed pressure from local governments to develop an airport with the critical mass of passengers to support a larger number and range of direct international services led to a new phase of assessment. A number of other possible sites also exist in the region and a site selection methodology has been developed for Korea independently by Aéroports de Paris Ingénierie (ADPI) to sift options.

It is important to ensure that the suite of options considered is comprehensive, and that schemes examining flexible (or incremental) airport expansion plans are included in the exercise. There are two benefits to taking such a flexible approach:

- It helps to respond to the significant uncertainties that arise in even the best forecasts of air traffic demand, and in the other key drivers of the assessment.

- It helps to improve acceptability, both by demonstrating that the chosen investment plans are reasonably robust to future risks, and by recognising alternative proposals and providing evidence based reasoning for their non-selection.

The value of this approach is supported by both the experience shared at the Expert workshop (for example, the largely successful incremental development of Sydney Airport, associated with land purchases at another site which might provide for a new airport when needed) and by experience in both North America[5] and Europe[6].

The potential for enhanced surface access to each site might also be examined. For example, in addition to expanded and realigned Busan Gimhae, expansion plus enhanced surface access from Daegu (96 km by road) to reduce access time from this part of the catchment area (currently 1 hour 45 minutes by public transport – rail plus bus – from Daegu station) might be examined.

In the case of options where NIMBY issues threaten to be show-stopper to the project it will be useful to iteratively fine tune the option to see whether small changes to the specification – or a package of compensating actions such as effective noise management (noise budgets, surcharges and insulation) or programmes to foster local economic development – can materially reduce the impact.

Scenarios

As noted, even the best forecasts of air traffic growth – and some of the other key drivers that need incorporating into the project appraisal – are subject to significant uncertainties, particularly due to the long-term lifespan of airport infrastructure. For that reason, it is important to reflect these uncertainties in the assessment of the different site options by exploring different scenarios for future development. Comparing the various site options across a range of scenarios will help:

- Understand whether an (apparently) promising option under the central case may be less favourable under other plausible, albeit less likely scenarios.

- Develop risk management measures; these may involve an incremental development strategy which holds open options for subsequent developments (e.g. contingency land purchase in Sydney to accommodate potential additional capacity expansion).

- Enhance acceptability by providing a ready response to criticisms/disagreements with the air traffic forecasts.

The value of scenarios in airport forecasting is supported by the experience discussed at the Expert workshop (London is a useful illustration) and by experience in North America (see ACRP, 2007).

Assessment process

Choosing a site for airport capacity expansion between competing alternatives will involve several stages of assessment at different levels of detail. Social cost-benefit analysis is fundamental to project assessment in all of the case studies reviewed at the expert workshop. The decision to proceed with expansion is usually contingent on achieving a positive benefit-cost ratio and reasonable rate of return on investment under CBA.

A CBA type of framework is typically applied in comparing alternative sites for expanding airport capacity. Some important factors may not be amenable to monetisation and will need to be brought to the attention of decision makers separately. Best practice includes preparation of a summary impact table to support decision-making, designed to highlight key trade-offs in terms that are readily understood. Some jurisdictions employ multi-criteria analysis to quantify and combine impacts that are not readily monetised but when employed, compound MCA results need to be presented alongside or as part of the summary impact table rather than in place of it, in the interest of transparency. Examples of summary impact tables are available for reference on the web in the UK Department of Transport's Transport Analysis Guidance.[7]

Site screening on the basis of a reduced list of criteria may be indicated at some stage. In mountainous Youngnam, for example, air space constraints in relation to topography are a hard constraint that limits the number of sites suitable for further consideration. Even here though, there may be a trade-off with costs, as expensive civil engineering works might be undertaken to remove obstacles including mountain tops. Or a military base might ultimately be located to another airport. Similarly, with difficulty to monetise impacts such as habitat loss it may be possible to create compensating habitat areas off-site at the project developer's expense. Screening on the basis of a reduced set of criteria may be used to narrow the field but will not necessarily eliminate projects where modifying the design might mitigate its drawbacks at higher cost and CBA is then best suited to weigh the trade-offs.

While sifting sites to reduce the options for detailed examination to a relatively small number can be done on the basis of relative performance against a limited number of site selection criteria, CBA should be performed on the most relevant options and usually on more than just one short listed option. This is in order to get a full understanding not only of the pros and cons of the proposals, but also the costs and benefits of potential mitigation and improvement strategies for alternative options.

As explained in Chapter 1, CBA is worth bringing into the assessment. This well-established and well-understood technique offers a transparent framework for assessing impacts of investment decisions and provides useful insights into the value of the project to the society. But CBA also has weaknesses which are important to acknowledge and mitigate to the extent possible. While the overall aim is straightforward and appealing – comparing benefits to costs – the technical detail is often complex. For that reason, communication with stakeholders is often better served by using indicators which illustrate key outcomes (e.g. surface access times to different airports). Also, while CBA provides answers to questions of efficiency, it usually does not provide much insight into other important dimensions of appraisal, in particular equity considerations (or the incidence of costs and benefits) and the issues of deliverability and financeability.

The papers presented to the Expert workshop illustrate how in practice site screening incorporates CBA, simplified where possible. Screening on a reduced set of factors might be used to eliminate sites subject to "show-stopper issues" as was the case with noise nuisance when sites for the New Kansai Airport were selected, with all remaining cases then subject to a CBA. Subjecting the remaining cases to a CBA can be done in stages. When there still is a considerable number of cases to be examined (e.g. 17 in the discussed Sydney case), a less detailed CBA can be conducted. Many assumptions in such a simple CBA, for example on the on-ground or in-air value of time, may be kept constant across all sites. Environmental externalities such as noise impacts, as well as most safety and operational assessments, can also be incorporated into a simple CBA.

NIMBY and PIMBY considerations will be prominent in the Youngnam airport planning process and will need to form part of the assessment process and to the extent possible reflected in site selection criteria. As they involve relatively large individual losses (or sometimes gains) to relatively small numbers of people, such considerations can often become political stumbling blocks due to the perceived unfairness of incidence. For that reason, it is important to assess the gains and losses involved, in both the winning and the losing jurisdictions as well as to engage with stakeholders in a pro-active, open and transparent way. Such an assessment of gains and losses should involve devising policies that would mitigate and/or compensate for the impacts of expanding or displacing airport capacity in terms of, for example, noise envelopes, emissions caps for surface transport accessing the airport, economic regeneration measures, or replacement of wildlife habitats.

Deliverability should be assessed as an important part of the overall assessment process. This is one of the main conclusions in relation to development of assessment procedures in the UK over the last decade, required by HM Treasury (Ministry of Finance) guidance for all projects, including airports. Deliverability covers a range of factors, some included in the site selection criteria developed by ADPI, others more suited to treatment in a CBA. It includes the prospects for finance to be raised by the owners of the airport (not currently relevant in Korea where central government is expected to fund development with national tax resources). It includes planning hurdles, risks associated with land acquisition and the potential for legal challenge in relation to environmental and other regulations. And it includes vulnerability to demand risks which is suited to assessment through scenarios.

Projects designed to phase investment flexibly, with expansion in stages as demand unfolds, can reduce cost and risks in relation to deliverability as well as overall value for money. This in turn can be part of the strategy for securing acceptability for the site recommendation among stakeholders (and potential investors).

Scenario-based analysis of passenger forecasts, and forecasts of other key drivers, is central to this analysis and an important part of building acceptability of the project is to present its business case in a variety of scenarios to demonstrate its robustness across different potential states of the world and/or to show how risk management strategies will work.

Airport site selection criteria

The approach taken by ADPI to developing an airport site selection methodology was discussed in depth at the expert workshop and found to be independent, transparent and comprehensive in relation to the objectives outlined above.

The methodology was developed through a benchmarking exercise that compared airport site assessment methodologies developed by ICAO, FAA and IATA, as well as previous site selection procedures for specific airports both in Korea (MOLIT, 2011) and in other countries. This was to ensure

that ADPI developed an integrated suite of assessments covering a broad range of environmental, economic and social impacts. ADPI also employed an international benchmarking approach to developing a methodology for balancing the criteria in order to come up with a recommendation on which site or sites to assess in detail for development.

ADPI developed a comprehensive suite of assessments related to the potential social, economic and environmental impacts of the proposed schemes. Comments on the draft criteria and process of assessment and on the weighting of the criteria for decision making are summarised below together with recommendations as to how the initial methodology might be improved.

Weighting and balancing different criteria

Expert workshop participants acknowledged that the Korean political and policy environment may require applying a set of weights to the criteria in order to come up with a recommendation despite the inevitably subjective nature of weighting dissimilar criteria. At the same time they stressed the importance of sensitivity testing the weights applied in order to reveal how each of the options performs in relation to the different dimensions of assessment (environmental, social and economic). This confirms the importance of the sensitivity testing proposed by ADPI.

One issue that pertains to all of the assessments is the methodology developed to assign marks to each of the assessment sub-categories and to aggregate those marks and then convert them into a score for each criterion. ADPI developed non-continuous functions for each assessment sub-category according to which marks between 0 and 5 are allocated to each site. There are several issues with applying this methodology:

- The functions developed to assign scores vary substantially. There is a question why such an approach was taken and whether alternative functional forms are more appropriate.

- Allocating discrete marks from 0 to 5 implies that very similar assessments may receive different scores based on a tipping point selected in an arbitrary manner. For example, in the system proposed for site potential, a mark of 89% scores a rating of 4 and 91% scores 5 whereas both 81% and 89% score a 4. In order to avoid such an arbitrary assignment of scores, continuous functions should be used to quantify the results of all the assessments. All quantitative assessments should use continuous functions. As much homogeneity as possible should be sought in the rating systems for non-quantifiable factors.

- Many assessment sub-categories whose scores are added to one another are in fact non-additive, for example different weather impact assessments. A different approach should be considered in which non-additive sub-categories are not added to one another but, for example, the minimum or the maximum score (depending on the assessment) is taken into account.

- Adding and mathematically trading-off criteria is sometimes contested even when all the variables can be monetised (through surveys of willingness to pay and proxies including the value of time and the statistical value of life). Assigning scores to non-monetised variables for computation in a compound, multi-criteria assessment, designed to produce a single value outcome, is particularly problematic.

Multi-criteria assessment is used to differing degrees in different jurisdictions in appraisal procedures – for example, in a cost-benefit analysis or an environmental impact assessment - and it is increasingly replaced by more transparent procedures. Similarly, in many jurisdictions weighting of site

selection criteria is avoided because of the unavoidable arbitrariness of the weights, and the information that the weights will inevitably conceal. The UK assessment procedures for appraising infrastructure projects, for example, require the results of CBA and strategic environmental assessment (SEA) to be presented in a short, one or two-page Summary Appraisal Table designed to highlight irreconcilable issues and trade-offs that require an explicit political/societal decision rather than a technocratic calculation.[8] As the guidelines put it "[t]o ensure that decision-makers are always presented with a full account of the impacts, all impacts – monetised, quantified, qualified wherever feasible – are summarised and presented in the form of an Appraisal Summary Table." The results of appraisal are presented in several sections, with the version in use at the end of the 1990's particularly relevant to site selection processes (ECMT, 2004). Categories cover the main economic, social and environmental impacts of a project, and the information presented includes to following:

- the welfare outcome foreseen by cost-benefit analysis, in monetary units
- quantifiable, monetised social costs, such as air-pollution and noise
- quantifiable social costs in physical units – pollutant emissions, CO_2 emissions, noise footprint
- qualitative description of unquantifiable impacts
- the relation of impacts, unquantifiable as well as quantifiable, to key policy objectives of the government of the day (e.g. in relation to overcoming inequality).

It would be useful to accompany the results of the airport site selection criteria assessment and weighting exercise with a summary appraisal table of this type.

The UK Airports Commission used informed judgement by the commissioners, rather than a weighting formula, to arrive at a decision on the best site for expanding airport capacity in the southeast of England. This places emphasis on the quality, credibility and acceptance by stakeholders of the members of the commission and its Chair. This emphasis was reflected in one of the initial commissioners, and the only one with direct background in aviation, leaving the exercise at an early stage over concern that he was identified too closely with one of sites on the long list of potential expansion options, even though that option was eliminated at an early stage. This illustrates that transparency and the consultative nature of the commission's process was key to its acceptability. For transparency reasons, the commissioners' judgement was supported by exhaustive assessment documentation. The commission also extensively engaged with a broad range of stakeholders through a series of meetings and consultations on all the evidence that it considered and all the materials that it produced.

In Portugal, the selection process for the new Lisbon international airport was based on conducting a CBA together with a Strategic Environmental Assessment (SEA). Over 40 different experts were divided into several teams. One team was responsible for the CBA, while each of the other teams looked after one of the seven critical decision factors which formed the basis for the decision-making framework. Each critical decision factor had its own assessment criteria and metrics that were simple to understand. Each critical decision factor represented a strategically important dimension of the decision-making process and all seven critical decision factors were given equal weighting when they were aggregated to produce a recommendation.

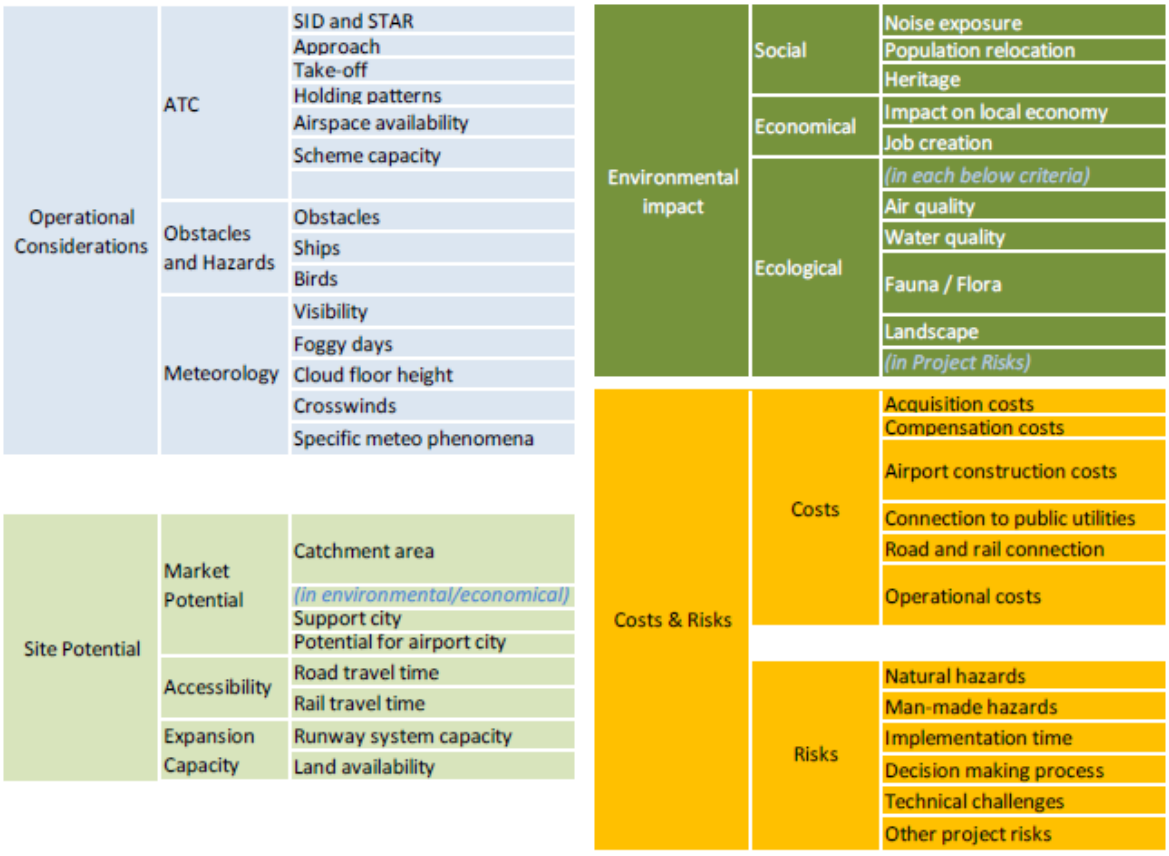
In selecting the site of Japan's New Kansai International Airport, site selection criteria were assessed and then weighted by vote of a committee of 17 non-ministry stakeholders (from local government, business and NGOs) chosen for representativeness and independence. Voting took place in two rounds. Committee members were allotted 1 000 points to assign to the weighting criteria according to the importance they put on each factor. The averages of the votes cast were used to establish the weights applied. Points were then awarded to assessment criteria at each of the sites by each committee member and the assessments combined with the weighting formula. The voting system removed arbitrariness from the weighting and avoided discontinuities in the assessment of the criteria. Among the weighting systems reviewed by ADPI for benchmarking purposes this is by far the most robust. ADPI interpreted their remit, however, to exclude recourse to further local consultation. Some of the other methodologies for developing weights that were examined by ADPI used a restricted set of criteria (e.g. Berlin) not suited for application to other cases.

For Youngnam, it would be ideal to use the methodology derived in Kansai rather than the average of the weighting systems examined, as proposed. There is no reason to believe that taking an average of the approaches reviewed is particularly appropriate to conditions in Youngnam. The extremes of the weights revealed in the benchmarking exercise might, however, be used to test sensitivity to the central weighting system adopted.

Improving the site selection criteria

The sections below provide specific recommendations on how each of the assessment categories developed by the ADPI (see Figure 2.1) could be improved.

Figure 2.1. **Summary of airport site selection criteria proposed by ADPI**



Source: ADPI, *Final Site Evaluation Methodology,* 19 February 2016.

In order to improve the selection process on the basis of the case study material prepared for the Expert workshop, the assessment criteria could be divided up in the following way:

- Strategic fit considerations
  - market potential
  - expansion potential
- Operational considerations
  - airspace availability, SID and STAR characteristics, holding capacity
  - hazards and obstacles – mountains, man-made obstacles, birds, ships
  - meteorology
- Site potential – surface access
  - road
  - rail, light rail, metro
- Socio-economic impacts
  - benefits to local economy: short term construction jobs, long term jobs and economic development dependent on the existence of the airport
  - losses to local economy (fisheries for example)
  - social costs: noise, air pollution (including from surface transport for access to the airport), population relocation, loss of heritage sites

- Ecological impacts
  - water quality
  - habitat loss (flora and fauna) and mitigation potential
  - landscape
  - CO_2 emissions (especially from surface access)
- Expenditures
  - land acquisition and compensation
  - airport construction
  - access and utilities connections
  - operations
- Risk and deliverability
  - technical challenges and construction risks
  - potential for legal challenge
  - potential for political/decision making hurdles
  - Gimhae staying operation in competition with new airport
  - phasing potential.

Strategic fit and operational considerations

Capacity to accommodate traffic should be assessed under strategic fit in terms of the project's ability to accommodate air traffic movements, both in terms of airside capacity and in terms of airspace considerations. Such a strategic assessment would have to entail a connectivity assessment as the scheme's attractiveness should not be exclusively based on the potential number of ATMs that it can handle but also on the level and the nature of traffic (e.g. short-haul or long-haul) that it can potentially attract. This is linked to the market potential and expansion capacity sub-categories from the site potential assessments. All of such assessments should be tested against different scenarios of how the economy and the aviation markets may develop.

The strategic fit considerations might also incorporate long-term financial prospects of a project. Costs of the project would be an important indicator to use in such an assessment. At present costs will be covered by the central government and charges to use the airport set nationally. However, particularly if there are cost over-runs there could be pressure in the future to recover some of the costs through higher airport charges which could have adverse impacts on the traffic levels. Higher cost sites will be more vulnerable to this eventuality. If restrictions on operations are likely at any of the sites in order to mitigate noise nuisance, the sites should be assessed for the potential impact on effective capacity.

Site potential: Surface access

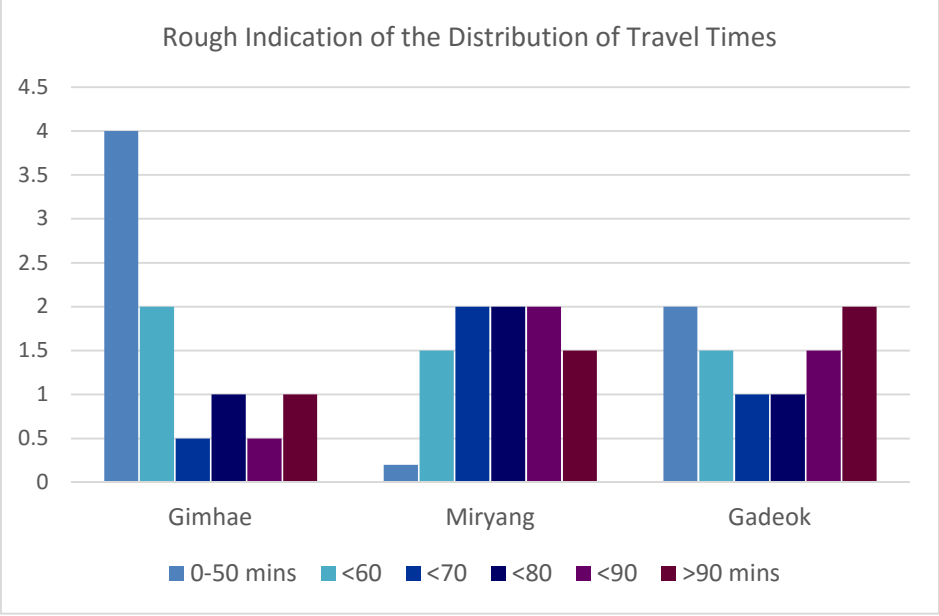
Accessibility will be one of the key determinants of the viability of the airport and its ability to attract potential passenger and freight demand. The criteria chosen by ADPI for assessment aim to reflect this but are insufficiently specified. Alternative approaches might also be used. It would be worth examining what formulae have been used elsewhere.

The proposed criteria are a combination of two factors, average and maximum travel time by road, weighted two-thirds to one-third. The average travel time is presumably the average for all potential passengers from the region, but this is not specified and it might not be reasonable to expect some of the 13 million inhabitants in regions furthest from the site to not use the airport at all, given alternatives of other domestic airports, high speed rail service, and long distance bus services to Incheon.

The calculation of the average travel time is based on the mean (not mode or median), and this should be specified as it could make a significant difference depending on the shape of the distribution of travel times. Given the rather different locational characteristics of the main sites this consideration is of great importance. The figure below gives a very rough indication of how different the distributions might be. The very different shape of the expected distributions means that these should be reported to decision makers along with any indicators of average travel time.

The maximum travel time criteria is defined by the ADPI methodology as the time for 90% of potential passengers to travel to the site, combined with time to reach the site from the most distant of the three major cities. Just how the two factors are to be combined is not specified. And again the boundary condition for potential passengers is not specified. Taking the entire population of the region may be particularly misleading in this case. The criteria will need to be more completely described and refined. The shape of the distribution of travel times could again make a big difference.

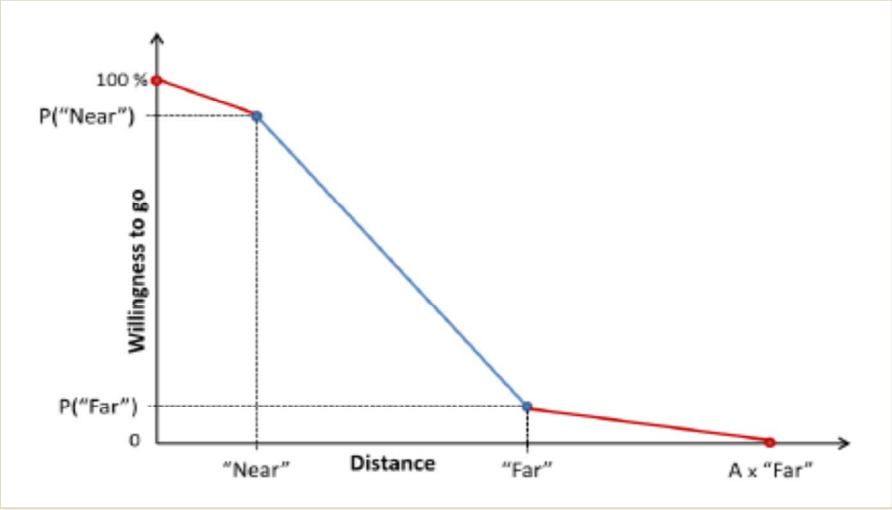
Figure 2.2. **Distribution of travel times**



Ideally it would also be useful to give an indication of travel times at peak hours for the use of the road network. Peak times for aircraft arrivals and departures tend to coincide with the morning rush hour. This would probably require use of a transport network model. This may well be beyond the scope of the present exercise but should be taken into account in the cost-benefit analysis. It might be an option to use S curve functions as the basis for determining accessibility, reflecting the convenience of access to the sites. Research on travel behaviour reveals threshold values for relative indifference to airport access time and then intolerance to access times above a certain level.[9] The figure below represents the willingness of passengers to travel increasing distances to an airport for a specific trip purpose. The proportion starts to fall away significantly from the first inflexion point perceived as "near" in terms of distance (or more strictly access time) with a second inflexion point at "far" beyond which only a small number of passengers are still prepared to make the trip. These thresholds differ greatly between business and leisure travel, with "far" perhaps around 50 minutes free flow traffic time for domestic business travel, longer for intercontinental flights and perhaps 90 or 120 minutes for leisure travel. The curves can be calibrated from local data, for example survey data on trip purpose and access journey times for Incheon airport, data that has been collected in Korea. This should be an easier task than estimating travel times for the whole population of south east Korea to the potential sites.

In the proposed methodology it is not specified if data on travel times would be generated from a public source like Google Maps or from a road network model.

Figure 2.3. **Typical distance decay function for access travel time behaviour**



Source: Viegas and Martinez (forthcoming).

Access by public transport should also be assessed. Dedicated airport bus services carry a very large share of passengers to Incheon International airport and it seems sensible to assume a similar network of direct bus services would develop for a new airport in the Youngnam region. A similar approach to access by car might be taken, adding a constant time penalty for access to the bus terminal or stop.

Access by rail, plus bus for the last leg, could be determined on the basis of existing timetables from major stations. A number of web-based services offer routing and scheduling information and could be used as the data source. An inflexion point for "far" as on the graph above could be chosen to define the relevant catchments.

The potential for investment in rail spurs into new sites could be addressed, with an estimation of the time saved by eliminating the last leg bus links.

Where rail is interconnected with the metro network in a neighbouring city this should be reflected in the assessment. The more interchanges with metro lines are available the better, broadening the effective catchment area, and this should be reflected in the assessment.

Socio-economic and ecological impacts

Separate criteria currently grouped as "environmental" should be split into three distinct categories of socio-economic criteria:

- Benefits to the local economy of the Youngnam region: short term construction jobs, long term jobs, and local economic development due to the existence of the airport and the productivity benefits associated with improved air connectivity.
- Losses to the local economy of the Youngnam region (e.g. fisheries).
- Social costs: noise, air pollution (including from surface transport for access to the airport), population re-location, heritage.

Economic impacts (benefits and losses to local economy)

A large part of the benefits for the local economy will take the form of jobs and investment that is displaced geographically rather than a net addition to the overall economy. This distinction is typically important when viewing projects from a local versus national perspective. Cost-benefit analysis usually takes a national welfare perspective and thus ignores jobs that are created locally to the detriment of other regions that see less economic growth or lose jobs to the new site. However, in the present case, most of the local benefits will be effectively transferred from one part of the Youngnam region to another, development of job opportunities in Miryang and Daegu versus in Busan for example. The ADPI assessment will evaluate economic benefits and losses for the Youngnam region as a whole, the devised methodology can thus be expected to capture the economic activity transfer within the region. This will need to be stressed as the potential to favour one location within the region will be central to stakeholder acceptance of the results of the site selection process.

Insights into the potential characteristics of the forecast aviation demand resulting from building each option will be particularly significant to these assessments as long-haul traffic tends to drive higher productivity improvements than other types of connections. Whether long-haul traffic potential will materialise is impossible to accurately assess, but such developments are much more likely at locations in the vicinity or with convenient access links to high tech industry or financial service industries, as these make significant use of air freight or business passenger services. Identifying the benefit potential requires an investigation into potential business or other activities that can be expected to make the most of the opportunities provided. Such an assessment can be conducted separately for business passenger travel and freight transport. Any wider impacts of the project's realisation on the economy will also have to be assessed.

Participants at the expert workshop cautioned against the use of input-output models to assess the magnitude of local economic benefits, as input-output assessments are vulnerable to the problem of double-counting of benefits.[10] The strength of the cost-benefit analysis framework, on the other hand, is that it avoids double-counting and follows well established best international practice.[11]

Social costs

While noise costs tend to dominate assessments of the social costs of airports, air pollution is proving an increasingly significant issue in many locations. Pollution from NOx and particulates is receiving ever increasing attention for its health impacts, notably on asthma, other respiratory problems, cardiovascular disease and cancer. The impact of airports on air pollution arises as much or usually more from access to the site by road than from aircraft movements and ground transport inside the airport. Plans for carrying passengers to and from the airport by rail, metro or bus instead of private cars and taxis are often a key to approving plans to expand airports. This is the case at Heathrow in London and is a key aspect to the sustainability performance of Incheon International Airport. In London, air quality in the area around Heathrow chronically exceeds PM10 and NOx limits established by the national government and the European Union. Whilst the fundamental problem is road traffic on the surround highway network, and while air quality limits are exceeded, any expansion has to show that it will not exacerbate the problem.

Noise is a major and increasing factor in determining the potential to expand airport activity in most built up areas. It can limit not only the total number of aircraft movements allowed but also limit night flights and flights in the early morning period, which may be particularly valuable to airlines. Opposition to expansion is often vociferous and can be a knock-out factor, preventing any development. Screening in Kansai was restricted mainly to off-shore sites because most on-shore sites would have faced too

much local opposition. Reductions in engine noise have been continuous and substantial; larger, quieter aircraft have been introduced. Airports like Heathrow have seen large growth in passenger numbers with a decreasing noise footprint. Partly as a result, Itami was not closed as planned after the opening of the New Kansai International airport. It is important to acknowledge projections of future aircraft noise performance rather than today's reference noise footprint.

Noise reductions, however, are difficult to predict, particularly as there are trade-offs that need to be considered in terms of the policy goals of targeting emission reductions versus other environmental objectives, including noise. For example, minimising noise impacts by setting out flightpaths that avoid densely populated areas may lead to increase fuel burn and higher CO_2 emissions. Another example could be the development of high bypass-ratio turbofan engines that can lead to reduced fuel consumption and so lower CO_2 emissions, but such engines tend to have higher NO_X emissions than their counterparts that burn more fuel. The rate of noise mitigation achieved in future engine types could thus be significantly affected by whether policy makers decide to prioritise reductions in aviation noise or aviation's CO_2 emissions.

Another challenge in assessing noise impacts on populations is that residents who are exposed to noise for the first time are particularly sensitive to it, unless they can see a direct benefit from the changes. Social and economic development in South Korea may lead to increasing sensitivity to noise such that noise levels considered acceptable now may not be so in the future. These considerations should be taken into account in ADPI assessments.

Noise assessments are also challenging in terms of communicating the results to local residents in terms of decibels. Moreover, all assessments usually rely on a set of indicative flightpaths, which may be changed in the future. Lack of understanding of complex noise metrics and uncertainty over the future flightpaths (and any promised noise envelopes) usually translates into fear about future property prices as well as quality of life and health. Determining the assessment or weight to attach to noise impact is as much a matter of perceptions as exposure.

Ecological impacts

In terms of ecological impacts, ADPI suggests an analysis of impacts on water quality, habitat loss (flora and fauna) and landscape. The expert workshop participants pointed out that CO_2 emissions (especially from surface access) need to be taken into account in the ecological impact assessment even if issues relating to carbon and climate change are not currently at the forefront of policy considerations.

In terms of impacts on landscape, ADPI suggested that the plans of the potential schemes should demonstrate how the new infrastructure could be integrated into the landscape by minimising the visual impact of the development on the landscape.

Costs (expenditures), risks and deliverability

Costs and risks should be separated into two different assessment categories. Risks should be separated into the following distinct, materially different, categories:

- hazards (belongs with safety)
- engineering risks and cost overruns
- demand risk, which requires scenario testing by separate passenger category, business/leisure.

The risk category "stakeholders" seems poorly formulated as the essential risk of opposition for any site selected is opposition from local governments in the locations not selected. Using "5 or more" as the threshold for risk versus no risk appears arbitrary in the extreme. The issue would be better addressed in a purely descriptive fashion and in an analysis of deliverability, perhaps accompanying a CBA. The risk of noise nuisance resulting in restrictions on night time operations could also be assessed if this is thought to be a significant factor.

As for the "decision making process" risk category, ADPI suggests using the number of major stakeholders as the indicator. This is taken to mean the three main municipal governments and the two regional governments only. This will not yield information beyond the easily appreciated PIMBY positions – determined by the administrative location of each site. This criterion could, however, yield useful insight if it was combined with the risk in relation to each site of keeping existing Gimhae airport open rather than consolidating flights at a single new site.

The criteria could also be extended to include the number and variety of different potential opposition NGOs and citizen groups in relation to socio-economic impacts, and the existence or otherwise of a specific legal basis for challenging a siting decision; for example, if legislation for protecting habitat or preserving air quality exists.

The full implications of noise nuisance are notoriously difficult to capture in a quantitative assessment of the noise footprint. The inequality of the relatively small number of people seriously affected by noise versus the large number of people that benefit from the presence of an airport can make noise impacts, noise mitigation measures and compensation for noise carry decisive weight. In the UK the Airports Commission has recommended a billion-pound package of investments in local communities to compensate for local environmental impacts, spending that goes far beyond noise insulation measures. At the same time the importance of noise nuisance can be over-estimated, and the decision to continue operations at Itami airport in the built up area of Osaka after opening of the new off-shore Kansai International airport may reflect that.

Delivering the outcomes intended from airport expansion will depend critically on the decisions of airlines. Their views should be sought on site selection.

Final remarks

However good the procedures adopted, airport decision making is seldom straightforward, as the case studies reveal.

In Lisbon a robust and transparent screening system was eventually developed, with a weighting system that attracted stakeholder support. It resulted in the location originally chosen for development of a large new airport being overturned in favour of a better site. Development was delayed by the economic crisis and the emerging front running option for expansion – retention of the current airport plus a small one-runway airport for low cost carriers – was not among the options screened.

In the Kansai region, an irreproachable system of screening sites and weighting criteria through a process of stakeholder voting resulted in an optimal decision for the technology of the day and construction of a new off-shore airport. However, changes in policy on the part of local governments in Osaka and Kobe resulted not just in operations at the existing airport being retained but construction of a second new airport at a site that failed the screening process.

In the UK, the Airports Commission undertook an exemplary and exhaustive screening and assessment process that appears to have arrived at an optimal choice. It clearly identifies Heathrow as

best suited to meeting the strategic objectives of expansion; it identifies Gatwick as a possible alternative site for expansion if local issues prevent Heathrow expansion, although with much less potential for delivering on the strategic objectives.

Suffice it to say that however good the site selection process followed in Youngnam there will be further hurdles to clear. It is therefore not productive to over-complicate the selection process. The emphasis should be on clarity and transparency. This calls for simplicity where possible and for a qualitative discussion of key trade-offs and impacts that affect important social policies to accompany publication of the quantitative results of screening. Effort should be directed at developing clear summary information and if a balance needs to be struck in meeting deadlines the emphasis should probably be here rather than on producing large volumes of exhaustive supporting analysis.

The other lesson is that screening should be undertaken for a reasonably complete range of feasible options. The option now pursued in Lisbon was among those promoted when screening was undertaken but not included for assessment as it didn't conform to the large new replacement airport concept that was the focus of the exercise. Had it been included construction might now already have been well advanced.

Notes

[1] https://data.oecd.org/unemp/unemployment-rate.htm

[2] http://www.ft.com/intl/cms/s/0/b00fff3c-1ff8-11e5-aa5a-398b2169cf79.html#axzz41vV6FLUQ

[3] http://www.backheathrow.org/

[4] NB – the traffic objectives of the 2011 study were different.

[5] See ACRP Report 85: http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_085.pdf.

[6] See Burghouwt G. (2007), *Airline Network Development in Europe and its Implications for Airport Planning*, Aldershot: Ashgate.

[7] https://www.gov.uk/guidance/transport-analysis-guidance-webtag

[8] Guidance for transport projects is provided on the Department of Transport's Webtag page: https://www.gov.uk/guidance/transport-analysis-guidance-webtag.

[9] See for example, Viegas J. and L. Martinez, *Urban Accessibility: perception, measurement and equitable provision*, ITF, forthcoming.

[10] It was noted that only additional jobs can be counted under the economic benefit criteria. Existing jobs belong in the cost category (of a cost-benefit analysis).

[11] Participants also noted that, in case the employment effects are important economically and politically, the best methodology to analyse these would be an extended CBA which would comprise the computable general equilibrium (CGE) effects.

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Chapter 3. Airport site selection criteria in the UK

Introduction

The focus of this chapter is the development of the UK Airports Commission's airport site selection criteria and the process that led the commission to its final recommendation. The commission ran a transparent process and published the details of its approach, methodology, and assessments on its website.[1] For that reason, the chapter will not go into the methodological and assessment details as these are widely available to the public. Instead, it will discuss how the commission developed and balanced a broad range of assessments in order to arrive at its final recommendation.

There were three distinct exercises undertaken in the commission's appraisal process: sifting 58 proposals against eight criteria that reduced the commission's list to four proposals, conducting four feasibility studies to enable the decision on whether to shortlist a new site in the inner Thames Estuary, and finally a detailed appraisal of the remaining three options against more refined appraisal criteria comprising 16 assessment modules and 29 objectives. Although the proposals assessed by the commission offered quite different solutions for dealing with the airport capacity problem in London and the south east, the commission succeeded in applying a consistent framework towards assessing the three shortlisted proposals and developing a robust process that enabled it to identify the most suitable airport expansion options.

This chapter discusses the commission's process to offer lessons that governments, policymakers and other interested parties can learn in terms of developing and applying a robust set of airport site selection criteria. In particular, the assessment process conducted for the proposals to build a new hub in the inner Thames Estuary sheds light on how to effectively conduct more challenging appraisal of new airport sites alongside capacity expansion options at existing sites.

The Airports Commission

There has been continuous debate over how to expand airport capacity in the south east of the UK for decades. The first independent commission that investigated potential sites for a new airport for London, the Roskill Commission, was set up in 1968 and reported three years later. It recommended Cublington, in Buckinghamshire, as the site of a new airport for London. One of the commissioners however recommended an alternative site at Foulness (later called Maplin Sands)[2] on environmental and planning grounds. The government decided to select Maplin Sands for the location of a new London hub airport, only to abandon it a few years later when a new government was voted in.

In 1978, an Aviation White Paper identified Heathrow's capacity as "restricted".[3] Expansion of Heathrow, the UK's only hub airport was recommended to successive governments, albeit in different expansion configurations, together with Manchester in 1997 or Stansted in 2003. Most recently, the Labour Government backed a recommendation to build a third runway at Heathrow in 2009, but that decision was overturned by the coalition Conservative and Liberal Democrat Government a year later.

In 2012, the Prime Minister established another independent commission to investigate UK airport capacity issues. The Airports Commission started its work in September 2012 and in July 2015 reported back to the Government with a unanimous recommendation to build a third runway at Heathrow.

The task given to the commission by the government was to "examine the scale and timing of any requirement for additional capacity to maintain the UK's position as Europe's most important aviation hub; and […] identify and evaluate how any need for additional capacity should be met in the short, medium and long term."[4]

The commission was asked to "maintain a UK-wide perspective, taking appropriate account of the national, regional and local implications of any proposals", and to engage openly with a range of stakeholders to build consensus in support of its approach and recommendations. [5] The government also set out a framework for the commission's work which was divided into two phases with clearly defined timeframes. The commission was asked by the government to report:

- no later than the end of 2013 on (1) its assessment of the evidence on the nature, scale and timing of the steps needed to maintain the UK's global hub status and (2) its recommendation(s) for immediate actions to improve the use of existing runway capacity in the next 5 years – consistent with credible long term options

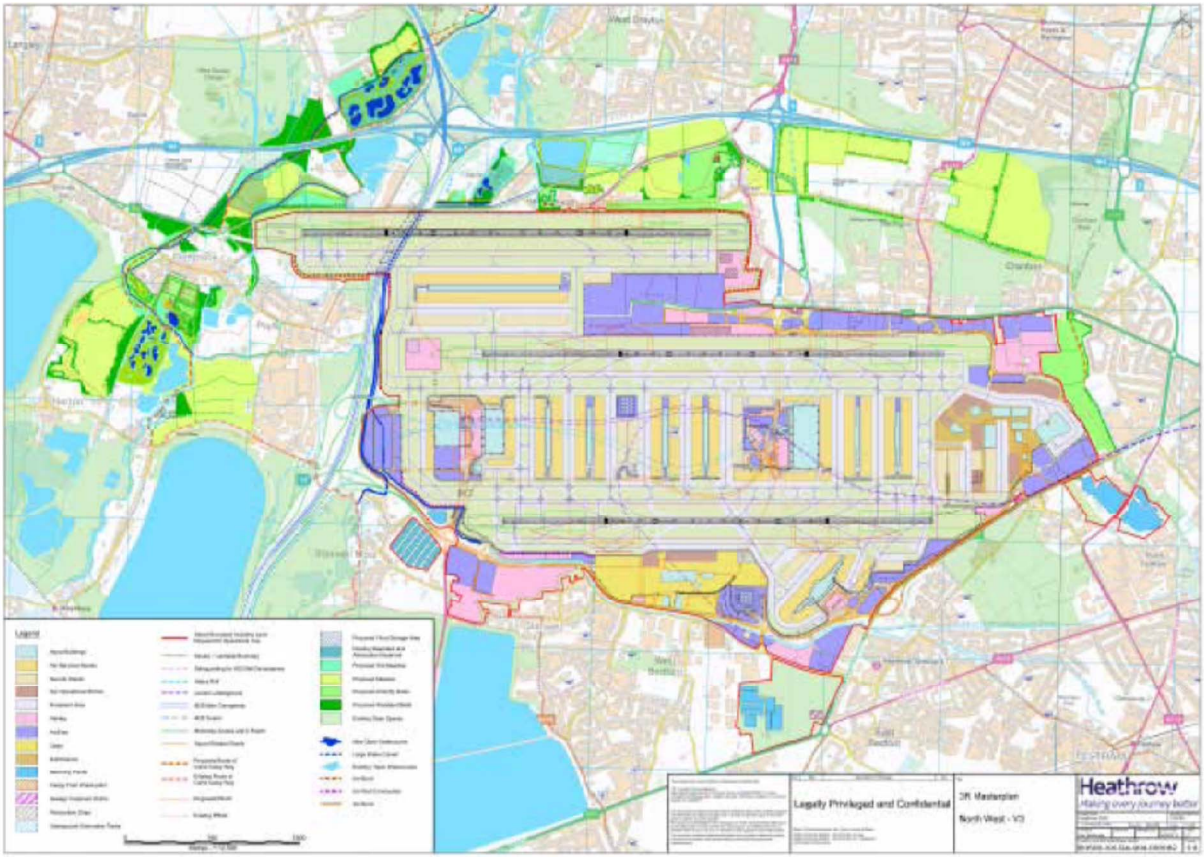
- no later than summer 2015 on (1) its assessment of the options for meeting the UK's international connectivity needs, including their economic, social and environmental impact, (2) its recommendation(s) for the optimum approach to meeting these needs and (3) its recommendation(s) for ensuring that the need is met as expeditiously as practicable within the required timescale.[6]

The Airports Commission's recommendation

At the end of 2013, the Airports Commission published an Interim Report[7] in which it concluded that there was a need for one net additional runway to be in operation in the southeast by 2030, and that there was likely to be a case for another runway to be built and operational by 2050. It also shortlisted three expansion options for detailed appraisal, two at Heathrow and one at Gatwick, and announced that it would conduct further studies of the Isle of Grain option to decide whether the option would be shortlisted. In September 2014, the commission announced its rejection of the Isle of Grain proposal for a new airport in the inner Thames Estuary.[8]

In July 2015 the commission published its unanimous recommendation to build a third runway at Heathrow to the northwest of the existing runways, the project promoted by Heathrow Airport Ltd (Figure 3.1).

Figure 3.1. **Heathrow Airport Northwest Runway masterplan**

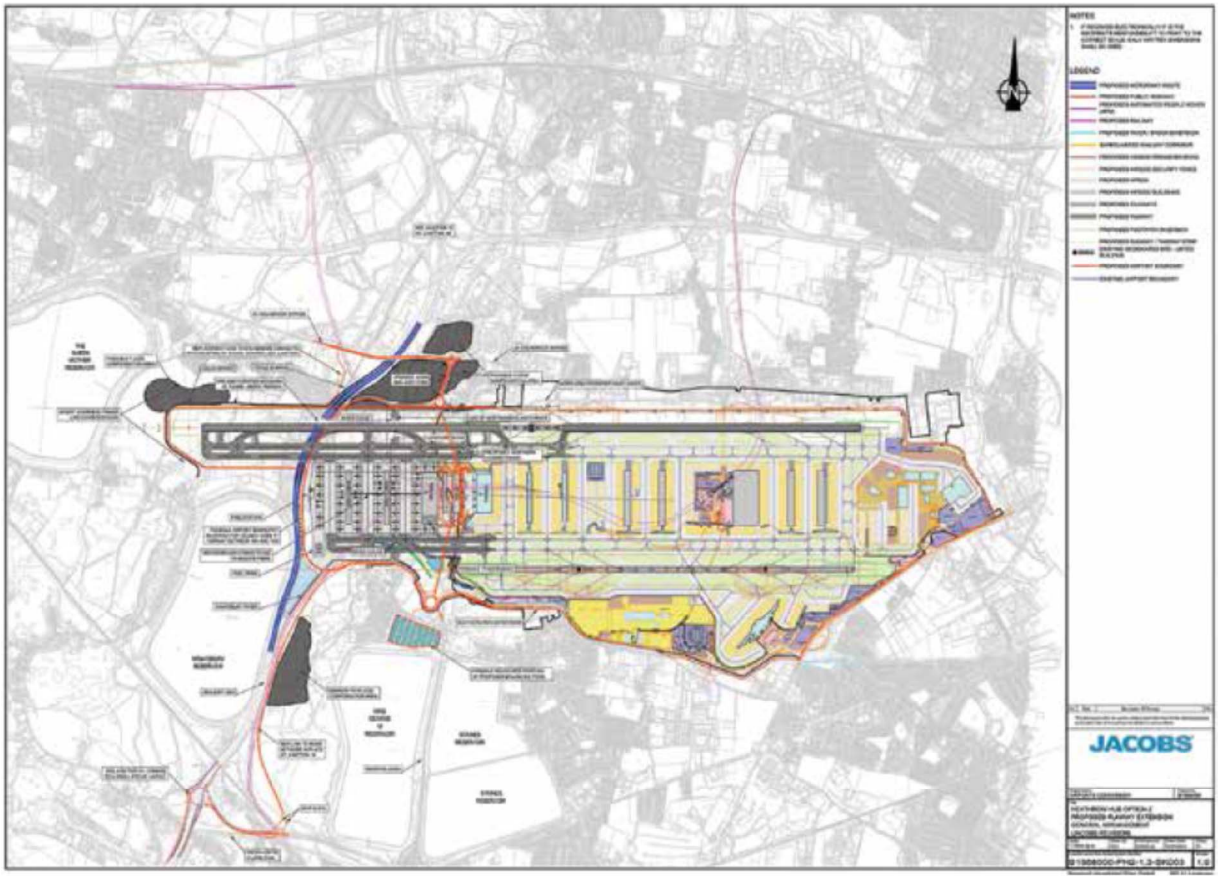


Source: Airports Commission, *Final Report*, p. 99.

The other Heathrow proposal, the so-called Heathrow Hub (Figure 3.2), while described by the commission as an "imaginative idea"[9], was considered less attractive than the Heathrow northwest runway option due to several factors:

- It could not offer respite that was expected by the communities around Heathrow.
- While having comparable noise impacts, it was capable of delivering 40 000 fewer air traffic movements than the northwest runway option.
- It would have significantly more adverse air quality impacts on local residents than the northwest runway proposal due to the proposal's configuration of roads.

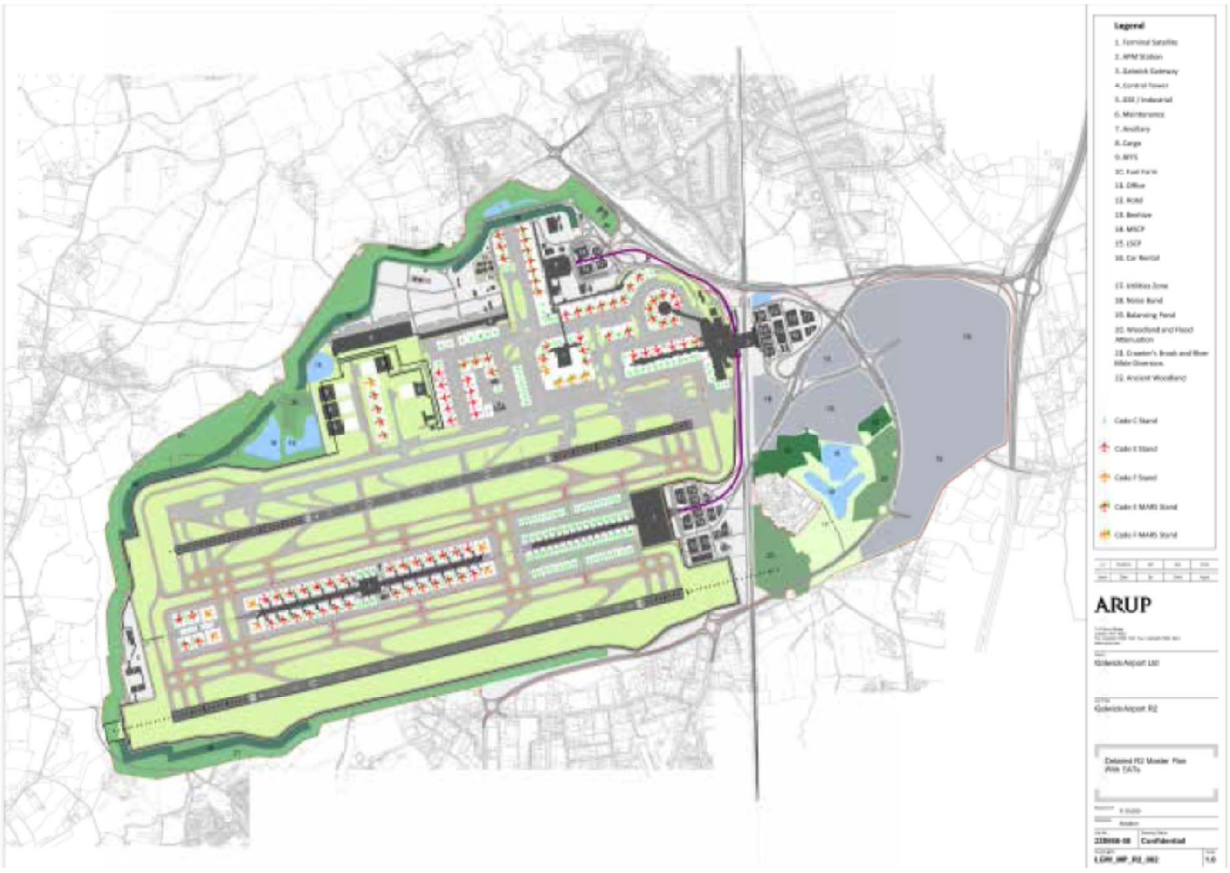
Figure 3.2. **Heathrow Airport Extended Northern Runway masterplan**



Source: Airports Commission, *Final Report,* p. 101.

Gatwick (see Figure 3.3) was considered by the commission "a plausible case for expansion"[10], which was well placed to cater for growth of European leisure travel. The commission however judged that capacity expansion of Gatwick was not likely to provide the UK with the type of connectivity that was most needed: long-haul flights to new destinations. This was one of the conclusions from the commission's scenario-based analysis of what kind of connectivity is likely to be delivered under different expansion options.

Figure 3.3. **Gatwick Airport Second Runway masterplan**



Source: Airports Commission, Final Report, p. 97.

Expansion of Heathrow, on the other hand, would be much more likely to provide such connectivity and would provide it more quickly.[11] Expanding Heathrow would unlock significant suppressed demand at the airport and, in turn, unlock the benefits of competition between carriers. The benefits of expanding Heathrow were estimated to be significantly greater for business passengers, freight operators and the UK's economy.

In December 2015 the government issued a statement accepting the Airports Commission's case for airport expansion in the Southeast and its shortlist options for expansion. It also confirmed that the commission has identified the most appropriate way of delivering planning consents for new capacity, through a National Policy Statement[12] following which a scheme promoter would need to apply for a Development Consent Order.[13]

The government however also decided to keep the door open for Gatwick at this stage in the process, motivating its decision with the need to conduct further assessments of the environmental impacts of all three shortlisted schemes, including air quality, noise and CO_2 emissions. In a statement published in December, the government committed itself to testing the Airports Commission's air quality analysis "using the latest projected future concentrations of nitrogen dioxide" and to developing the best possible package of measures to mitigate the impacts of airport expansion on local people and the environment. The government also acknowledged that the Airports Commission published a large amount of very detailed analysis on air quality and CO_2 emissions for the shortlisted schemes and that

further work will focus on mitigation measures. The government said it expected to conclude its work over the summer of 2016.[14] In January 2016, the Transport Secretary suggested that the decision may be further postponed until after the referendum on the EU membership which may imply further delays.[15]

The commission's process: A transparent, collaborative and scenario-based approach

The Airports Commission, comprising Sir Howard Davies as Chair and four commissioners[16], was asked by the Government to follow an approach that was open, transparent and collaborative.

A transparent process was essential for the credibility of the commission's work and subsequent recommendation. The commission held public evidence sessions, published discussion papers, and made public minutes from its meetings. Openness and transparency are guiding goals for all government departments in the UK[17]. It is seen to potentially save money; strengthen people's trust in government; and encourage public participation in decision making.[18]

Involving a wide range of stakeholders along the way further increased transparency and offered insights and perspectives that might have otherwise been missed. The commission had extensively engaged with a broad range of interested parties through formal consultations, and a programme of meetings and visits. A series of discussion papers on key topics invited a broad range of responses. As the outcome of the government's decision in the aftermath of the Roskill Commission demonstrated, a project that does not have the backing of important stakeholders is unlikely to succeed. One of the major problems of the government's decision to favour the Maplin Sands development was both that it was recommended by only one commissioner and lacked the support of any major stakeholders, in particular the airlines.[19]

The commission's engagement with the public through a consultation process, helped to significantly improve on the appraisal framework and the methodology behind the Commission's assessments. For example, the commission significantly updated its evidence base with respect to the strategic fit assessments. These updates were based on a number of technical reviews of the responses that the commission had received during the consultation:

Review of the commission's forecasts and scenarios

The commission received a number of responses that questioned their approach towards forecasting future demand for aviation in the UK. On the back of these responses, the commission asked a member of its Expert Advisory Panel, Professor Andreas Schafer, to review both the commission's and Gatwick's demand forecasts. The commission also asked the ITF and SEO Economic Research to respond to the technical queries and criticisms raised by the stakeholders on the subject of their demand forecasts and scenarios. Both reviews confirmed the robustness of the commission's approach.[20]

Review of the technical responses on airline competition

A number of technical reports estimating the benefits of competition from expanding capacity at Heathrow or Gatwick were submitted to the commission's consultation. The commission asked the ITF to scrutinise in detail these responses, in particular the estimates of competition benefits put forward to the Commission by Heathrow Airport Ltd and Gatwick Airport Ltd. Further work was also commissioned from SEO Economic Research with the ITF to produce additional estimates of the benefits of competition that each of the options may provide. This work confirmed that the Heathrow expansion options would deliver higher and more certain competition benefits than the Gatwick scheme.

Review of the responses on the impact of aero-charges on passenger demand and ticket prices

The commission asked the ITF to review the responses to the consultation that argued that higher aero-charges would have an adverse impact on passenger demand and ticket prices. The ITF scrutinised all the evidence submitted to the consultation and provided the commission with further evidence that, under all expansion options, not only would the aero-charges be very likely to be absorbed by the airlines, but also that a fall in ticket prices was plausible, particularly at Heathrow where scarcity rents are higher than at Gatwick.

Review of potential mechanisms to facilitate connectivity outcomes

The commission received numerous responses highlighting that in the future regional connectivity (i.e. connectivity between London and other UK cities) may not be adequately provided due to constraints at the busiest London airports. The commission carefully considered these arguments and consulted the Airport Coordination Ltd.,[21] its legal advisors and the ITF on the subject. A report was commissioned from the ITF to explore different ways in which long-haul or, particularly, regional connectivity could be safeguarded. The commission concluded that there is no viable legal basis – other than Public Service Obligations (PSOs) – upon which slots could be ring-fenced to protect or limit the operation of particular airlines or aircraft to an expanded airport. Based on this analysis, the commission recommended that the government allows the establishment of PSOs on routes between specific airports, and reviews its guidance in relation to these provisions. The commission also noted that structuring aero-charges in order to benefit regional services could also be an effective measure. Other measures, such as the use of local rules and the ring-fencing of slots through planning provisions, were not considered sufficiently credible, implementable or effective.

A scenario-based approach to assessing the case for airport expansion

In assessing future needs for airport infrastructure, the commission acknowledged that the future is uncertain and particularly so for the constantly evolving aviation sector. It pointed out that the UK Government's 2003 White Paper "The Future of Air Transport"[22] mentioned Dubai only once, in the context of Emirates commencing a new route from Glasgow International Airport, to illustrate that it has always been difficult to predict how the aviation sector will develop in 10 or 20 years' time.

The commission's ambition was to model an integrated process covering a range of economic, social and environmental factors that affect how much and what kind of airport capacity will be needed in the UK in the future. The commission developed an approach in which the assessments were tested against a set of five different scenarios to ensure that the final recommendation would be robust under different possible states of the world. Since demand for airport capacity is to a degree dependent on the location of that capacity, in the second phase of its work the commission assessed the impact of the shortlisted capacity expansion options on aviation demand in the London airport system.

A scenario-based, transparent and collaborative approach contributed significantly to making the recommendation of the commission robust and deliverable. While some stakeholders criticised not running parts of the commission's appraisal through all the scenarios or the methodological details of some of the appraisal modules, none of the interested parties criticised the commission's integrated, scenario-based approach.

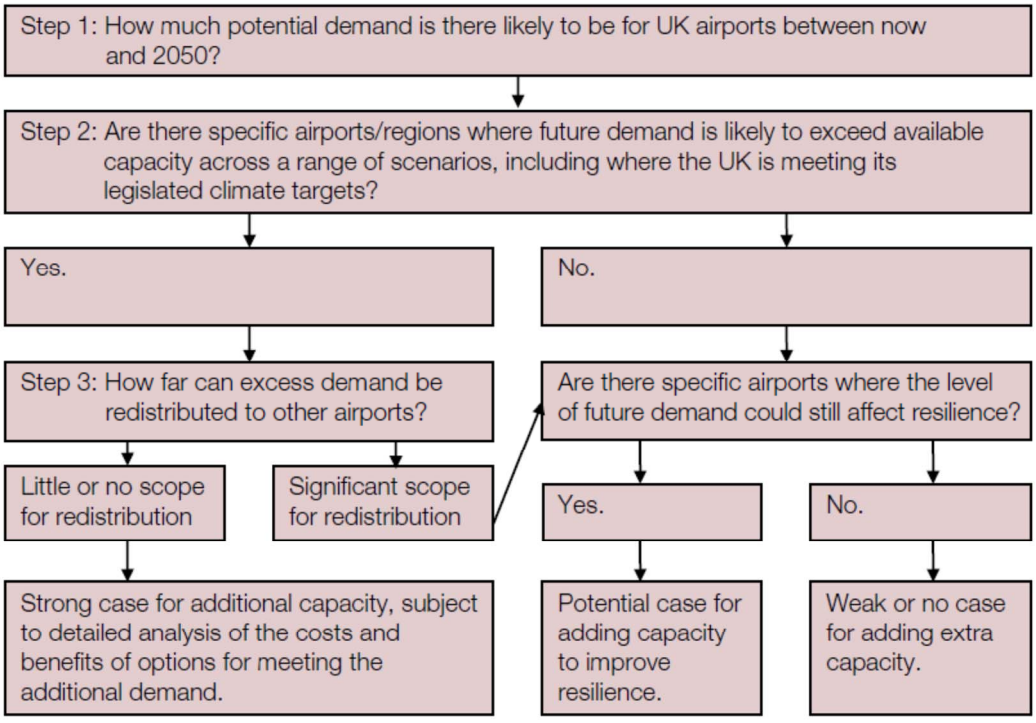
The case for airport expansion in London and the southeast

During the first phase of its work, parallel to sifting through different airport expansion proposals, the commission undertook an exercise to establish how much and what kind of aviation capacity the UK will need in the future. To estimate the scale and timing of capacity needed, the commission developed a

set of core forecasts for future aviation demand. It used these forecasts to identify regions where future demand is likely to exceed available capacity. Across all scenarios considered, including when the UK is meeting its climate change targets, the commission estimated significant growth of demand for aviation over the forecast period of 60 years (or up to 2050). This growth in demand was particularly strong at the already stressed airport infrastructure in London where the demand is forecast to be significantly in excess of the total available capacity.

Before concluding that additional capacity is needed, the commission considered the scope for redistributing demand within the existing airport capacity using a range of potential policy mechanisms, such as a variable rate of the Air Passenger Duty, changes to the slot allocation regime or the Traffic Distribution rules. The commission's process is illustrated below.

Figure 3.4. **The commission's airport capacity assessment framework**



Source: Airports Commission, *Interim Report*, p. 104.

The commission's analysis concluded that there was a little scope to redistribute the demand away from London and southeast airports without jeopardising the UK's connectivity and capacity. The commission therefore concluded that there was a case for at least one net additional runway in London and the Southeast by 2030, and most likely a case for a second additional runway by 2050 (see Airports Commission, 2015a).

The assessment of need criterion became the necessary (but not sufficient) condition that the recommended option would have to meet. This conclusion was consistent across all five of the commission's scenarios and took into account the Committee for Climate Change's advice that the target of constraining CO_2 emissions from UK aviation to 2005 levels by 2050 should remain the most appropriate basis for planning future aviation capacity by the commission.[23]

In terms of the nature of the capacity that was needed, the commission concluded that there was no binary choice between providing additional hub connectivity or additional point-to-point connectivity. The optimal approach according to the commission was to continue to invest in an airport system that would cater for a range of airline business models. This is particularly important in a competitive airports system, like London, where airlines can choose how to use the available capacity, and the market can be expected to respond dynamically to the provision of new infrastructure.[24]

The development of the Airports Commission's sift criteria

At the outset, the commission stated two principles that it followed in the process of developing proposals and sifting through the options: first, to ensure that all appropriate consideration is given to all plausible options and second to develop a rigorous framework for assessing options, consistent with European and national legal requirements.[25] Following these two principles was intended to ensure that the government could make a swift decision and would not have any compelling reasons to delay the decision.

At the beginning of its process, the commission invited interested parties to submit proposals for long-term aviation capacity options. They received 52 credible proposals. These were scrutinised by the commission, alongside proposals that they developed themselves in order to provide a complete suite of possible options for further analysis. The proposals were published on the commission's website and stakeholders were invited to submit their views and any relevant additional evidence.

The commission first excluded all the proposals that either presented fundamental challenges that could not be credibly overcome, were very similar in scope to more credible but better developed options, or were inconsistent with the commission's terms of reference. It then conducted a three-stage process of sifting through the 58 proposals remaining on the table.

The first sift reduced the number of options from 58 to 28 and grouped them into five categories to enable more meaningful comparison:

- Four proposals for alternatives to new runways: a broad range of options, including radial railways around London and "hub-and-spoke" models based from a single central London terminal that did not rely on building any new airport infrastructure.
- Five proposals for dispersed capacity: options that proposed expanding one or more of the following non-hub airports: Birmingham, Gatwick, Manchester, and Cardiff.
- Five proposals for Heathrow expansion: proposals of expanding capacity at Heathrow Airport.
- Nine proposals for a new hub airport: proposals for building a new hub airport, either in the Thames Estuary or west of the current Heathrow site, or in Oxfordshire.
- Five proposals for hubs at existing airports: options that proposed expanding one of the existing airports (Gatwick, Stansted or Luton) into a hub airport.

The second sift left only nine options on the table, the number of options was then reduced to four in the third sift. Out of these four options, three made it onto the commission's shortlist of potential answers to the problem of airport capacity constraints in London and the southeast: two at Heathrow and one at

Gatwick. These proposals were then further developed, jointly by the commission, its experts and the scheme promoters themselves, and analysed against the commission's appraisal framework.[26]

One of the most important guiding principles of the sifting process was to rely on comparison between different options that were similar in ways in which they could potentially fulfil the commission's terms of reference and then choosing the "dominant" option. For example, none of the Stansted airport options were shortlisted. A two-runway Stansted option was considered less attractive than a two-runway Gatwick: as Stansted was not forecast to reach capacity until approximately 2040, even with other London airports becoming constrained, there were risks around whether building an additional runway at Stansted would provide an effective solution to capacity constraints in the London airport system.[27] The commission's assessments demonstrated that these risks would not be outweighed by other wider costs and benefits of the scheme. In comparison to Gatwick, a second runway at Stansted was not significantly less expensive, Stansted's 40 and 60 minute catchment areas were projected to be significantly smaller, and it would require the loss of a higher number of listed buildings and a larger area of greenfield land. A five-runway hub at Stansted was considered less attractive than the proposals in the Thames Estuary; while it would be close to the cost of the Estuary sites, it would also be highly disruptive to airspace and would not present the same regeneration opportunities.[28]

The commission continued to develop and flesh out its airport site selection criteria throughout the process. It published three documents to guide the stakeholders through the methodology:

- February 2013 – "Guidance Document 01: Submitting evidence and proposals to the Airports Commission[29]
- May 2013 – "Guidance Document 02: Long Term Capacity Options: Sift Criteria"[30]
- April 2014 – "Airports Commission: Appraisal Framework".[31]

In February 2013, the Commission published six broad categories of factors which the scheme promoters should strive to consider in their proposals:

- economic factors
- social factors
- climate change impacts
- local environmental factors;
- accessibility
- feasibility considerations.

The commission also encouraged the stakeholders to explore the barriers to their proposals - e.g. technical barriers or barriers following from the UK or EU legislation - and consider possible means of overcoming them. The commission consulted on the details of these six categories and came up with a set of eight better defined sift criteria which were published in "Guidance Document 02*"* in May 2013 (see Table 3.1).

Table 3.1. **Airports Commission's long-term options sift criteria**

Strategic fit	• What is the nature, scale and timing of the aviation capacity and connectivity delivered by the proposal? How will the proposal support or enhance the UK's status as Europe's most important aviation hub? • Does the proposal support the government's wider objectives and legal requirements (for example, support of national and regional economic growth, re-balancing of the economy or alignment with national climate change commitments and global targets)?
Economy	• What are the potential national economic impacts of the proposal? • What are the likely impacts of the proposal on the regional/local economies surrounding a) the proposed site for new or enhance capacity and b) other airports affected by the proposal? • What is the likely impact of the proposal on the UK aviation industry? How will other airports be affected by the proposals and what will the impacts of this be for air passengers and other users, airlines and the wider economy?
Surface access	• What estimate has been made of the surface access requirements of the proposal in relation to existing and new infrastructure? • Does the proposal provide effective surface access for passengers, businesses and relevant freight traffic? o Will surface access plans provide the capacity needed for expected future demand? o How does the proposal impact upon local traffic and congestion? o What is the expected surface access split between public and private transport? • How will the proposal change journey times from major business and population centres for users of aviation services?
Environment	• What are the air quality implications of the proposal (including impacts du to aircraft, air side operation and local surface transport links)? Are these consistent with the legal frameworks for air quality? What mitigation plans are proposed? • What are the noise implications of the proposal? o How will the proposal alter current and predicted patterns of noise in the surrounding area? o What changes to noise profiles would be seen at other airports as a result of the proposal? o What measures are envisaged to limit or reduce the number of people affected by noise? • Does the proposal affect any designated sites (for example Sites of Scientific Interest or Special Protection Areas) and if so how any effects might be managed? • How might the proposal compare, in terms of its impact on greenhouse gas emissions, with alternative options for providing a similar amount of additional capacity? What are the proposal plans for continuous improvement and reduction of carbon emissions over time? • Are there other significant local environmental impacts which should be taken into account?
People	• How will the proposal impact upon the passenger experience (e.g. Choice, cost, accessibility, etc.)? • What are the likely social impacts of the proposal, including impacts around the propose location for new capacity and around any other airports which would be affected, for example on employment, housing and local communities, vulnerable groups, quality of life and health. • Are there other significant wider social impacts of the proposal which should be taken into account? • How does the proposer plan to engage with local communities in taking forward their plans?
Cost	• What is the estimated cost of the proposal, including surface access, land purchase, compensation and any other associated infrastructure? What are the associated cost

	assumptions and risks? • Is it likely that the cost can be met entirely by the private sector? o If not, what is the likely split between public and private sector funding and how has this been calculated? o How would the proposal be financed? o What are the associated assumptions and risks?
Operational viability	• Is the proposal consistent with relevant safety requirements? What operational, safety and/or resilience risks are associated with the proposal? What measures are proposed to mitigate these? • Is the proposal deliverable within relevant airspace constraints? What assumptions underpin this assessment?
Delivery	• What are the main delivery risks in the proposal?

Source: Based on Airport Commission, Final Report.

The sift criteria reflected the Commission's desire to take an integrated approach towards the assessments, taking into account the full spectrum of local, national and international issues relevant to airport expansion. They were also developed to be broadly compatible with:

- HM Treasury's Green Book for appraising infrastructure projects[32]
- the Department for Transport's appraisal guidance, called WebTAG[33]
- the Department for Environment, Food & Rural Affairs' (DEFRA's) proposed Sustainable Development Indicators[34]
- the UK's legal commitments in the Climate Change Act of 2008.[35]

To support its analysis of the proposals, the commission appointed a consortium of technical advisers led by two consulting firms and comprising different areas of expertise, including aviation planning and operations, transport economics, engineering, transport planning and environmental assessment, commercial analysis and acoustics. The commission was also supported by the Civil Aviation Authority (CAA) which regulates airports in the UK and NATS.[36] Finally, the commission also appointed an Expert Advisory Panel to ensure access to the very best scientific and technical expertise, and to provide challenge and quality assurance of its work. Not only did the commission's panel of experts ensure that the appraisal was based on the best available practices, but it also gave the commission credibility with external parties.

At the end of the three-stage sifting process, the commission was left with four proposals on the table, which were presented in the commission's Interim Report at the end of 2013:

- Heathrow Airport: Northwest Runway (Heathrow NW)
- Heathrow Airport: Extended Northern Runway (Heathrow ENR)
- Gatwick Airport: Second Runway (Gatwick SR)
- A new hub airport in the inner Thames Estuary

The Interim Report shortlisted three proposals for building new capacity at the existing sites, one at Gatwick and two at Heathrow, for more detailed appraisal. These proposals satisfied both the

commission's eight sift criteria and their assessment of need that was published alongside the shortlisted options in the Interim Report.

The option of a new airport in the inner Thames Estuary potentially offered attractive benefits as well, but it also posed significant challenges in terms of assessing whether it should join the commission's shortlist.

The commission's assessments of a new hub airport in the inner Thames Estuary

The inner Thames Estuary project entailed a completely new four-runway hub airport, the closure of Heathrow and required significant surface access infrastructure to be provided,[37] and posed significant challenges to the commission's process. Applying the commission's sift criteria to a new site was a significantly larger undertaking than assessing expansion at already existing sites. Had the commission waited for the assessments of the inner Thames Estuary and only then proceeded to the analysis of the shortlist, it most likely would not have been able to report the recommendations to the government in the summer of 2015, as set out in its terms of reference. Had it decided to run detailed sifts based on all eight criteria of the Estuary site; it probably would not have been able to report on time either.

The commission thus decided to take a pragmatic approach. Due to the complexity of assessing a new airport site, while further work began on assessing the short listed schemes, the commission decided to focus on four critical aspects of the inner Thames Estuary scheme. In January 2014, the commission announced it would conduct the following four feasibility studies into the inner Thames Estuary scheme. The four studies were outlined as follows:[38]

- **Study 1: Environmental impacts** – assessment of the impacts on the Natura 2000 sites,[39] coastal system, habitats and species affected as well as historical and archaeological sites, in constructing and operating a new airport and identifying whether the legal tests could be met.

- **Study 2: Operational feasibility and attitudes to moving to a new airport** – assessment of key potential operational issues and potential mitigation, including meteorological and wildlife impacts, the SS Montgomery and relocating energy facilities; assessing airline, airport, business and industry attitudes to the decision to move operations to a new hub airport, and to then moving operations.

- **Study 3: Socio-economic impacts** – assessment of the local, sub-national and national economic and social benefits and impacts of building a new hub airport in the inner Thames Estuary, closing down Heathrow and London City airports, and redeveloping the Heathrow site.

- **Study 4: Surface access** – assessment of the operational, cost and environmental impacts of any surface transport proposals required to support a new hub airport, as well as impacts on existing and planned local and strategic transport infrastructure.

At the same time the commission launched a call for evidence inviting all interested parties to submit evidence in relation to the four study areas. The responses received were considered by the commission as it developed the studies. After reviewing the consultation material, the Commission recognised that it could have provided more detail in some areas covered by the four feasibility studies. However, it concluded that sufficient analysis had been provided to make an informed decision on whether the inner Estuary option should be shortlisted.

A number of proposals for a new hub airport at either Grain or Cliffe on the Hoo Peninsula were reviewed, including the schemes submitted by the Mayor of London and Foster + Partners.

The four completed studies were published for consultation in July 2014. At this point, the commission again sought feedback on whether there was any information in its studies which was inaccurate and whether there was any additional or new information that they should consider before making a recommendation.

In September 2014, the commission published its conclusion and a summary of its decision with reference to the phase-one sift criteria i.e. the same criteria that were applied to other sites that made it onto the commission's shortlist.[40] On balance, it decided not to shortlist the inner Thames Estuary as its disadvantages had "collectively outweighed its potential benefits".[41] Cumulative obstacles to delivery, including high costs and uncertainties in relation to its economic and strategic benefits, prevented it from being a credible option for shortlisting.

A new airport in the inner Thames Estuary would be able to provide an increase of capacity in line with the commission's assessment of need for one net additional runway to be added to the London airport system by 2030. The commission however identified significant challenges to the timely provision of new capacity. These included the schemes adverse impacts on protected habitats and the resulting provision of new habitat required to compensate for the scheme's environmental impacts and the challenges related to relocating aviation and other related services from Heathrow to the new site. There were also reservations as to whether a new airport could coexist with the nearby Liquid Natural Gas storage facility and whether the surface access improvements package that would be required could be delivered in a timely manner. A new airport would also create significant airspace and birdstrike management challenges. There was also considerable uncertainty related to whether concentrating a lot of capacity in a single location would reduce the London airports system's resilience and flexibility.

The costs of building the airport would be very high, rising to more than GBP 120 billion to deliver a four-runway airport with the required surface access infrastructure, with potentially very high cost to the taxpayer. The location of the airport would also be more inconvenient for travellers, with the average rail journey times for passengers rising by 26 per cent in comparison to Heathrow. Finally, a hub airport in the inner Thames Estuary was supported by few stakeholders outside the direct advocacy groups supporting the schemes. Importantly, no major airline stakeholders supported a new airport in the inner Thames Estuary. As all costs of building new capacity have to be met by passengers and/or taxpayers, the attitude of airlines towards building a new hub airport only increased uncertainty regarding the financing viability of the scheme.

The commission's appraisal framework to assess the shortlisted airport sites

The insights from the scenario-based predictions were used in the formulation of the appraisal framework, which itself was used to determine which of the remaining options should be recommended. While the appraisal framework was based upon HM Treasury's Green Book and the Department for Transport's WebTAG, it also incorporated some new approaches towards considering the national and local economic impacts, competition impacts, and noise.

The Commission also considered how to best align the appraisal framework and its assessments with any future steps that the government would have to take if it decided to endorse the recommendations. For instance, to help the government proceed to swift implementation of the commission's recommendation, the commission developed its criteria taking into account the requirements for a National Policy Statement (NPS).[42]

As the appraisal framework was not available when the proposals were first submitted, a collaborative process between the scheme promoters and the commission was required. Based on the appraisal framework published in April 2014, and dialogue with the commission, scheme promoters could further develop their proposals to meet the criteria set out. As the three shortlisted options were quite different, it was challenging to provide the same information and apply the same criteria to the different schemes.

Commission's objectives

In its appraisal framework the commission defined a set of objectives against which the three shortlisted schemes would be assessed. These were based on the eight sift criteria that the commission applied to all the schemes in the first phase of its work, and they represented an evolution of the commission's thinking in terms of its ambitions as to what the proposals could potentially achieve and how their key adverse impacts could be mitigated (see Table 3.2).

Table 3.2. **Commission's objectives for airport proposals**

Phase 1 sift criteria categories	Phase 2 objective	Phase 2 appraisal module
Strategic fit	To provide additional capacity that facilitates connectivity in line with the assessment of need.	Strategic fit
	To improve the experience of passengers and other users of aviation.	
	To maximise the benefits of competition to aviation users and the broader economy.	
	To maximize benefits in line with relevant long-term strategies for economic and spatial development.	
Economy	To maximise economic benefits and support the competitiveness of the UK economy	Economy impacts
	To promote employment and economic growth in the local area and surrounding region.	Local economy impacts
	To produce positive outcomes for local communities and the local economy form any surface access that may be require to support the proposal.	
Surface access	To maximise the number of passengers and workforce accessing the airport via sustainable modes of transport.	Surface area
	To accommodate the needs of other users of transport networks, such as commuters, intercity travellers and freight.	
	To enable access to the airport from a wide catchment area.	
Environment	To minimise and where possible reduce noise impacts.	Noise
	To improve air quality consistent with EU standards and local planning policy requirements.	Air quality
	To protect and maintain natural habitats and biodiversity.	Biodiversity
	To minimise carbon emissions in airport construction and operation.	Carbon
	To protect the quality of surface and ground waters, use water resources efficiently and minimise flood risk.	Water and flood risk

	To minimise impacts of existing landscape character and heritage assets.	Place
	To identify and mitigate any other significant environmental impacts	To be defined
People	To maintain and where possible improve the quality of life for local residents and the wider population.	Quality of life
	To manage and reduce the effects of housing loss on local communities.	Community
	To reduce or avoid disproportionate impacts on any social group.	
Cost	To make efficient use of public funds, where they are required, and ensure that the benefits of schemes clearly outweigh the costs, taking account of social, environmental and economic costs and benefits.	To be assessed in the business case
Delivery	To be affordable and financeable, including any public expenditure that may be required and taking account of the needs of airport users.	Cost and commercial viability
	To have the equivalent overall capacity of one new runway operational by 2030.	Delivery
	To actively engage local groups in scheme progression, design and management.	
Operational	To enhance individual airport and airports system resilience.	Operational risk
	To ensure individual airport and airports system efficiency.	Operational efficiency
	To build flexibility into scheme designs.	
	To meet present industry safety and security standards.	
	To maintain and where possible enhance current safety performance with a view to future changes and potential improvements in standards.	

Source: Based on Airports Commission, Appraisal Framework.

The commission's appraisal framework comprised 16 appraisal modules, each of which corresponded to the objectives set by the commission. The scheme promoters were invited to present their updated scheme designs in terms of five different elements:

- a strategic argument outlining how the proposal can address the UK's future capacity and connectivity needs, and how it may support the local socio-economic development as well as regional and national development
- an airport master plan that would provide details of the airfield design and its planned modes of operation, including planned airspace requirements
- an engineering plan comprising information on costs, energy and utilities' requirements, geo-environmental issues and surface development plans
- a mitigation strategy comprising plans to limit detrimental consequences of airport expansion and strengthen positive impacts on local communities and the environment

- development strategies detailing how the additional capacity would be funded and the project-managed to delivery.

The scheme promoters were also invited to submit details of their proposed surface access strategies, but not any updated designs in this regard. This was because the commission deemed the Department for Transport, the Highways Agency and Network Rail better positioned to develop the schemes in this regard.

The appraisal framework set out a matrix summarising the relationship between the suggested objectives, the suggested elements of the updated scheme designs and the appraisal modules (see Figure 3.5).

Figure 3.5. **Relationship between the commission's objectives, elements of updated scheme designs and the appraisal modules**

Phase 1 Sift Criteria Categories	Phase 2 Objectives	Updated scheme design element						Assessment Modules
		Strategic Argument	Airport Master Plan	Engineering Plans	Mitigation Strategies	Development Strategies	Surface Access Strategies	
Strategic Fit	To provide additional capacity that facilitates connectivity in line with the assessment of need.	■	■					Strategic Fit
	To improve the experience of passengers and other users of aviation.	■	■				■	
	To maximise the benefits of competition to aviation users and the broader economy.	■						
	To maximise benefits in line with relevant long term strategies for economic and spatial development.	■	■				■	
Economy	To maximise economic benefits and support the competitiveness of the UK economy.	■					■	Economy Impacts
	To promote employment and economic growth in the local area and surrounding region.	■		■		■	■	Local Economy Impacts
	To produce positive outcomes for local communities and the local economy from any surface access that may be required to support the proposal	■	■			■	■	
Surface Access	To maximise number of passengers and workforce accessing the airport via sustainable modes of transport.	■			■		■	Surface Access
	To accommodate needs of other users of transport networks, such as commuters, intercity travellers and freight.	■			■		■	
	To enable access to the airport from a wide catchment area.	■					■	
Environment	To minimise and where possible reduce noise impacts.		■		■		■	Noise
	To improve air quality consistent with EU standards and local planning policy requirements.		■		■		■	Air Quality
	To protect and maintain natural habitats and biodiversity.			■	■		■	Biodiversity
	To minimise carbon emissions in airport construction and operation.		■	■	■		■	Carbon
	To protect the quality of surface and ground waters, use water resources efficiently and minimise flood risk.			■	■		■	Water and Flood Risk
	To minimise impacts on existing landscape character and heritage assets.		■	■	■		■	Place
	To identify and mitigate any other significant environmental impacts.							To be defined
People	To maintain and where possible improve the quality of life for local residents and the wider population.		■	■	■			Quality of Life
	To manage and reduce the effects of housing loss on local communities.		■	■	■		■	Community
	To reduce or avoid disproportionate impacts on any social group.				■			
Cost	To make efficient use of public funds, where they are required, and ensure that the benefits of schemes clearly outweigh the costs, taking account of social, environmental and economic costs and benefits.					■	■	To be assessed in the business case
Delivery	To be affordable and financeable, including any public expenditure that may be required and taking account of the needs of airport users.			■		■	■	Cost and Commercial Viability
	To have the equivalent overall capacity of one new runway operational by 2030.			■		■		Delivery
	To actively engage local groups in scheme progression, design and management.				■	■		
Operational Viability	To enhance individual airport and airports system resilience.		■					Operational Risk
	To ensure individual airport and airports system efficiency.		■					Operational Efficiency
	To build flexibility into scheme designs.		■	■				
	To meet present industry safety and security standards.		■	■				
	To maintain and where possible enhance current safety performance with a view to future changes and potential improvements in standards.		■	■				

Source: Airports Commission, 2015.

Each of the appraisal framework modules set out the technical approaches to be used to assess the schemes against the objectives. As with the sift criteria, the commission was guided by the members of its Expert Advisory Panel. It also appointed an advisory body, a Sustainability Reference Group which comprised relevant government departments, the Environmental Agency, Natural England, and English Heritage. The commission then used the outputs of its appraisals to compile a Business Case and a Sustainability Assessment for each proposal.[43]

Business Case

The Business Case was a document that provided the commission with an integrated assessment of the overall case for a proposal - taking into account all relevant factors. The three proposals were

assessed against a consistent "do minimum" case which made specific assumptions on the future of the UK aviation sector without airport expansion, but taking into account other developments (such as construction of HS2[44]).

The Business Case comprised the following elements:

- Strategic Case – assessing the proposal's alignment with the assessment of need set out in the commission's Interim Report, and providing an overview of its wider impacts, both positive and negative.

- Economic Case – assessing the value for money of the proposal, taking into account the full range of potential costs and benefits (including non-monetised as well as monetised impacts).

- Financial and Commercial Case – assessing the overall cost and sources of funding for the scheme and the risks around commercial deliverability, including discussion of the options for public sector contribution.

- Management Case – assessing the potential benefits realisation, risk management, contingency plans and structures that would enable robust management of delivery following the Commission's Final Report.

Should the government want to adopt the commission's recommendation, it will be able to use the commission's Business Case as a basis for the National Policy Statement.

Sustainability assessment

The sustainability assessment also gauged each scheme's performance against a baseline. The main aim of producing sustainability assessments for the shortlisted options was to provide the commission with information in respect to the scheme's performance against a range of environmental indicators. Should the government want to adopt the commission's recommendation, the sustainability assessment should provide a useful foundation for the production of the appraisal of sustainability. Although the commission's sustainability assessment was not intended to assess the total scheme's impacts, it provides useful insights into the cumulative impacts of each of the schemes, in line with the principles of the EU Strategic Environmental Assessment Directive.

As there was a large degree of overlap between the assessments included in the Business Case and the sustainability assessment, there is a question as to why the commission decided to compile both documents. The reason behind choosing these two formats was to facilitate comparison across options and to make it easier for the government to, if appropriate, adopt the recommendation. The Business Case and the Sustainability Assessment had very distinct roles to play in the commission's decision-making process. Typically, the two assessments would require collection of very similar or identical data, but it would be used in different ways.

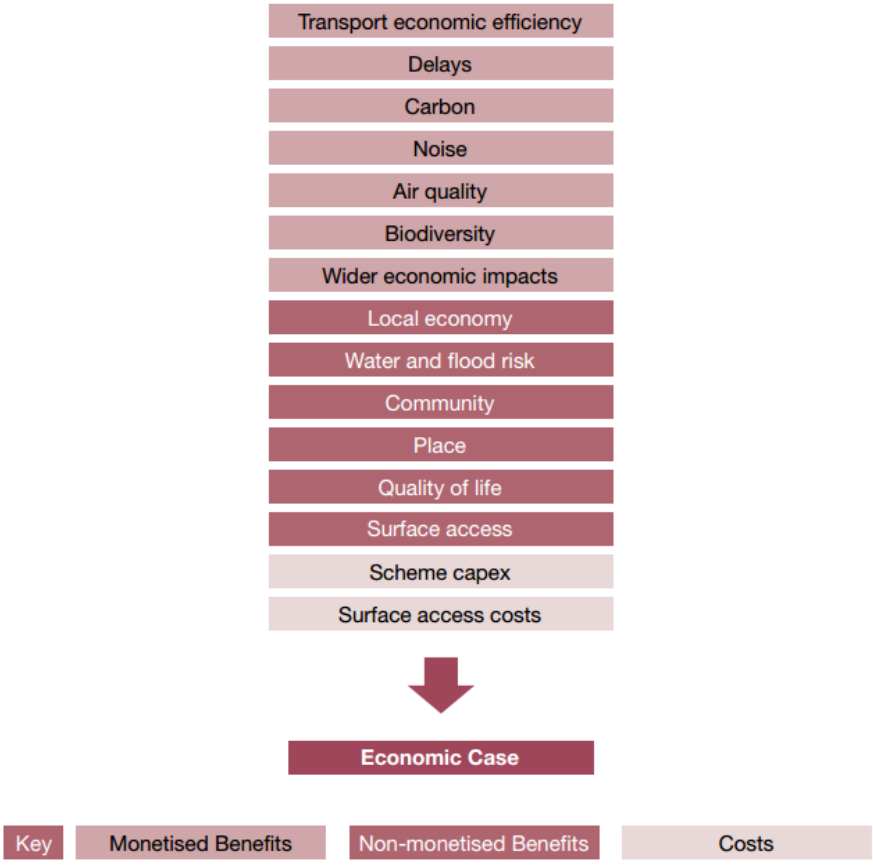
By being comprehensive and consulting on each of the stages of the process, the commission ensured that all evidence needed to make the decision on the shortlist was available to the commissioners. That helped immunise the commission from any potential judicial review.

The commission's recommendation: How did the commission balance its assessments?

The commission stated very clearly in its appraisal framework that it would not apply weights to the appraisal modules, but that it would rather consider them "on balance". A consideration of 16 different modules comprising 29 different objectives is by no means a straightforward exercise. Deciding between Heathrow and Gatwick, two very different proposals, adds to the complexity, as, at least at first glance, where one performs well, the other encounters significant challenges, and vice versa.

To reach its recommendation the commission considered the results of all 16 assessment modules and compared the three shortlisted schemes. The commission did not use a particular formula for accounting costs and benefits of expansion; neither did it apply any "weights" to its assessment modules. In fact, that would be impossible to achieve in an assessment of which many components cannot easily be monetised (as depicted in Figure 3.6 that outlines the components of the economic appraisal framework). Applying weights to such a complex policy problem where a lot of refined expert judgment is needed would have been an unmanageable task. Instead, the commission ranked the proposals against one another on each of the objectives that it had developed and then compared them on balance.

Figure 3.6. **Economic appraisal framework**



Source: Airports Commission, Business Case and Sustainability Assessment, p. 52.

The commission concluded that, while all the three schemes shortlisted for detailed consideration were credible options for expansion and capable of improving the UK's connectivity, building a third

runway at Heathrow was most likely to help maintain the UK's position as Europe's most important aviation hub (see Box 3.1).

Box 3.1. **Fulfilling the commission's terms of reference: Strategic fit assessments**

The first objective of the strategic fit assessment in the appraisal framework, "to provide additional capacity that facilitates connectivity in line with the assessment of need", is the objective that most directly relates to the commission's terms of reference: to "examine the scale and timing of any requirement for additional capacity to maintain the UK's position as Europe's most important aviation hub".

The Commission's assessment of need from the Interim Report concluded that London and the south east of England will need a capacity increase equivalent to one net additional runway by 2030. The Commission also identified that the best approach to maintaining the UK's status as Europe's most important aviation hub would be through investing in an airport system that is "flexible and adaptable, catering effectively for a range of airline business models".

In the Interim Report the Commission identified significant capacity constraints in the London airport system, and shortlisted expansion options and Heathrow and Gatwick to look into alleviating these constraints. The Commission also identified that the most significant constraint in the UK route network is a lack of the necessary capacity to promote hub connectivity, in which origin and destination passengers would be supplemented by transfer traffic to support the establishment of new routes. Airport capacity promoting hub traffic is particularly important for developing a wide route network of long-haul connections, where transfer passengers and freight can be the crucial factor in making a link viable.

After the publication of the *Interim Report*, the Commission undertook a programme of work to establish how the proposals to expand Heathrow or Gatwick could facilitate growth of hub connectivity and enhance UK's long-haul connectivity. The Commission thus asked external experts from the International Transport Forum at the OECD and SEO Economic Research to investigate how airlines may decide to take up new capacity at Heathrow and at Gatwick in terms of potential connectivity and competition outcomes.

In their work, the ITF and SEO followed the principles of the Commission's assessment i.e. a range of possible outcomes was investigated for a range of the Commission's scenarios and for a range of potential future airline business models. These scenarios ranged from business-as-usual assumptions for the route network to investigating futures in which new trends, for example connectivity supplied by low-cost long-haul carriers, dominate the markets. Expanding Heathrow would strengthen its hub status; it would also enable airlines operating from Heathrow to compete more effectively for transfer passengers with other European and international hubs. While the Commission clearly stated that attracting transfer passengers should not be a goal in its own right, it concluded that attracting transfer passengers is often a decisive factor in determining the viability of long-haul connections. Moreover, the competition assessment showed significantly higher positive impacts on competition from expanding Heathrow, due to the evidence of significant scarcity rents at the airport today. Expansion would facilitate competition, which would most likely translate into lower fares at the airport.

For Gatwick, the Commission's assessment concluded that to deliver connectivity benefits closer in scale to those from Heathrow, substantial changes would be needed, such as an airline alliance moving to the airport or low-cost carriers creating wide long-haul route networks. While none of these are impossible, they are not very likely either, and the Commission gauged it imprudent to base its recommendation on very uncertain developments, particularly as all three airline alliances wrote letters to the Commission informing it that they would not have any intention to move to an expanded Gatwick, providing evidence to back these statements. Finally, even if these developments were to materialise, there was no reason to presume that an expanded Heathrow would not benefit from these trends, and most likely to a higher degree than Gatwick due to higher benefits of competition.

For more information see: https://www.gov.uk/government/publications/additional-airport-capacity-strategic-fit-analysis

The commission judged that the proposal for a third runway at Heathrow, in combination with a package of measures (see Box 3.2) to address its very significant environmental impacts in terms of noise, air quality and other impacts on local communities, presented the strongest case.[45]

Box 3.2. **Community package recommended by the Airports Commission**

A Balanced Approach to Expansion (from the Final Reports by the Airports Commission):

"Expanding Heathrow provides a unique opportunity to change the way the airport operates. The additional income generated as a result of operating a third runway should be allocated in a new way, and the airport should be obliged to develop a better and more collaborative relationship with its local communities, as some overseas airports have done.

The Commission therefore recommends that a number of measures should be taken forward, in parallel with the approval, construction and operation of any new capacity at Heathrow, to address its impacts on the local environment and communities:

- Following construction of a third runway at the airport there should be a ban on all scheduled night flights in the period 11:30pm to 6:00am. This is only possible with expansion.
- A clear 'noise envelope' should be agreed and Heathrow Airport must be legally bound to stay within these limits. This could include stipulating no overall increase above current levels.
- A third runway should allow periods of predictable respite to be more reliably maintained.
- Heathrow Airport Ltd should compensate those who would lose their homes at full market value plus an additional 25% and reasonable costs. It should make this offer available as soon as possible.
- Heathrow Airport Ltd should be held to its commitment to spend more than GBP 1 billion on community compensation. In addition, a new aviation noise charge or levy should be introduced to insure that airport users pay more to compensate local communities. Taken together these would fund enhanced noise insulation and other schemes. Support for schools should be included as a priority.
- A Community Engagement Board should be established under an independent Chair, with real influence over spending on compensation and community support and over the airport's operations.
- An independent aviation noise authority should be established with a statutory right to be consulted on flight paths and other operating procedures.
- Training opportunities and apprenticeships for local people should be provided so that nearby communities benefit from jobs generated by the new infrastructure.
- A major shift in mode-share for those working at and arriving at the airport should be incentivised, through measures including new rail investments and a continuing focus on employee behaviour change. A congestion or access charge for motor vehicles should also be considered.
- Additional operations at an expanded Heathrow must be contingent on acceptable performance on air quality. New capacity should only be released when it is clear that air quality at sites around the airport will not delay compliance with EU limits.
- A fourth runway should be firmly ruled out. The government should make a commitment in Parliament not to expand the airport further. There is no sound operational or environmental case for a four runway Heathrow."

Source: Airports Commission, Final Report, pp. 10-11.

The commission did take full account of the greater environmental impacts of expansion of Heathrow versus expansion of Gatwick, but judged that a third runway at Heathrow together with a package of mitigation and compensation measures to the communities was a more attractive option.

The commission applied the same kind of balanced approach to assess the differences between the two expansion options at Heathrow. They judged that the proposal for a third runway at Heathrow presented a stronger case to meet the UK's aviation capacity and connectivity needs than the Heathrow Hub proposal of an extended runway. The Heathrow Hub proposal was assessed to be cheaper to build than the third runway at Heathrow (its estimated costs were roughly GBP 3 billion lower) and some of the impacts of building the Hub proposal would be significantly lower as well (e.g. only 242 homes would have to be abolished, in comparison to 783 homes for the third runway option). However, the commission did not judge that these advantages would offset a number of other assessment areas where Heathrow Hub had performed worse than the third runway proposal, including:

- The Hub proposal would continue to concentrate take-offs and landings along two approach and departure paths. Unlike the third runway proposal, the Heathrow Hub proposal would not be able to retain all-day runway alteration. While the level of respite would reduce from current levels with the third runway, it would be more reliable than with two runways.
- The Hub proposal was estimated to deliver 40 000 fewer air traffic movements a year compared to the third runway proposal. This would in turn lead to reduced wider economic benefits, a smaller route network at the airport, and a less significant impact on long-haul connectivity at the national level. Greater capacity of the third runway option would also provide more resilience to manage any potential airspace disruptions, hence improving the predictability of noise patterns for local communities. The third runway proposal would also have space for building on-site freight capacity.
- The Heathrow Hub proposal presented greater challenges than the third runway proposal in terms of compliance with the EU Air Quality Directive.

Concluding remarks

The Airports Commission's airport site selection criteria were developed in order to reflect the principles of a transparent and collaborative process. Collaboration with stakeholders enabled the commission to improve its methodology and develop the shortlisted proposals to higher standards than what would otherwise be possible. The involvement of the stakeholders exposed the commission to different perspectives and new ideas on how assessments could be handled in a pragmatic way.

One important difference from the previous inquiries was that the commission decided to test its assessments against a range of possible futures, in order to assess the robustness of the shortlisted options. This improvement to the process was welcomed by the stakeholders and the government. On the other hand, a scenario-based approach created new challenges in terms of communicating the complexity of the commission's material to the public. A snappy standalone summary of the 342 page long *Final Report* could have made the efforts of communicating the recommendations more productive.

Another advantage of the commission's process was that the assessment of need for future capacity was run as a separate work stream and the commission published its conclusion with respect to this as a separate recommendation. That enabled the commission to focus its process on finding a recommendation that would fulfil the goals included in their terms of reference.

When deciding on its recommendation, the commission did not use a specific formula for comparing the costs and the benefits of different proposals, nor did it weigh different airport site selection criteria. Instead, the commission used expert judgment and considered all the assessments on balance. While there are challenges related to such an approach, particularly with communicating the conclusions to the

public, there does not seem to be a better approach which balances complex impacts, many of which cannot readily be quantified in a comparable way.

Notes

[1] https://www.gov.uk/government/publications?departments%5B%5D=airports-commission

[2] Maplin Sands was recommended by one of the members of the commission who wrote a minority report favouring Foulness over the Cublington site.

[3] http://webarchive.nationalarchives.gov.uk/20050301193958/http://dft.gov.uk/stellent/groups/dft_aviation/documents/divisionhomepage/029650.hcsp

[4] https://www.gov.uk/government/news/airports-commission-membership

[5] Ibidem

[6] https://www.gov.uk/government/organisations/airports-commission/about/terms-of-reference

[7] See Airports Commission (2013c)

[8] See Airports Commission (2014b)

[9] See Howard Davies' foreword to the *Final Report* (Airports Commission, 2015a).

[10] Ibidem

[11] http://www.itf-oecd.org/expanding-airport-capacity-competition-connectivity-and-welfare

[12] For more details, see: http://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/national-policy-statements/

[13] "Government confirms support for airport expansion in the south-east", Government statement on airport expansion in the south-east, https://www.gov.uk/government/news/government-confirms-support-for-airport-expansion-in-the-south-east

[14] https://www.gov.uk/government/news/government-confirms-support-for-airport-expansion-in-the-south-east

[15] http://www.airportwatch.org.uk/2016/01/patrick-mcloughlin-hints-that-eu-referendum-could-delay-runway-decision-even-beyond-this-summer/

[16] Sir John Armitt, Professor Ricky Burdett, Ms Vivienne Cox, Professor Dame Julia King, and Mr Geoff Muirhead (who stepped down from the Commission in September 2013) were appointed as the Commissioners of the Airports Commission. More information available at: https://www.gov.uk/government/organisations/airports-commission/about/terms-of-reference.

[17] https://www.gov.uk/government/news/letter-to-government-departments-on-opening-up-data

[18] https://www.gov.uk/government/topics/government-efficiency-transparency-and-accountability

[19] Needham (2014).

[20] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/439173/strategic-fit-review-of-airports-commissions-forecasts-and-scenarios.pdf

[21] http://www.acl-uk.org/default.aspx?id=1

[22] http://webarchive.nationalarchives.gov.uk/20050301193958/http://dft.gov.uk/stellent/groups/dft_aviation/documents/divisionhomepage/029650.hcsp

[23] https://www.theccc.org.uk/wp-content/uploads/2013/07/CCC_letter_aviation_commission.pdf

[24] For more information, see Chapter 4 of the Interim Report (Airports Commission, 2013c).

[25] See Guidance Document 01 for more details.

[26] Airports Commission (2014a).

[27] Without any additional airport capacity in the London airport system, Gatwick was forecast to reach capacity constraints by 2020.

[28] The commission however judged that Stansted could be a credible option for building a second net additional runway in the 2050s.

[29] https://www.gov.uk/government/publications/submitting-evidence-and-proposals-to-the-airports-commission

[30] Airports Commission (2013a).

[31] Airports Commission (2014a).

[32] www.hm-treasury.gov.uk/greenbook

[33] www.dft.gov.uk/webtag/index.php

[34] Which at the time had recently been consulted on by DEFRA: https://www.gov.uk/government/statistics/sustainable-development-indicators-sdis

[35] http://www.legislation.gov.uk/ukpga/2008/27/contents

[36] NATS provides air traffic navigation services to aircraft flying through UK-controlled airspace and at some UK and international airports.

[37] Airports Commission (2014b).

[38] More details can be found in the Annex to the Commission's note on the inner Thames Estuary Feasibility Studies: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/271658/airports-intro-note.pdf

[39] http://ec.europa.eu/environment/nature/natura2000/index_en.htm

[40] See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/349518/decision-and-summary.pdf

[41] See Final Report, p 18.

[42] The requirements for a National Policy Statement are set out in the Planning Act 2008 and the Strategic Environmental Assessment Directive (2001/42/EC) as well as other relevant elements the European legislative framework.

[43] For more information, see Airports Commission (2015b).

[44] https://www.gov.uk/government/organisations/high-speed-two-limited

[45] See Airports Commission (2015), Chapter 13.

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Chapter 4. Airport expansion and site selection in Sydney, Australia

Introduction

The issue of the second Sydney airport has been on the agenda, with periodic major studies, for about 40 years. It has been recognised that the current Sydney airport (KSA-Kingsford Smith Airport) has limited capacity to expand, and that additional capacity will be needed. In the 1970s and 1980s multiple studies looked at potential new sites as well as the possibility of building a third runway at KSA. In the early 1990s the third runway option was chosen, and thus the need for a second airport was postponed. However, demand is now pressing up against capacity, and a recent report (Joint Study, 2012) argued that all slots at KSA will be allocated by around 2027. This, however, was a controversial conclusion. For example, the current owner of KSA argues that a second airport will not be needed for many more years. In recent years, different governments have settled on two pre-selected sites, Badgerys Creek and Wilton (which is further from the central business district (CBD) but also with fewer environmental problems such as noise). The government of 2012 preferred Wilton, but the following government preferred Badgerys Creek. In May 2017 the government announced that it would invest to build a second airport and that the construction would start in 2018. The new airport is due to open in 2026.

This chapter looks at several issues concerned with the choice of sites for the airport and related issues. It begins with a historical introduction to the Second airport issue, and notes what studies were done (and not done). Secondly, it looks in detail at the evaluation techniques which were used, such as cost-benefit analysis (CBA) and more recently, computable general equilibrium (CGE) modelling. Next it looks at the different sites, and the evaluation criteria (such as availability of land, air space constrains and closeness to population growth) which were used to evaluate them, along with CBAs. Then the chapter looks at how decisions were taken in practice, finishing with some lessons from the Sydney case, which can be of broader relevance.

Like the story of Heathrow expansion, the Second Sydney airport story has begun a few decades ago. While recent material such as reports (e.g. the Joint Study of 2012) and articles are readily available, this is not the case for older material. It has been archived, destroyed or is stored in hard to get places. It would take a major research exercise to find what is available. As a result, it can be quite difficult to determine the reasons behind decisions taken many years ago. This chapter makes use of the limited secondary sources which are available.

There are several lessons which can be learnt from the Sydney experience. There have been several positive features of the evaluations, including:

- substantial use of appropriate techniques such as CBA, and more recently, CGE models
- transparency and good provision of information, which enabled those outside the evaluation process to check results and advance the debate about the options
- provision of simple CBA assessments of a whole range of sites.

However, there have been some limitations to the process, including:

- the ranking criteria of the sites not being clearly set out, nor clearly related to the subsequent CBA
- little by way of detailed CBA or CGE studies of the two or three most preferred options;
- Somewhat uncoordinated evaluation analysis performed by various consultants
- little use of sensitivity analysis - results presented as one, single answer without providing an explanation of key factors (e.g. demand growth projections, the values of time) fed into the results
- the exclusion of noise and greenhouse gas emissions costs, which made it impossible to assess the importance of these aspects in the final assessment.

Overall, there are some issues which are not resolved and this is to be expected in studies which are at the cutting edge. These include:

- the integration of CBA and CGE model results
- the attempt to measure wider economic benefits (WEBs) of air transport - in this case, benefits from inbound tourism and freight movements
- the need to better explain the results to the broader community, including politicians, business groups and local communities so that they are appraised of the key trade-offs and the debate on the issues is not wrong-headed..

Sydney Kingsford Smith Airport (KSA) is 8 km away from the CBD of Sydney. It handled 38.7 M passengers and 308 000 air transportation movements (ATMs) in 2014. It operates from a constrained site of 905 hectares. It has three runways: two parallel runways and one cross runway. At times its effective capacity is affected by wind and storms. It has an effective monopoly in the Sydney agglomeration; there are two medium-length airports at Canberra (287 km away) and Williamtown (176 km away), and the nearest full sized airport is Melbourne, some 800 km away.

The site is conveniently placed for the passengers, but its coastal location makes it difficult to expand - it is in the midst of light industrial and medium density housing. The current expectations are that additional capacity will be needed by 2027. The effective capacity can be increased given that its operations are constrained by a curfew, which could be changed. Demand is now beginning to reach capacity; there is a slot rationing system and some slots are difficult to obtain. There may be some scope for using a general aviation airport at Bankstown, which has a short runway, and for using an Air Force base, further out, which has a medium-length runway. However, none of these are solutions to the long-term capacity problem at KSA.

The preferred location of a new site is Badgerys Creek, 47 km south west from the CBD, on the outskirts of the city. It is about 10 km away from the nearest train line, and upgrading of roads would be needed. The site is 1 700 hectares, about double the size of KSA. The idea is for the airport to start small, but grow larger as demand increases. There is no plan for an immediate rail connection, though this is a salient issue among the stakeholders. The plan is for it to operate with no curfew.

The Badgerys Creek site will, over time, become more accessible for the Sydney agglomeration, given that the centre of Sydney is being developed to the west. This will make it convenient for many residents, particularly as KSA is relatively difficult to reach from the Western suburbs.

Historical developments

Sydney has one commercial airport, which operates from a constrained site. Sydney airport expansion has been under active discussion since the early 1970s. Over the years, governments have addressed the question of options for increasing capacity at a new site. The capacity of the airport has been growing, most notably when a new runway was added in 1994. While there still is some scope for increasing its capacity, it has always been recognised that additional capacity provided by a new site would eventually be needed. An overview of the political decision-making regarding airport capacity expansion in Sydney is summarised in a table at the end of this section.

The capacity crisis at Sydney is now imminent. By 1994, when the new runway was nearing completion, flights were being delayed and there was a peak pricing system for smaller regional aircraft. The demand for peak slots is now exceeding capacity, and airlines cannot get some of their preferred slots.

Serious consideration of a second airport for Sydney began in 1971 (Fitzgerald, 1998). The Federal Government announced that a site would be selected. It appointed a consulting firm which drew up a shortlist of five sites and stated that a cost-benefit analysis would be done. Before this was completed the government lost office, and the new government announced that another site, not on the short list, would be chosen. After the announcement the government quickly lost its interest in building new capacity.

The first thorough examination of site selection was with the Major Airports Needs of Sydney (MANS) study, which commenced in 1976 (Mills, 1982). This was a joint federal and state initiative – it was a well-funded and rigorous study. Initially the requirement was for the site to be capable of including a six-runway airport. (It is not clear why this was stipulated, though at the time, two-runway airports were considered.) It included a CBA of several configurations of a second airport, with and without a third runway at KSA. The conclusion was that a third runway for the existing airport would delay the need for a second airport, though not eliminate it. The federal government was in favour of the third runway, though the state government opposed it.

During the 1980s further studies of sites were done – from 1983 to 1984 ten sites were considered. Each study included the Badgerys Creek site, but other sites were also considered. One such site is at Wilton, which is further away than Badgerys Creek, and in need of more substantial earthworks. In 1986, the then federal government announced that Badgerys Creek would be chosen (Fitzgerald, 1998).

In the meantime, the question of whether or not there would be a third runway at KSA remained a salient issue. As time went on, the demand for KSA continued to grow. By the late 1980s it was clear that a new airport would not be able to meet the increased demand , and that delays, slot rationing and peak pricing would be required if there were no third runway. The third runway issue was controversial, with some groups arguing for the new airport to be fast-tracked. Eventually the federal government decided to build the third runway. It did not produce a CBA of the investment, though it did undertake a brief economic impact assessment (EIA) as part of a wider environmental impact study (EIS). One of the groups objecting to the runway did, however, produce a CBA (ACT, 1990, see below). The third runway was built over 1991 to 1994.

After construction of the third runway, the second Sydney airport issue became less pressing. The federal government purchased 1 700 hectares for the airport at Badgerys Creek. While governments had

announced that the airport would be built at Badgerys Creek, they kept their options open – after all, land purchased can also be re-sold. Studies were done from 2004 to 2008. Then, from 2009 to 2012, another major study was done of the Badgerys Creek site (Joint Study, 2012). This study was done by consulting firms reporting to a joint federal and state steering committee of civil servants.

The 2012 report was quite comprehensive. It again looked at 10 sites for a large parallel runway airport, and 17 sites for a smaller airport. It also looked at possible roles for a general aviation (GA) airport at Bankstown and a military airport at Richmond, both in the Sydney area. The study used both CBA and CGE approaches to evaluation. It concluded that the best site would be Badgerys Creek. However, given the political sensitivities of the day (see below), the report suggested that the option at Wilton might be best. The federal government at the time was in favour of Wilton, and the state government came out, unrealistically, in favour of using Canberra (287 km away from Sydney) as the secondary airport for Sydney which would be achieved through building a fast (and expensive) railway to it.

Since then, there have been leadership changes in both the federal and state governments. The federal government announced, in 2014, that the new airport will be built at Badgerys Creek, and that the owner of KSA, Sydney Airport Corporation Limited (SACL), will have the first option to develop it. More recently, SACL announced that they would not take up a legal option to build and operate the second airport at Badgerys Creek. In response to that the federal government announced in May 2017 that the government would invest to build a new airport, with construction commencing in 2018. The airport is planned to be operational in 2026.

The political dimension

The choice of site and timing of the second airport and the decision whether or not to proceed with a third runway for KSA appears to be far from straight-forward. To a large extent political cycle is responsible for the policy U-turns and broken promises. At both the federal and state level, there has been a succession of conservative and left of centre governments. These governments are protecting their voters, though at the same time, seeking to do what is in the public interest.

For most of the period since 1970, most of the parliamentary seats (at both the federal and state level) surrounding Sydney KSA airport party have been held by the Labor, left of centre, party. While the airport is a source of jobs, the main concern is that of aircraft noise nuisance for the local community. Thus, the Labor party most of the time has been opposed to the third runway and other forms of development which increase the capacity of the airport. Instead the party has sought to advance the building of the second airport. The parliamentary seats around the Badgerys Creek site are more mixed, including rural and low density urban districts, which tend to be swing seats. Noise is less of a problem, and the issue of jobs and development of the region more of a concern.

There have however been cases where parties have acted against their own interests, with a final go-ahead for the third runway. For example, during a period of recession, both the state government headed by the Liberal Party and the federal Labour government were promoting economic reform. The federal government decided to build the third runway with the support of the Liberal Party, even though this caused intra-party strife.

Table 4.1. **Sydney expansion debate timeline**

Years	Decisions/Announcements	Comments
1971	Study producing a short list of five sites, including third runway at KSA Badgerys Creek not included in the short list	CBA to be used, not acted upon
1973	Galston chosen as the preferred location	Not on the short list of preferred locations
1976	MANS Study commences Sites considered capable of hosting six runways	Extensive use of CBA
1979	Short list of two sites, including Badgerys Creek	Federal government supported third runway, state opposed
1984	Two sites chosen as preferred options, out of ten considered: Wilton and Badgerys Creek	
1986	Badgerys Creek announced to be the location for a second airport for Sydney	
1989-91	Land purchased	
1989	EIS for third runway at KSA Decision not to have use CBA	Community group undertakes CBA
1989	Decision to go ahead with third runway and Badgerys Creek, subject to EIS	
1991-1994	Third runway constructed	
2004-2008	Further site selection studies	
2009-2012	Joint Federal-State Study Badgerys Creek considered best location	
2014	Go ahead for Badgerys Creek, construction to be commenced in 2016	Sydney Airport's owners (SACL) to have right to develop and operate the new site
2017	SACL decides not to build and operate a second Sydney airport, government announces it will invest in building the airport	Construction expected to commence in 2018. Airport expected to be operational in 2026

Economic evaluation techniques

The primary technique used in evaluating the economic impact of project is cost-benefit analysis (CBA). It was used extensively in the 1976 MANS study commissioned by the federal government (Mills, 1982). The MANS study followed on from the earlier Roskill evaluation of the third London airport, with a number of the personnel of the Roskill study also involved as consultants in the MANS study. By the time of the MANS study CBA had become widely used in Australia, and bodies such as the Commonwealth Bureau of Roads and the Bureau of Transport Economics were using it extensively.

However, by the time of the evaluation of the third runway for KSA in the late 1980s there was less use of CBA. The runway was not subjected to a CBA, but an Environmental Impact Statement (EIS) (Federal Airports Corporation, 1990). An EIS was done by consultants for the owners of the airport, the Federal Airports Corporation (FAC). As part of the EIS there was also a simple Economic Impact Assessment (EIA). The EIA did not seem to have been a critical factor in the decision to go ahead with the runway – rather, environmental issues dominated. However, one of the bodies generally opposed to the runway, the Airport Co-ordinating Committee (ACT), undertook a CBA, mainly using information from the EIS (ACT, 1990). It was not especially critical of the runway, and saw some merit in it, though it preferred the Badgerys Creek without the KSA third runway option.

The Joint Study of 2009-12, the next major study also used CBA extensively to compare sites. The analysis was done by consultants, and provided a simple but informative analysis for all of the possible sites. Interestingly, the report also produced a computable general equilibrium (CGE) analysis (something which had not been done often before – one example is Ueda et al, 2005) of the cost of not undertaking the investment, and explored the timing issue. The two studies, the CBA and the CGE study, were not integrated. There was a further regional CGE modelling study done of the Second airport. This was done by consultants for business interests in the State of New South Wales (NSW) and in particular, in Western Sydney, the area in which Badgerys Creek is located. This looked at regional economic impacts, and in particular on Gross Regional Product and Employment (NSW Business Chamber, 2013).

Evaluation techniques used in the Sydney airport capacity debate

Of the three different techniques, the oldest and most established is CBA (for its application to airports, see Jorge-Calderon, 2014; Forsyth, Niemeier and Njoya, 2015). Over time, the use of CBA and its application to airports in Australia has been developed, which is reflected in the studies of Sydney. The MANS study was, for its time, a state of the art study. It paid particular attention to the cost side, though it did not analyse the benefit side in much detail. It estimated the infrastructure costs, such as the costs of runways and terminals. It paid particular attention to delay costs, developing a model of delay costs at KSA. In doing this it made a particular effort to estimate the value of time. It also measured noise costs, concluding that they were surprisingly small relative to other costs (Mills, 1982). It also made an estimate of demand suppression costs, i.e. the benefits forgone due to lack of adequate capacity. It did not take account external costs other than those of noise. It did not analyse pricing of scarce capacity.

The ACT CBA of the third runway for KSA and the alternative second Sydney airport options was similar to that of the MANS study (ACT, 1990). It paid particular attention to taxiing costs and airline route costs, as well as infrastructure, delay, and suppression costs. It also measured ground access costs, which turned out to be the largest single cost item. Noise costs were of moderate size, with some options being larger than delay costs.

Both of these earlier studies evaluate the total costs and benefits pertaining to all passengers, both residents and foreign visitors. This approach was also used by the Airport Commission for London. In

most recent CBA done for the Joint Study in 2012, only benefits to residents are counted; there is no counting of the benefits accruing to foreign visitors. However, benefits from tourism are included.

The main elements of the Joint Federal-State Study are much the same, though there are some new features. One of these is an attempt to include wider economic benefits (WEBs) in the benefits measure. In practice, this comes down to a measure of inbound tourism benefits and a freight benefits measure. The tourism benefits measure is an approximation derived from assuming that the tourism benefits equal to 25% of tourism expenditure. This seems to be an over-estimate. Both Australian and UK studies use a CGE framework to estimate the net gain to the home economy from tourism at around 5-10% (assuming full employment) (Blake, 2009; Forsyth, 2006; Forsyth et al, 2014). There was no estimate of the cost to the economy of outbound tourism. The study did include an estimate of the consumer surplus accruing to outbound travellers, which is correct. However, there are costs which are comparable to the benefits from inbound tourism in addition to the consumer surplus benefits. These should have been included. Research suggested that they are of a comparable order of magnitude (though not as large as the 25% of expenditure assumed for inbound tourism) (Forsyth et al, 2014). Having used a CGE model for some parts of the assessment, the Joint Study surprisingly did not use its CGE model to explore the benefits from outbound tourism, something which a CGE model is ideally suited to.

There is also an estimate of the benefits of freight flows which would not come about were the airport capacity not expanded. For the Badgerys Creek option, the estimated tourism benefits are close to AUD 3 billion, and the freight benefits are AUD 1.5 billion, which compare to the consumer benefits of AUD 6.5 billion and delay reduction benefits of AUD 1.3 billion. Noise and other environmental costs are discussed, and measures of impact (e.g. in terms of houses affected by noise) are discussed but not evaluated, with the exception of road congestion.

Economic impact assessment: A flawed technique

As mentioned, the technique of EIA has not been used much in the Sydney case. EIA has been used in other contexts in Australia and is extensively used to assess airport expansion in other countries (for example, Germany; see Forsyth, Niemeier and Njoya, 2015). EIAs typically make an estimate of the economic impact of the project in terms of GDP and employment. However, EIA is very much a flawed technique and it has been regarded with suspicion (for a critique see Forsyth, Niemeier and Njoya, 2015).

There are several related problems with EIA. It relies on an input-output approach to estimate the additional economic activity (GDP, employment) associated with the development of the project, usually the multiplier equals around two (an expenditure of AUD 1 billion will create an impact of AUD 2 billion). An EIA does not account for the costs of the project, in effect, resources are assumed to be free of charge. Neither are other negative effects considered. For example, the EIA does not take into account demand and substitution effects which occur in real economies. It is a technique which always gives a positive result, even if the project is never used. As a result, EIA is not regarded as a satisfactory means of evaluating whether an investment increases economic activity or employment, or produces benefits greater than its cost. As a result, it has often been supplanted by CGE studies, which can indicate if a project reduces economic activity or yields benefits less than cost.

The growing role of computable general equilibrium models

Computable general equilibrium (CGE) models have been used in airport evaluation in Australia and it is likely that they will have a greater role in future. The Joint Study (2012) reported on a CGE exercise to measure the cost, in terms of GDP and employment foregone, resulting from not building the second Sydney airport. The model was also used to answer the question of when to build the airport. The assessment was in terms of the impacts on "macro" variables, such as GDP and employment. There was

no attempt to address the "micro" questions such as whether the investment was worthwhile, in terms of it adding to welfare or whether the economy would be better off.

Over the past 20 years, there has been considerable use of CGE models in Australia to assess investments in road and rail, and also government investment in special events. Often there have been both CBA and CGE studies of the same investment, as was the case with Melbourne road and rail investments (Eddington, 2008), though no systematic approach was developed to integrate them or analyse the relationship between the two forms of evaluation. This is an important step in the analysis, particularly as both CBA and CGE approaches shed light on whether a particular investment should be made, and hence they should be analysed in tandem.

The two methods can complement one another. CBA relies on partial equilibrium analysis and, as such it fails to take into account tax and market imperfections, it cannot handle an assessment of externalities such as greenhouse emissions or any distributional analysis. Such assessments can be in fact handled by applying CGE modelling techniques (see, for example, Broecker and Mercenier, 2011).

The issue of how best to integrate CBA and CGE has not been fully resolved, but it has been progressed substantially over recent years. For example, the UK Airports Commission (2014) used a CBA approach to provide the inputs for a CGE analysis of the wider economic impacts of different airport options for London.

Airport site selection criteria for expanding airport capacity in Sydney

Sites in the Sydney context

Over the years, several sites have been considered for airport capacity expansion. As of the 1980s there were the following sites, not all of which are mutually exclusive:

- a large new airport in the fringes of Sydney
- a third runway for the existing airport, KSA
- a development of the Richmond Air Force base
- the existing General Aviation airport at Bankstown.

Of these options, the second has already been implemented. The fourth one has some limited potential to cater for domestic flights (e.g. using Dash 8s); however it is not likely to yield major increases in capacity. In effect the main options are to develop the Richmond base and later, build a large new airport, or begin quickly to develop the large airport without developing Richmond.

In the 1980s, the trade-offs were as follows. A new runway for KSA would have provided capacity much closer to the origins and destinations of travellers, but it would also have created more aircraft noise. There was uncertainty on the other hand with respect to airlines' decision if a new airport was built with KSA remaining in operation. No doubt all airlines would have preferred to use KSA rather than the new airport, though they could have been persuaded by higher prices or lower slot availability.

Today, the options are to start with a new airport, or develop Richmond and then build a new airport in the future. Richmond could be developed into an airport capable of handling about 40 flights per hour, though its capacity to handle further expansion is severely limited. As an Air Force base, it is currently owned by the government, and it has one 2.1 km runway. It would need further runway and terminal investment as well as investment in road and rail infrastructure. It is not close to the CBD (65 km away) and there are some issues of airspace conflict with KSA. The Joint Study made a CBA of several

Richmond development options some of which have a positive net present value (NPV), though the NPV was smaller than for the preferred greenfield sites. In short, Richmond is a possible option, though it is not as attractive as building a new airport.

The most recent site evaluation was done for the 2012 Joint Study looked at a range of locations in detail. It did a CBA evaluation for 17 sites capable of handling a small airport and 10 sites capable of accommodating a large parallel runway airport. These were all in the urban fringes of Sydney, or slightly farther away. They have fairly similar characteristics. They are not in built-up areas, so the noise impacts are much smaller than for an urban airport such as KSA, though some noise issues remain. The earthworks needed to render them suitable for an airport varies, but the cost of each of them is less than AUD 1 billion. Since the land is currently used for low density activities (duck farms, piggeries), it is cheap (around AUD 200-300 million) per site.

The main problem with these sites is their accessibility. They are all quite distant from the CBD. Distance can be conquered by transport, but the existing transport options imply long travelling times. Realistically, most passengers and goods are likely to come by local roads. Most sites are more than 10 km from a motorway. New roads will be built to the airport, but it will be some time before the traffic at the airport warrants high standard roads.

Surface access connectivity was a salient issue in the debate. Most of the sites were not very close to rail lines. The preferred site at Badgerys Creek is about 10 km from a railway and the government stated that it would build the airport with provisions to incorporate a railway, to be built sometime in the future. A Sydney-Canberra-Melbourne Very Fast Train (VFT) line or a dedicated fast airport train have been discussed for many years (High Speed Rail Study, 2013), though no government has been willing to build or fund it. Many commentators argue that there should be a rail connection from the day the airport opens, with the exception of the Chief Executive Officer of Qantas, who argued that a rail connection should be provided only when demand warrants it. Sydney suburban trains which are relatively slow and inconvenient for airports users are unlikely to gain a large market share for many years to come. A rail link is expected to be provided about 15 years after the airport opens.

There are challenges of building a second airport for Sydney which the government will need to consider. Airlines may not want to move to the new site and, in order to ensure that they do, the government may eventually have to consider closing (at least temporarily) closing down KSA.

Site selection: Recent studies

Sites have been selected for the second Sydney airport for many years, and they have been subjected to detailed study for about 40 years. With each study, the same sites tend to come up time and time again, and the currently preferred site, Badgerys Creek, has been the preferred site for most of the past 30 years. For present purposes, attention is confined to the most recent study, the Joint Study of 2012.

The site selection process in the Joint Study report is opaque and difficult to follow. Several dozen criteria are listed, under which potential sites were considered. The approach was to look at broad locations and then to examine specific sites.

There were four steps in site selection:

- identification of potential locations
- shortlisting of locations

- identification of sites
- economic assessment of sites (using CBA).

In terms of locality selection, amongst the criteria listed are flora and fauna impacts, scope for commercial opportunities nearby, proximity to origins and destinations of likely users, noise impacts and impacts on national parks. As set out in Table 4.2 some criteria were noted as more important criteria than others.

Table 4.2. **Criteria for localities**

	Criterion	Priority criteria
1	Capacity created	X
2	Applicability to potential demand segments	
3	Ease of connectivity between KSA and site ease of connectivity between KSA and site	
4	Development costs	
5	Accessibility to Sydney land transport network	X
6	Proximity to NSW growth centres	
7	Commercial opportunities at/near site	X
8	Proximity of users to site	X
9	Airspace interactions	X
10	Obstacle limitation surfaces	X
11	Frequency of meteorological conditions affecting capacity	
12	Potential impact on other residents from land acquisition	
13	Noise impacts on residents	X
14	Noise impacts on sensitive users	
15	Risk of aviation accidents	
16	Greenhouse emissions from surface transport	
17	Local air quality	
18	Potential impact on waters	
19	Catchment impact	

20	National and state parks	X
21	Flora/fauna in location	X
22	Indigenous cultural heritage	
23	Non-aboriginal heritage items	
24	State significant sites	X
25	Flood risk	
26	Bushfire risk	
27	Earthquake and other disasters	
28	Land remediation and contamination	
29	Presence of underground mining	
30	Unexploded ordinance risks	X

Source: Joint Report, 2012.

The more detailed assessment of sites takes into account a range of criteria including accessibility to the land transport network, cost of earthworks, noise impacts, airspace interactions, and designated mine subsidence, the number of lots which would require acquisition and other factors. All of these criteria are relevant, but there is no guidance as to the degree of their importance.

The possible sites were summarised according to a check list of ten factors. The sites were assessed according to how suitable they were for a small or large airport, and some quantitative factors (see Table 4.3).

Table 4.3. **Site evaluation factors**

Criterion	Badgerys Creek Distance from CBD- 45 km	Wilton Distance from CBD- 83 km
1. Comparative transport **Upgrade costs (AUD millions)**	X O 460 (Road) 1 100 (Rail)	X O 190 (Road) 1 130 (Rail)
2. Proximity to growth centres	O O	O O
3. Earthworks costs **(AUD millions)**	O O 810	X O 360
4. Noise impacts	X X	O O
5. Mine subsidence	O O	X X

6. Property acquisition / N of lots	O O 40	O O 40
7. Airspace interaction	X O	O O
8. Potential to expand	O O	O O
9. Flood risk	O O	O O
10. Other costs	X O Power lines	X X Catchment area

Key: X X- Not Suitable; X O – Some Problems; O O – Very Suitable

The cost-benefit analysis

Once sites were judged according to these criteria, some 17 sites are subjected to a high-level CBA. All of these sites are capable of accommodating a smaller airport, and of these, ten are capable of handling a large parallel runway airport. In spite of the "high-level" tag, these studies do provide quite a lot of information. In particular they answer some of the questions which the broader criteria raise. For example, the costs of earthworks are listed in the CBAs, giving a quantification of the importance of terrain suitability. It also suggests that the Steering Committee for the Joint Study put a large amount of emphasis on the CBA results.

The high-level CBAs did not evaluate all benefits and costs separately for all sites. Many of the costs were assumed to be the same for all sites; the cost of building a terminal was assumed to be the same for all sites, as were the wider economic benefits, and the environmental externalities (not including noise). The results for two sites, Badgerys Creek and Wilton are presented in Table 4.4a and 4.4b.

Table 4.4a. **Discounted costs (7% discount rate)**

AUD millions, 2011 terms

		Badgerys Creek	Wilton	Comments
Capital costs				
Generic airport construction costs	Land acquisition	49	32	
	Property purchase	4	0	
	Earthworks	162	367	
	Sub-total	215	399	
	Runways/taxiways	122	122	Same as other sites (SAOS)
	Aprons	61	61	SAOS

	Car parks	45	45	SAOS
	Landing aids	19	19	SAOS
	Terminal-international	400	400	SAOS
	Terminal-domestic	129	129	SAOS
	Other capital	6	6	SAOS
	Contingencies	234	234	SAOS
	Project management	156	156	SAOS
	Sub total	1 171	1 171	SAOS
Supporting infrastructure costs	Road	42	100	
	Rail	247	241	
	Utilities	72	30	
	Fuel	97	106	
	Contingencies	138	143	
	Project management	92	95	
	Sub total	688	715	
Ongoing costs				
Renewal	Airport	300	300	SAOS
	Supporting infrastructure	18	19	
Maintenance	Airport	371	371	SAOS
	Supporting infrastructure	110	104	
	Sub total	799	795	
Total costs		2 873	3 080	

Source: Joint Study (2012).

Table 4.4b. **Discounted benefits (7% discount rate)**

AUD millions, 2011 terms

		Badgerys Creek	Wilton	
Benefits				
Passenger benefits	Consumer surplus	6 480	6 480	Same as other sites (SAOS)
	Delay reduction	410	410	SAOS
	Peak spreading	5	5	SAOS
	Sub total	6 895	6 895	SAOS
Wider economic benefits	Tourism benefits	2 982	2 982	SAOS
	Freight benefits	1 512	1 512	SAOS
	Sub total	4 494	4 494	SAOS
Aircraft operations	Delay reductions	1 138	1 138	
	Sub total	1 138	1 138	
Road network impacts	Passenger land transport impacts	-2 101	-2 993	
	Freight land transport impacts	-2 043	-2 773	
	Sub total	-4 144	-5 766	
Environmental impacts	Noise abatement	-7	-1	
	Environmental costs - additional km	-715	-715	SAOS
	Sub total	-722	-716	
Total benefits		7 660	6 044	
Results	NPV	4 788	2 964	
	BCR	2.67	1.96	

Source: Joint Study, 2012

Some of the key differences between the sites are evident from the CBAs. These include:

- Land costs: Given that all of the sites are on the fringes or beyond, the land cost is small, in most cases below AUD 100 000.
- Cost of earthworks: This can be significant and variable. These are mostly between AUD 100 million and 300 million.
- Road and rail supporting infrastructure costs: These costs can be quite variable, and in the case of road, can be as low as AUD 50 million and above AUD 1 billion. Rail costs are mostly between AUD 50 million to 250 million.
- Noise abatement costs: Less than AUD 25 million.
- Environmental externalities: These are quite significant, at AUD 715 million for all sites. It is not clear what they do and do not include. Road congestion externalities do seem to be included in this category.

Noise and greenhouse gas emissions costs do not seem to be included in the CBA. There was a conscious decision to exclude noise costs, on the grounds that including them could be confusing. There are some physical measures of noise at the different sites. There appears to be no measurement of the cost of greenhouse gas emissions, though there is some recognition that these costs exist. These could be expected to vary from site to site because, for example, aircraft operation costs and delays vary.

Most likely, both of these costs will be small relative to the total cost of the projects. This has long been a conundrum with noise. Aircraft noise tends to generate community protests, but typically, when noise costs are measured, they tend to be quite small (Mills, 1982). Valuing emissions costs is a difficult exercise if a partial equilibrium approach is used, but it is quite straightforward if a CGE model is employed (Adams et al, 2000). Although both noise and greenhouse gas emissions costs are not likely to be large, it would be useful to have a measure of them, to complete the evaluation.

Institutions and their objectives

Of the various institutions involved in Sydney airport development, the most important is the federal government as it decides on where and when a new airport is built.

One of the main objectives of the federal government, especially since the 1980s, has been the promotion of economic efficiency. From the 1980s the government has put a large amount of emphasis on economic reforms (often accepting the advice of its main economic adviser, the Productivity Commission). Thus the 1970s MANS study and the recent Joint Study put a large amount of emphasis on CBA (and recently, CGE) results. While, at times, the government has not simply chosen the highest best-cost ratio in choosing investments, it has incorporated economic considerations into its decision-making.

When the decision on the third runway was taken, the government did depart from the economic approach to some extent. If anything, the runway was a well justified investment. At the time of its delivery, demand at KSA just started exceeding capacity, and there was not much use of slots or prices. Business passengers were complaining about delays. Both federal and state governments were emphasising their pro-business stance, and the economy had slowed. The runway however had a large (perceived) cost in terms of noise, which individual MPs and community groups were very concerned about.

New South Wales government

The state government does not have a specific role in aviation matters, but it does have an important role in infrastructure planning matters, and in surface access. A number of studies, such as the recent Joint Study, have involved both state and federal governments. Its objectives are less clear-cut than those of the federal government. The emphasis on economic efficiency is less strong. The response of the NSW Premier to the Joint Study Report was a classic NIMBY response. He suggested that the second Sydney airport should be in Canberra, the nation's capital, some 287 km from Sydney (about 3.5 hours by car and over 4 hours by train). It is possible that he was making an oblique point that the state would need federal funding for improved road and rail access to the chosen site.

The owners

The current owners of the airport are Sydney Airport Corporation Limited (SACL), which is a public company. This company was purchased by Macquarie Bank when the airport was privatised in 2002, and later the Bank sold over 50% stake to the public. In earlier years, the airport was owned by the Federal Airports Corporation (FAC), a corporatised public enterprise.

At the time of the federal government's decision to build the third runway, the owner was the FAC. The government ordered the FAC to undertake an EIS before going ahead with the runway. It is notable that the FAC did not do a financial evaluation of the case for the runway, even though it was required to act in a commercial manner. Undoubtedly it did not need to do so, since it had market power and it could increase prices to cover its costs if it needed to. It did not have a strong incentive to maximise the efficiency of the prospective investment. Indeed, public enterprises have a reputation for over-investing than under-investing.

The airport owner has an incentive to delay the construction of the new airport beyond the efficient starting point, and capture monopoly rents (see Forsyth, 2014). Thus there is a potential conflict of interest between the government and the airport owner. The response of the airport owner to the Joint Study supports this as the owner claimed that the Joint Study overestimated the urgency of the starting date. The study argued that the new airport would need to be opened by 2027, while the airport argued that it would not be needed by 2045. The difference in these two dates is partly due to the fact that the airport owner considered various ways of increasing the capacity of KSA, while the study assumed that some of these ways would not be acceptable to the government.

SACL has the first option to develop the new airport, but it decided not to do so.

Local government and community groups

Local governments reflect community attitudes and can act as a conduit for community action. This was especially evident during the debate on the third runway at KSA (see Fitzgerald, 1998). There were two conflicting objectives: noise reduction and economic development. Before the runway was built, local groups were concerned that the runway would contribute to increasing aircraft noise at KSA, both through additional traffic and through the use if more flight paths. The main organised opposition to the runway came from the Airport Co-ordinating Taskforce (ACT) which produced a CBA to highlight the benefits of starting early on the second airport rather than the third runway. At the same time, there was some support for the third runway on the grounds that it would foster economic development. Support for the third runway, however, was not very strong, which is unsurprising given that the airport is situated in a densely populated area with homes and businesses. After the runway was opened, demonstrations were held, and a "No Airport Noise" political party was formed.

The Badgerys Creek site is unlikely to be exposed to such strong opposition from local communities, due to much fewer households that will be affected by the airport. Currently the area is rather low density, though over time there will be low density housing built nearby – the centre of Sydney is gradually shifting westwards. This creates some concerns about noise, but not to the same extent as at KSA. On the other hand, the new airport is perceived as a generator of business and jobs (a lobby group did a CGE analysis of the gains in economic activity) (see TTF, 2012; NSW Business Chamber, 2012). On balance, local groups are in favour of the airport development.

The airlines

The airlines have not been playing a visible role in the airport capacity expansion debate in Sydney. The airlines were in favour of an early start to the runway and the second airport. They are particularly concerned about whether any specific groups of airlines will be forced to use the second Sydney airport. For example, the regional airlines are keen for the new airport to be built, as long as they do not have to move there. Qantas however has recently stated that it would use it, along with its low cost subsidiary, Jetstar.

What is interesting is that none of the airlines seems to have factored into their calculations the profits which they can gain from slot rents if demand exceeds capacity. This may be because they expect the airport to use pricing of the slots as the rationing device and they hence do not want to reveal the true value of slots to the airport (Forsyth, 2008).

The decision-making process

In most of the major airport capacity investment decisions, the federal government instructs the Department of Transport to provide a detailed analysis of sites and other options for expanding capacity. The largest studies have so far been done by federal/state committees. The Department for Transport appoints consultants to provide a detailed report. It then advises the federal government on the final decision. With the two major studies, the MANS study and the Joint Federal-State Study, more detailed studies were done by Departmental committees and the consultants produced the reports with CBA being the key component of the analysis.

To a large extent, the governments of the day followed the recommendations of the committee, though not precisely. The recommendation of the Joint Study was that the Badgerys Creek site be selected. At the time, the government preferred an alternative site, Wilton. It later reverted to Badgerys Creek mainly because the government changed.

The decision to go ahead with the third runway was rather different. The MANS report did not comprise a CBA and the government decided to instruct the FAC to go ahead with the construction of the runway, subject to an EIS. This was completed, and after some debate, the runway was built.

There was one aspect of the decision-making process which was different than in other countries and potentially valuable for future inquiries. The government provided a substantial amount of funding (AUD 100 000) to the two leading lobby groups to fund further studies: the second Sydney Airport Coalition (SSAC) and the ACT. The latter produced a CBA of the runway and alterative options for the second airport (ACT, 1990). This approach is an effective means of ensuring that community groups have sufficient resources to fund credible analysis of the issues.

Airport capacity decisions in practice

Taking the 40-year period of evaluation of the Sydney airport capacity expansion decisions as a whole, the process has been working quite well, despite some difficulties. This cannot be said for many

infrastructure decisions in Australia, especially over recent years. Relevant information has been available for public scrutiny. In the case of the MANS study and the Joint Study, adequate investment assessment approaches were used. The key trade-offs were articulated, sometimes with considerable input from community groups. Governments did respond to concerns, though they did not always agree with popular views.

The MANS study was a major exercise in economic and social evaluation for its time. Amongst other things, it set out the options of a new airport and increasing capacity at KSA by building a new runway (and it pointed to the latter as the likely best way to proceed in the short term). It identified a best option for a new airport - Badgerys Creek - which different studies over the past 30 years have kept coming back to.

The decision to build the runway at KSA was less well handled. While the runway was probably the best option for increasing airport capacity at the time, it was not carefully evaluated (there was no CBA, for example). It was likely built too soon, though the gains from delaying it would not have been too great (the runway cost less than AUD 400 million). The government was not sufficiently prepared to build the new airport at that point even if it was the best option.

The next major site selection study was the Joint Study of 2012. In broad terms, this was capably done. The study looked at a wide range of decision criteria. It recognised a range of options to make better use of existing capacity at KSA and other airports, it produced useful CBAs of the main possible sites, and did a CGE study of the costs of not investing in a new airport in terms of its impact on GDP and employment. The study provided sufficient information for others to explore the issues further, such as a CGE study of the impacts for Western Sydney (NSW Business Chamber, 2013).

There are a number of limitations to the Joint Study. One is that it was done by many consultants, and the pieces do not always fit into a coherent whole. There are many criteria for the evaluation of the sites, which are all listed, but there is no ranking of importance. The environmental aspects of the sites are not given much discussion or analysis, and there is no way of comparing the sites in terms of their environmental costs and benefits. The infrastructure and running costs of access, using road and rail, are included in the CBAs, but in a very opaque way. Given that the critical disadvantage of the new airport sites is that all of them are far away from the CBD, and from the existing airport, KSA, this is a real limitation. Much of the critical discussion of the preferred site has been how difficult it is to get to.

The Joint Study was produced by a Steering Committee of civil servants and advisers from the federal and state governments. They reported back that the best site for a new airport was the Badgerys Creek site. This site has few disadvantages (though there are some noise problems) and had the second highest NPV (the highest was slightly higher, though it would require land purchases and other transaction costs). They recognised that, at the time of the report, that the site was not favoured by either the federal or state government. At the time, the government preferred the Wilton site, which had a positive, but lower NPV than many other sites (curiously, the report stated that the Wilton site was the second best site, though it did not provide any reason why this was so). The government eventually reverted to the Badgerys Creek site and announced that it would be built. In May 2017 the government announced that construction would start in 2018.

The behaviour of the state government has been somewhat surprising. One would have expected it to have been very much on top of the detailed reasoning in the report, which the government was party to. Instead, the State Premier of the time responded by saying that the new airport should be in Canberra, some 287 km away. Since then it has more or less accepted that the Badgerys Creek site is going ahead.

However, it is now advocating that a very expensive fast rail line to be available from the time the airport opens, which suggests that it is not interested in decisions which promote efficiency.

Lessons for the Sydney case study

The Sydney experience of airport capacity evaluation and site selection is one which policymakers can learn from.

Some of the positive aspects of the process are as follows:

- It has been capably handled, making good use of the relevant economic techniques, such as CBA and more recently, CGE modelling.
- Sufficient information has been publicly provided to enable assessment of the options, by expert committees directly involved with decision-making, as well as other interested groups. An interesting innovation was government funding for groups which opposed the government's preferred option, which happened with the debate over the third runway for KSA.
- Basic assessments using CBA were provided, which effectively illuminated the main trade-offs and differences between the sites. More detailed assessments of the preferred can be left till later.

Some limitations of the process are:

- Decision making criteria were not ranked by importance, instead a large number of decision criteria were included without ranking their relative importance. A detailed and rigorous analysis of the two or three preferred options has not been done. As noted, there was no official CBA of the third runway. Likewise, there has not been a detailed (public) comparison of the Badgerys Creek and Wilton (and devils are prone to lurk in details).
- Consulting reports should have been better coordinated and integrated so that they tell a consistent story.
- Sensitivity tests should have been included in the studies, rather than a single result being presented as was the case with the second Sydney airport. Sensitivity to different assumptions, be they about data (demand growth, construction costs, values of time, benefits of tourism, noise costs, access costs and discount rates), or about model structures (full employment or not, saving and investment, budget closure and the current account) are crucial to include to help decision makers factor in robustness and resiliency. Noise costs and greenhouse gas emissions should have been included in the final assessment.

Finally, there are some unresolved issues:

- Integrating CBA and CGE: CGE models have great potential in evaluating investments, including airports. The Joint Study of 2012 was a pioneer in using CBA and CGE techniques. However it completely avoided integrating them. It is granted that the integration of the two techniques is in the early stages, and no one approach to integration has been devised. The work of the UK Airports Commission has gone further in this respect.

- Measuring Wider Economic Benefits (WEBs): These may become an important aspect of airport evaluation. The Joint Study made some estimates of how large these might be (as did the UK Airports Commission, which used a CGE approach).

- Explaining results to the community: There was wide community debate at several stages of the second Sydney airport evaluation process. This was welcome, but much of it was ill informed, even though reports were readily available. Several of the reports were complex and opaque, the key reasons for the recommendations were not articulated, and the key trade-offs were not explained to the community or state government ministers. Moreover, several parts of the report are difficult to understand even for a technical audience.

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Chapter 5. Airport site selection in Tokyo and Osaka

This chapter examines airport site selection in Tokyo and Osaka, inter alia, Narita Airport and Kansai Airport.[1] Experience of location selection for Narita Airport and Kansai Airport, which came in this order, addresses two important questions. What happens if location is selected in a discretionary and covert manner? What does it take to draw an objective conclusion of choosing the optimal site from multiple candidates within a region?

In an earlier ITF discussion paper[2] written in 2013, observations were made about how airport development in Greater Tokyo and Greater Osaka evolved through the years. The 2013 paper tried to capture a unique history of dynamic interaction between multiple airports that manifested in the two largest metropolitan areas in Japan.

This chapter specifically focuses on airport site selection of Narita Airport and Kansai Airport, describing in detail what kind of appraisal criteria were used, how they were applied, and what were the consequences of the selection process. It is expected that two papers combined would give a clearer picture of the overall airport development process in these two metropoles.

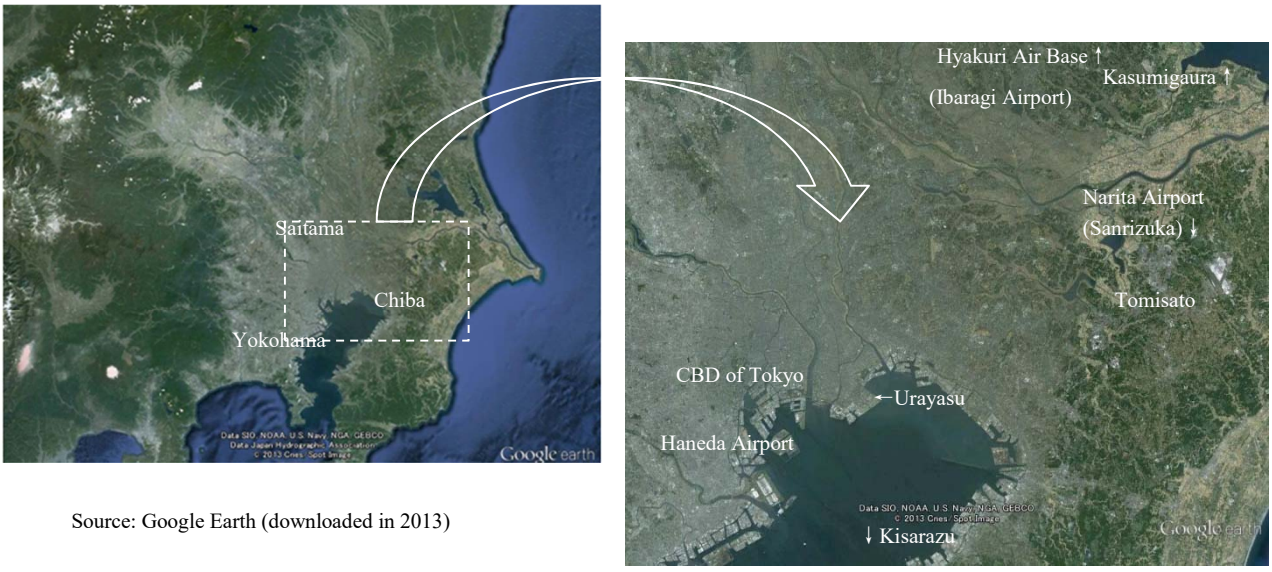
Airport site selection in Tokyo: Narita Airport

Turbulent from the outset

It was in the mid-1950s that the Ministry of Transport (MOT)[3] started to explore construction of a new airport in the Tokyo Metropolitan area so as to respond to growing demand at Haneda Airport, which was expected to reach its capacity by the 1970s. The idea to expand Haneda Airport by reclaiming Tokyo Bay faced issues related to the possibility of depriving vessels from entering or exiting Tokyo Harbour, which is the major gateway to access deep into the bay area. Additionally, at that time, there were technical difficulties in reclaiming the bay. Even if there were solutions to these problems, capacity increase through expansion of Haneda Airpor was deemed insufficient to meet future demand.

In 1962, the first research budget on new airport construction was appropriated to the MOT in the national budget. In 1963, the MOT compiled a so called "Ao-hon" (meaning "blue book"), a pamphlet on basic ideas about the new airport with various examples from other countries. The Minister of Transport and the Minister of Construction, however, advocated different locations for the new airport without any administrative consultation. The Minister of Transport advocated an off-shore site in Urayasu, while the Minister of Construction advocated an off-shore site in Kisarazu. Both areas were located on the bay-side of Chiba Prefecture facing Tokyo Bay. In July, relevant ministers got together and discussed the issue and confirmed that the new airport would be located off-shore of Chiba Prefecture in Tokyo Bay and they would consult with the Governor of Chiba Prefecture to specify the location. Eastern side of Tokyo Bay, however, was close to the flight paths of Haneda Airport. Thus, from an air traffic control perspective it would be necessary to close-down or significantly limit Haneda Airport's operation. This obviously was not an option.

Figure 5.1. **Aerial view of Greater Tokyo as of today**



Source: Google Earth (downloaded in 2013)

Quest for inland location

The Civil Aviation Bureau (CAB) of the MOT understood the problem of air space conflict regarding off-shore Chiba proposals. As shown in Figure 5.1, the greater Tokyo district has little room on the western side not only due to the mountainous area close by, but also due to several airbases located in the vicinity. Also, there was the issue of US forces controlling the air space at Yokota Air Base. The CAB tried to suggest an inland alternative in Chiba, but due to the ministers' argument on the issue, the CAB was unsuccessful.

The CAB tried to infuse objective discussion by commissioning the location and capacity of the new airport to Aviation Council, a deliberative council under the MOT. In the central government, it has been a practice to commission relevant deliberative councils on important policy decisions. Commissioning itself is not mandatory. It is, however, stipulated in the law establishing the ministries that reports from the formal deliberative councils have to be taken into consideration in decision-making by the ministers.

On 20 August 1963, the Aviation Council initiated the consultation and established a committee composed of relevant experts including, for example, air space, air traffic control, civil engineering, and aircraft pilots. The council is said to have considered a variety of aspects related to potential location of the new airport such as air space, air traffic control, weather conditions, landscape, construction conditions, and transport to the city centre. Details of the consultation, however, were not open to the public. On 11 December 1963, the Aviation Council delivered a report that rejected the eastern side of Tokyo Bay and recommended the inland area of Tomisato, Chiba Prefecture as the best location. The report also mentioned Kasumigaura, Ibaragi, as another appropriate site pending co-ordination with Self Defence Agency regarding air space.[4]

After World War II, Tomisato was mostly used for farming. As early as 1964, its inhabitants unionised and stood up against airport construction. In September 1964, the central government established a Ministerial Committee composed of the Ministers of Finance, Agriculture, Forestry and Fishery, Transport, Construction, Home Affairs, Self-Defence and the Chief of Cabinet. The Ministerial

Committee confirmed that Tomisato was not the only candidate. Reclaiming a part of Tokyo Bay or Kasumigaura also remained an option, as did the possibility of utilising the US airbase. Vice-Ministerial meetings were held but they could not identify any potential location other than Tomisato and Kasumigaura.

By the time a bill to establish the New Tokyo International Airport Authority, a special purpose government organisation, was passed in mid-1965, opposition against Tomisato had become a social issue. The government tried to fix the location at Tomisato in November 1965. However, the towns and villages of Tomisato officially declared that they were opposed to the plan. In early 1966, a riot occurred in Chiba Prefecture office building and soon the Governor of Chiba announced that considering the severe confrontation the only option was to wait-and-see.

Behind the scenes, informal consultation between the Vice-Minister of MOT and the Governor of Chiba took place. In June 1966, Sanrizuka of Narita City, a few kilometres north of Tomisato, was announced to be the location of the new airport. Sanrizuka had encompassed a vast ranch for the Emperor. Although two-thirds of the ranch had been released to the farmers after WWII, it was nevertheless believed that there would be less opposition. But now the antagonism leaped across from Tomisato to Sanrizuka. On 4 June 1966, when the Cabinet Decree on the location of the New Tokyo International Airport was delivered, assemblies of Chiba Prefecture, Narita City and Shibayama Town declared their resolution to oppose the plan. This was the start of a prolonged conflict with the landowners of Sanrizuka.

Befuddled construction

The basic plan included 1 065 ha of land with a 4 000 m runway A, a 2 500 m parallel Runway B and a 3 200 m cross-wind runway C. It was down-sized by half compared to the initial plan. 91% of the land was located in Narita City and the rest in Shibayama Town. 670 ha composing 63% of the total were privately owned by 325 residents and around 1 000 owners living outside the district. The rest of the land was owned by the state and prefecture.

Although the assemblies of Chiba Prefecture, Narita City and Shibayama Town subsequently withdrew their resolution, opposition groups grew in number and became radical in their actions. As hostility escalated, the New Left joined the violent protests. Not only did the scale of demonstrations increase, but also Chiba Prefecture's decision in 1969 regarding expropriation of land was taken to court. A number of opposition shacks were built in the vicinity of the planned site. "Hito-tsubo ($3.3m^2$) land possession campaign" spread. While construction went on in the acquired land, the situation in some parts of the privately-owned land became a battlefield.

Construction of the airport proceeded on land acquired through transaction. On 26 March 1978, four days before the airport was planned to open, opposition groups raided the restricted area and seized the ATC tower so that the opening had to be postponed by over a month due to mechanical damage. The airport was finally opened on 20 May 1978 but with only a single runway, Runway A.

Long and winding road to restoration

The opposition group continued their resistance, including the use of intermittent bombing raids on government officials by radical groups. In 1988, the chairman of land expropriation committee of Chiba Prefecture was attacked by a radical group. As a result all the members of the committee, including the chairman, resigned and eventually the committee had to cease its function.

Mediation was initiated in 1991 with a series of so-called "symposiums." After fifteen rounds of the symposium, which opened the door to the opposition groups, it was confirmed that the land expropriation

process would be withdrawn and discussions about Runway B and C with local stakeholders would begin again from scratch. Since 1993, the dialogue has continued in the form of "expert workshops" and a "Coexistence Committee." The farmer residing in the southern part of the originally planned location of Runway B was not expected to leave the premise in the near future. So Runway B was decided to be opened as a provisional runway (2 180 m) in April 2002, just before the opening of FIFA Soccer World Cup co-hosted by Japan and South Korea. In 2009, the northern part of the runway was extended to become 2 500 m long.

Airport site selection in Osaka: Kansai Airport

There were two motivations behind the need to construct Kansai International Airport. One was to meet the growing demand of the region. The other was to provide a solution to the noise issue at Itami Airport.

Itami Airport opened in 1939 with a single 1 828 m runway. In 1970, a parallel 3 000 m runway was added. Its close location to the city centre had caused severe noise issues, particularly since turbo-jet aircraft began operating in the 1960s. A curfew on turbo-jet aircraft between 11pm to 6am introduced in 1965 had not been sufficient in controlling the situation. Local residents filed lawsuits to ban evening operation and to seek compensation in 1969. When CAB initiated research for the second airport for Osaka in Kansai in the late 1960s, they were not only confronted by a "not in my backyard (NIMBY)" mentality due to Itami Airport's noise issue, but also by severe social disorder at Narita. CAB was tasked to identify a location in Kansai without any environmental problems through a democratic and transparent process.

On 13 October 1971, the Minister of Transport commissioned the Aviation Council to study the "Size and location of Kansai International Airport." The Kansai Airport Committee in the Aviation Council was composed of seventeen members including university professors, aviation experts, relevant industry representatives and mass media. Government representatives including that of the Environment Agency, the Fisheries Agency, the National Land Agency, the Ministry of Finance, the Ministry of Internal Affairs, and the Ministry of Construction also participated. Consultations began by announcing that no time limit would be set. A total of twenty-nine committee meetings, eleven subcommittee meetings and six informal meetings were held before the report was submitted three years later on 13 August 1974.[5]

Criteria of location comparison

The council identified the following seven criteria for evaluating candidate locations:

1. flight paths and airport capacity
2. convenience for users
3. construction issues
4. environmental impacts
5. co-ordination with vested interests
6. integrity with the future vision of the surrounding region
7. regional development effect

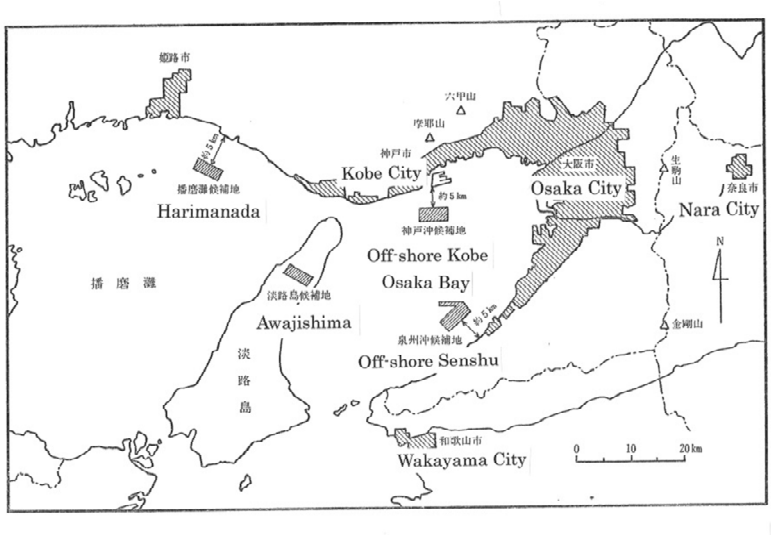
Among the seven criteria numbers 1, 2 and 3 are mainly related to the basic functioning of the airport. Criteria 4, 5, 6 and 7 deal with the relationship between airport development and the surrounding region. Considering the social situation in recent years, they were criteria that needed to be consulted in depth.

The council's responsibility was to evaluate different expansion options objectively. Actual implementation of the decision was left to the government bodies. The seven criteria were broken down in detail and evaluation standards were set forth for each of them.

Nomination of candidate locations

In nominating the candidate location, the council first considered the possibility of inland as well as sea areas. At the early stages of the consultation, however, inland location was dropped since level terrain in the Kansai region such as Osaka, Harima, Kyoto and Nara have already been heavily populated and segregated by mountains so that it was inevitable to cause noise issues if a new airport would be constructed.

Figure 5.2. **Candidates for airport location**



Source: Aviation Council, 1974.

According to MOT's preliminary research, there were seven potential off-shore locations: Sennan, Kishiwada, Nishinomiya, Rokko, Port Island, Akashi and Awajishima. The council reviewed these candidates and confirmed that there were no other to be considered. Also, Sennan and Kishiwada were consolidated as a single candidate of off-shore Senshu. Nishinomiya and Rokko were dropped since they were too close to the coast line and Port Island was renamed as off-shore Kobe. Akashi was reclassified as Harimanada including a wider area.

The island of Awajishima was initially considered as an option. After detailed research of the area, however, it was noted that there were residents that would be affected by aircraft noise level above 70 WECPNL[6]. Also, significant natural destruction was inevitable if an airport were to be developed.

Therefore, Awajishma was dropped, and in-depth considerations were made for the three remaining candidates: Senshu, Kobe and Harimanada.

Assessment of the seven criteria on three candidate locations

Flight paths and airport capacity

Capacity of an airport would be determined based on its flight paths. If the air space has sufficient room for the flight paths to be set straight in both take-off and landing, it would enable independent operation of a parallel set of runways. Then the airport could accommodate up to 190 000-200 000 take-offs and landings per year. This was the case of Harimanada. As for both Senshu and Kobe, although it was confirmed from simulations that flying over land area instead of circumventing it would not violate the environmental standard, the council chose to assess the capacity of these airports with flight paths restricted to the airspace above Osaka Bay so that any concern over the noise issue would be alleviated. The capacity assessment was between 150 000 to 160 000 take-offs and landings per year for these two airports.

According to the meteorological research, wind coverage ratio for Harimanada and Kobe was 98-99%, but for Senshu it would be approximately 94%. Therefore it was considered that Senshu would require a cross-wind runway.

Convenience for users

Convenience for users depends on the ease of access to the airport from residential and business areas. From this perspective, the question of how the new airport could be linked to existing and planned railway and road networks was assessed for each location. As for Senshu and Kobe, it is relatively simple to connect the airport to the network. However, in the case of Harimanada, considering the long distance to the populated area of Kansai, it would need a dedicated high-speed railway. Construction of such a railway would be a handicap for Harimanada.

Numerical representation of the utility level of each location was conducted. Volume of passengers travelling through a specific airport location is a function of generalised cost of access to the airport, i.e., out-of-the-pocket costs plus the monetary value of how long it takes to reach the airport. Compared to the benchmark index figure of 100 for passengers using Itami Airport, Senshu, Kobe and Harimanada would be 80, 85 and 55 respectively.

Construction issues

Reclaiming an island by landfill is an established construction method for utilising sea area. There are also other methods such as pier type or floating type facilities. The landfill method, however, is the most commonly used, technologically viable and relatively cost efficient. So the council adopted the land fill method as a means of reclaiming the sea.

In assessing the necessary area of land to be reclaimed, it was assumed that construction would comprise building runways and terminals in an integrated manner, rather than reclaiming the sea only for the runway and constructing the terminals in the costal zones.

As for Harimanada, the seabed is firm so the construction is easy. A bridge could be built to connect the airport to the coastal area. Both Kobe and Senshu have soft sea beds. Therefore both locations would be more challenging in terms of construction engineering and maintenance. As for Kobe, there is a need for an underwater tunnel to connect the airport to the coastal area; this would significantly increase the technological difficulty and construction cost. As for Senshu, there is no need for an underwater tunnel but the need for a cross-wind runway increases construction volume and cost. The estimate of infrastructure cost is listed in Table 5.1.

Table 5.1. **Estimated infrastructure cost (Billion JPY)**

	Senshu	Kobe	Harimanada
Reclaiming cost	530	450	270
Transport linkage to coastal area	40	120	50
Note 1: Cost of runway, taxi-way, terminals, ATC facilities are not included			
Note 2: Cost was assessed based on transport linkage for Kobe as under-water tunnel, whereas a bridge was assumed for Senshu and Harimanada.			
Note 3: Prices are in 1972 current prices.			

Environmental impacts

- Noise impacts

There was strong concern about the noise issue even though the candidate locations were offshore. At the outset of the consultation process, the council put great effort in gathering noise data. The council organised a series of test flights and measured the noise level in the candidate locations. The noise level of aircraft flying in a similar manner at Tokyo Bay was also collected.

The environmental threshold under the Aircraft Noise Abatement Law enacted in 1967 has been 70 WECPNL. If the zone above 70 WECPNL eclipses a residential area, specific abatement measures are required. WECPNL is calculated under specific conditions and manifested in the form of a contour line. The council conducted the calculation for each location based on the conditions listed in Table 5.2.

All the residential areas of the three locations were confirmed to be below 70 WECPNL. However, as for Kobe, contour of 70 WECPNL was somewhat close to Tarumi Ward of Kobe City and Iwaya of Awaji Town.

Table 5.2. **Conditions of WECPNL simulation**

	Conditions						Notes
Types of aircrafts	International			Domestic			Airbus includes L1011, DC10; Others include DC9, YS11, YX
	B747	Airbus	Others	B747	Airbus	Others	
	30%	10%	0%	10%	10%	40%	
Aircraft movements	Senshu		Kobe		Harimanada		Micro-ILS, RNAV
	160		160		200		annual (thousands)
	438		438		543		per day
Direction of runway usage	50% in each direction						
Ratio of daytime & night time usage	International			Domestic			Daytime: 7:00-19:00
	Daytime	Evening	Night	Daytime	Evening	Night	Evening: 19:00-22:00
	65%	20%	15%	85%	15%	0%	Night: 22:00-7:00

- Air pollution

There was no difference in air pollution effect to nearby costal zones in each location and environmental standards were met. However, in the case of offshore Kobe, there was a need for an underwater tunnel to connect the airport to the coast. Automobile gas coming out from the tunnel's exhaust pipe could cause a problem in specific areas.

Concentration level of aggregate NOx emission in each of the nearby area compiled by "Air pollution in Japan, FY1973" (Environment Agency) for offshore Kobe and Harimanada. It was a two-day air pollution survey carried out by MOT in August 1973. The results were as follows:

- Senshu: 0.006 ppm[7] (Izumisano City)
- Kobe: 0.040 ppm (Nada Ward, Kobe City)
- Harimanada: 0.036 ppm (Takasago City)

From the regional aggregate NOx pollution point of view, compared to the maximum cap of 0.02 ppm per average hour of a day, offshore Kobe and Harimanada have problems.

- Impact on tide and water contamination

Impact on tide and water contamination was marginal for all the locations and there was no significant difference between them.

- Impact from collecting soil for reclaiming

There was no significant difference between the candidate locations in impact from collecting soil for reclaiming.

Co-ordination with vested interests

Since the airport was proposed to be constructed 5 km offshore, there was no direct physical impact on ports and harbours.

There was, however, conflict between the airport and vessels coming in and out of the ports, particularly at Kobe. If the airport was constructed in the gateway to the Port of Kobe and adjacent to east-west route of the Osaka Bay, it would significantly impact navigation of vessels. There were also issues related to exhaust pipes from the underwater tunnel affecting the routes which would necessitate moving the quarantine-designated area elsewhere. Navigation of vessels could be accommodated by redesigning the routes and quarantine area, but compared to other locations there were substantial issues for Kobe.

As for Harimanada, although it was not as significant as Kobe's case, there was a need to change navigation routes for vessels coming in and out of the Port of Higashi-Harima.

Osaka Bay is often used as an evacuation zone for vessels in case of harsh weather like Typhoons. Compared to Harimanada, which is outside Osaka Bay and has a wider area, Senshu and Kobe would have some impact on available space for vessels seeking refuge.

If an airport was to be constructed on a reclaimed island, there would be a loss of fishery area as well as impact on places for fish to manoeuvre around during their lifecycle. To what extent the fishery would be affected by airport construction depends on surrounding natural conditions, resource endowment, fishery methods being used, etc. The expected scope and magnitude of impact differed for each candidate location.

For Senshu, the fishery volume in Osaka ranked low in national terms and the effect was insignificant In the southern part of Osaka, however, which would be within the location of the potential airport site, the fishery was relatively active. Fishery has diminished in Kobe due to urbanisation so the impact was negligible. Harimanada was close to an excellent fishing spot of Shikanose and the impact was significantly larger than in other locations.

Integrity with future vision of the surrounding region

It is important that the new airport is integrated and assimilated into the future vision of the surrounding region.

For Senshu, if airport related projects were conducted in line with the overall regional plan it would lead to integrated development of the region. Kobe, on the other hand, had a vision to control further concentration of population and industry. Construction of airport was inconsistent with the basic land-use plan.

Harimanada had a large-scale development plan of the inland region and airport development was not necessarily incompatible with it. However, considering the status of bayside industry and the long distance to the city centre, the beneficial impact of airport development on the local economic development would be limited.

Regional development effect

Airport development would lead to regional economic spill over effects such as new job opportunities and tax revenue for local governments. Airport development and future direction of the region need to be consistent for the economic spill over effect to be realised. Therefore, quantitative assessment should be put off and the airport development's integrity with regional plans should take precedence in terms of evaluation criteria.

Evaluation procedure

The procedure regarding how to consolidate the evaluations of multiple criteria was determined by the council. First, the pro rata ratio of the seven criteria was to be decided by averaging the points assigned by each of the council members through voting (excluding government representatives). Each council member would be given 1 000 points to allocate among the seven criteria and the points given to each criteria were aggregated to derive the pro rata ratio. Second, council members (excluding government representatives) would evaluate each criterion of the three candidates with a maximum of ten points. After aggregating each candidate’s points, the pro rata ratio of the respective criteria would be applied to derive each candidate’s total points. The total points of each of the candidate location would be used as the ranking for location selection.

On 17 July 1974, the Airport Division of the Aviation Council conducted voting by the members excluding those from the government. There were seventeen non-ministerial members that exercised votes. Voting was undertaken based on all the relevant documents presented to the Airport Division during the three years of consultation process.

The results of voting on the pro rata ratio are listed on Table 5.3. Convenience for users was appropriated the highest ratio of 21.7% followed by flight paths and airport capacity (19.9%), environmental impact (18.8%) and construction issues (12.4%). The results of voting on candidate locations by criteria are listed in Table 5.4.

Table 5.3. **Result of votes on pro rata ratio**

Criteria	Total	Pro rata ratio
Flight paths and airport capacity	3 390	199
Convenience for users	3 690	217
Construction issues	2 110	124
Environmental impacts	3 190	188
Coordination with vested interests	1 510	89
Integrity with vision of region	1 560	92
Regional development effect	1 550	91
Total (n=7)	17 000	1 000

Table 5.4. **Result of votes on each candidate**

Criteria/Member	Senshu	Kobe	Harimanada
Flight paths and airport capacity	137.5	124.0	155.0
Convenience for users	139.5	152.0	95.5
Construction issues	132.9	119.0	145.0
Environmental impacts	143.0	119.0	141.0
Coordination with vested interests	144.9	113.5	105.0
Integrity with vision of region	147.0	111.0	132.5
Regional development effect	144.5	109.5	127.5

Each candidate's total points, listed on Table 5.5, were derived by applying the pro rata ratio on the results listed on Table 5.4.

Table 5.5. **Each candidate's total points**

Criteria/Member	Senshu	Kobe	Harimanada
Flight path and airport capacity	27 362.5	24 676.0	30 845.0
Convenience for users	30 271.5	32 984.0	20 723.5
Construction issues	16 479.6	14 756.0	17 980.0

Environmental impact	26 884.0	22 372.0	26 508.0
Construction	16 479.6	14 756.0	17 980.0
Coordination with vested interests	12 896.1	10 101.5	9 345.0
Integrity with vision of region	13 524.0	10 212.0	12 190.0
Regional development effect	13 149.5	9 964.5	11 602.5
Total	140 567.2	125 066.0	129 194.0
100 percentile of maximum point	82.7	73.6	76.0

As a result, offshore Senshu achieved the highest total points. The council decided to recommend offshore Senshu as the best location for the new airport.

Implementation of the Council Report

Exasperated by the noise issue at Itami Airport, the Mayor of Kobe had announced his opposition in the 1973 election. The southern part of Osaka where Senshu was located had a similar reaction from the municipal assemblies. NIMBY sentiment was strong. In addition, spill over of resentment against airport construction at Narita had detrimental effects on the Kansai project. In 1976 when the MOT constructed an observation tower, they had to promise it would be without prejudice to the site selection. Following research on climate, natural and social conditions, airport configuration and environmental impacts of constructing the new airport offshore Senshu, in November 1979, MOT once again commissioned the Aviation Council to devise a plan for construction of the Kansai Airport. The Aviation Council reviewed the off-shore Senshu plan in terms of runway configuration (length, number, direction, location and capacity), airspace and air route plan, construction method (landfill, pier type or floating type) and airport facility plan (size, shape and facility allocation). Discussions were centred around the construction method and in September 1980 the council compiled a report, often referred to as the “Second Report,” in which landfill was recommended as the construction method.

In 1981, MOT delivered the so called "San-ten-setto" (meaning "a set of three documents") composed of: a plan of Kansai airport, an environmental impact analysis and a vision of regional development.

Osaka Prefecture, followed by Wakayama Prefecture and Hyogo Prefecture agreed to MOT's policy in 1982. Kansai International Airport Company (KIAC) was established in 1984 as the first private finance initiative (PFI) project in Japan, and administrative procedures including compensation to the fishery industry moved ahead. After extensive preparation and co-ordination, reclaiming was finally initiated in 1987. On 4 September 1994, Kansai Airport was opened with a single runway of 3 500 m. In 2001, landfill measures were started for the second runway. The second-phase island with the 4 000 m runway was opened in 2007 enabling around-the-clock operation. Due to advances in aircraft technology, there has been no need for a cross-wind runway.

Repercussions of high capital cost and subsequent airport reform

By the time Kansai Airport commenced service, its accumulated long-term debt had reached JPY 1 trillion. Moreover, 9/11 affected airline networks at Kansai Airport and thus its revenue. Faced with potential credit risk, the central government began to inject subsidy of JPY 9 billion into KIAC in FY2003.

In 2012, Kansai Airport and Itami Airport were integrated within the New Kansai International Airport Company (NKIAC), a 100% central government-owned entity. In so doing, resources and cash flow from both airports were pooled in NKIAC. Furthermore, in order to enhance service and secure expedited service of debt, operational rights for 44 years were sold to a consortium of private firms which began its operation on 1 April 2016. This fundamental restructuring and innovative way of cross-funding the infrastructure has enabled a phase-out of the subsidy.

Construction of Kobe Airport

Construction of Kobe Airport, which opened in 2006, has been and still is a controversial issue. In order to understand it, we need to consider categories of airports in Japan.

Airports in Japan are categorised as follows:

a) International airports: Haneda, Narita, Kansai, Itami[8] and Chubu
    i) Special corporations: Narita, Kansai, Itami and Chubu
    ii) Owned and operated by central government: Haneda (Itami had been under this category until 2012)
b) National airports: e.g. Sapporo, developed and operated by central government
c) Local airports: e.g. Kobe, developed and operated by local governments.

In the early 1990's, when Kansai Airport was being constructed, Kobe City changed its position about airport construction. City development at Kobe had conventionally proceeded by cultivating the northern mountainous areas and using the soil for reclaiming the bay side. The idea of reclaiming the bay side for airport construction was controversial and citizens were split on the issue. The Hanshin-Awaji earthquake in 1995 tipped the scales and it was finally decided to build a "local airport." It opened in 2006 as a domestic airport, but due to the air route conflict with Kansai Airport daily operation has been limited to 15 hours with 60 take-off and landings, which account for approximately 20 000 annually. The city of Kobe is currently seeking to sell the operational rights of the airport to private investors with a view to having the operator of Kansai Airport and Itami Airport integrate Kobe Airport.[9]

Conclusion: The importance of the deliberation process

Compared to only four months of deliberation yielding just six pages of report and one diagram showing the layout of the airport for Narita Airport, the same Aviation Council that delivered the report on Kansai Airport took two years and ten months for deliberation before submitting the 867-paged final report and relevant documents including minutes of the meetings, supporting evidences and a significant number of data and diagrams (Figure 5.3). Even after extensive deliberation by the Aviation Council, it took seven more years after the delivery of the Council Report before reclaiming works finally began at offshore Senshu. But it was significantly shorter than the time it took to resolve the devastating situation that prolonged construction for decades at Narita. History speaks for itself.

Figure 5.3. **Aviation Council documents**

Note: To the left, six pages of documents and one diagram for Narita Airport, and to the right, 867 pages of documents for Kansai Airport.

Inland vs. offshore

In a country like Japan where land suitable for airport location is scarce, it is inevitable that any search for a potential site extends far out from the urban area or out towards the sea. More remote inland sites in suburban areas could alleviate noise issues in the urban residential zones but such a location not only has challenges to overcome in terms of accessibility, but is also difficult in terms of land acquisition from private owners including farmers.

On the other hand, off-shore sites do not face land acquisition issues. If the site is located far enough from the coast to prevent aircraft noise from affecting the residential area, and co-ordination with the fishery industry and marine environmental issues can be settled, then the feasibility of the plan is relatively high. It does, however, involve high capital cost. Thus, cost benefit analysis (CBA)[10] and financial viability of the plan need emphasis. It could be said that high capital costs of off-shore sites are in effect internalising the negative externality (noise). So there is trade-off between inland and off-shore sites.

Implications to airport site selection in metropolitan areas

The airport site selection process in Kansai could be regarded as a reference for other metropolitan areas. It should be noted, however, that since the new airport was initially conceived to replace the existing one, CBA was not a critical issue. It was obvious that Kansai needed new infrastructure to meet growing demand. It should also be recognized that there was NIMBY sentiment in the region and it was imperative to select a site that would not cause noise issue. Thus, all the candidates were offshore. This is not to say that an off-shore site is always recommended in a metropolitan setting. Although it is often the case that a feasible location could only be found off-shore, it depends on geography. It is difficult to determine, a priori, whether off-shore is better than inland, since every region is different and each option has pros and cons.

Experience from Narita Airport and Kansai Airport suggests that if an inland site is to be chosen, the process of identifying and acquiring the land for an optimal location takes time. Even if there are requests from local constituencies to construct a new airport in the region, the voices of the actual owners of the land may be different. For land acquisition to be socially acceptable, democratic consultation with public involvement is necessary. An off-shore site does not mean that deliberation process is simple. However, relative to an inland site, the major challenge is project funding because capital costs tend to be significantly higher.

An objective comparison of an inland vs. an offshore location is challenging. The negative externalities associated with inland sites would have to be monetised to be included in the assessment the criteria. A comprehensive CBA that factors in all the monetary elements is indispensable when comparing the two.

Notes

[1] Formal names of Narita Airport and Kansai Airport are Narita International Airport (New Tokyo International Airport until 2004) and Kansai International Airport respectively, but in this chapter, commonly referred short names are used. Likewise, Haneda Airport and Itami Airport are used instead of Tokyo International Airport and Osaka International Airport respectively.

[2] Yamaguchi (2013).

[3] Ministry of Transport was integrated with other ministries in 2001 to become Ministry of Land, Infrastructure, Transport and Tourism (MLIT).

[4] See Annex 5.1 for the Council Report.

[5] See Annex 5.2 for the Aviation Council's report and Annex 5.3 for details of the consultation process.

[6] WECPNL = Weighted Equivalent Continuous Perceived Noise Level.

[7] Ppm = parts per million.

[8] Itami Airport is formally classified as an international airport, but all the operation has been transferred to Kansai Airport except for some own-use charter flights.

[9] Number of annual passengers (FY2014): Kansai, 13.5 million international, 6.5 million domestic; Itami, 14.6 million domestic; Kobe, 2.4 million domestic.

[10] CBA - Cost-benefit analysis - would involve demand forecasting. If domestic demand is limited, assessment of international demand, inter alia, international transit demand would be critical. This, however, is a challenging task.

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Annex 5.1. "Location and size of New Tokyo International Airport"

Aviation Council, Ministry of Transport, 11 December 1963

(Provisional translation by the author)

With technological improvement of aircraft, it is said that a transport revolution is now happening around the world. Air transport has shown dramatic growth in Japan increasing ten-fold in the past decade. It is expected that with economic growth and income increase in recent years, this trend would continue towards the future.

Tokyo International Airport – Haneda, our national gateway airport, has been increasing scheduled flights following this trend, and in FY1962 annual aircraft movement has reached 50 000 and annual number of passengers 2.5 million. Infrastructure of Tokyo International Airport, however, is limited to area of 350 ha with a single main runway of 3 000 m, and in comparison to international airports in major nations, it is indeed minimum in size. If the growth in number of passengers and aircraft movement continues to increase, it is expected to reach capacity by 1970 even when considering future facility development.

Major airlines worldwide as well as Japan Airlines have ordered newly developed supersonic aircraft and their inauguration are expected by 1970-71. Currently, Tokyo International Airport is incapable of accommodating these supersonic aircrafts and without any change, the Japanese position in global air routes would diminish to a local terminal in the east. Looking at other nations, every nation is planning to develop mega-airports to facilitate such circumstances. Washington Dulles Airport which opened last autumn has 4 000 ha of land and mega-airports, with 2 500-4 000 ha areas planned in Paris, New York and Hamburg, etc.

With long-term projection into the future, we deem that it is imperative to expedite powerful measures to construct a mega-airport in the vicinity of the capital city. Based on such understanding, this council has reached the following conclusion regarding “Location and size of New Tokyo International Airport”.

Size of the new airport

A large area of land is necessary for airport construction. However, having sufficient air space is even more important. There are already a number of aerodromes surrounding Tokyo and what is left of air space is limited. Taking this into account, it is almost impossible to locate an airport in addition to the new airport. It is therefore necessary to hold a basic stance to construct an airport that could accommodate as much capacity as possible rather that constructing a half-sufficient sized airport.

The basis of the decision with respect to the size of the airport should be to consider future demand of Tokyo district and thus the number of aircraft movements that the new airport is capable of facilitating and the types of aircrafts to be accommodated in an airport of Tokyo, which has strategic importance to global international air transport.

Bearing in mind general use of air transport in Europe and USA and economic growth rate of Japan it is expected that future demand of air transport in Tokyo district would continue to be strong into the future. Even if growth rate slows down after 1970, it is expected to reach a ten-fold increase within twenty years from now.

As for the aircraft types ahead, it is difficult to foresee the future under such rapid technological advance in recent years, however, it is at least necessary to take into account supersonic aircrafts that are being ordered in major states around the world.

The new airport should be capable of accommodating such quantitative and qualitative aspects of aircrafts and the size of the airport. An airport that would suffice these needs would be determined by the length and the number and the physical deployments of the runways.

The new airport should have at least two main runways, two secondary runways and one cross-wind runway, and they should be deployed parallel to allow independent efficient operation. Also, in order to accommodate supersonic aircrafts main runway should have length of approximately 4 000 m.

Furthermore, based on the configuration of these runways, apron, terminal building, maintenance centres, automobile parking lots and various buildings should be allocated adequately.

The most efficient layout of the new airport would be one depicted in Figure A.1 with 2 300 ha of land.

Noise abatement should be taken into account. With the advent of turbo-jet aircrafts noise issue has become a severe problem for airports and in constructing the new airport it is necessary to have sufficient measures, such as the development of buffer zones.

Location of the new airport

The first factor in considering the location of the new airport is the air space. This is because it has a profound impact on safety of aircrafts and efficiency of operation. Significant air space above the Tokyo metropolitan area is already occupied by existing aerodromes. In particular, the west side of the Tokyo metropolitan area is completely allocated to Iruma-gawa, Yokota, Tachikawa and Atsugi air bases and there is no room at this stage. Air space above mid Tokyo Bay, Kisarazu district in particular, is the critical route for aircrafts landing at Haneda Airport and if we are not to abandon the airport there is no feasibility in this area. When we consider that Haneda Airport is not only very close to the central business district (only 15 minutes away by highway) and convenient, but it is also capable of accommodating a large number of annual aircraft movement at 175 000 and there is considerable amount of capital investment planned towards 1970, there is no option to abandon the airport. Furthermore, it should be noted that there are multiple airports in major cities in various nations.

On the other hand, a variety of factors need to be considered in land conditions, however, for now, we considered areas where a significant amount of flat land is available and habitation is sparse. As for places in the sea, industrial and port/harbour areas unsuited for reclaiming land were omitted.

From such a perspective, the options of a new airport location are quite limited. The council considered three possible locations for the new airport: Urayasu, Chiba Prefecture, around Kasumigaura, Ibaragi Prefecture and around Tomisato Village, Chiba Prefecture. We considered various aspects pertaining to these locations, inter alia, the following factors:

- relationship with air traffic control concerning other airports
- meteorological conditions
- construction engineering issues
- access to the city centre

Among these factors, the relationship with air traffic control concerning other airports directly impacts safety of aircrafts and efficient airport operation. Thus, the strongest emphasis was placed on this factor in considering the location. The following is the gist of characteristics of each location.

Urayasu, Chiba Prefecture

Direct distance to this district is only 13 km to the city centre and it should be considered as the most convenient location from a user-benefit point of view.

The critical problem with this location is the relationship with air traffic control of Haneda Airport. Since air space above the Tokyo Bay is used for take-off and landing at Haneda Airport, there is little room for co-ordination even if ATC engineering is fully deployed. If capacity of the new airport were to be fully utilised at this location, annual capacity would diminish to one-sixth of the current level and in some wind conditions it would be impossible to accommodate scheduled flights at Haneda Airport.

As for reclaiming land, engineering difficulty depends on how far offshore it would be conducted. It is quite simple if it is reclaiming land adjacent to the shore, but if it is necessary from noise abatement perspective to build at least 2 km offshore there would be significant engineering difficulty coupled with twice as high reclaiming costs compared to inland locations.

As for the meteorological condition, it is similar to the current Haneda Airport and there seems to be no problem at this stage, although there may be problems if the bay area continues to undergo industrial development resulting in heavy smog affecting airport operations.

Around Kasumigaura, Ibaragi Prefecture

Regarding the relationship with air traffic control concerning other airports, this location has issues related to the Hyakuri Air Base. Bearing in mind the aircraft used at Hyakuri Air Base, it is not impossible to set the direction of the runway at Inashiki Daichi to be compatible with Hyakuri Air Base, however, operation at Hyakuri Air Base would inevitably be affected severely.

Reclaiming lake area would be too close to Hyakuri Air Base and the two would be incompatible. As for meteorological condition, there is nothing problematic in terms of fog or smog. Inashiki Daichi is relatively flat with firm foundation so there is no issue related to construction engineering. With respect to reclaiming lake area coordination with drainage plan is necessary to prevent floods. Finally, the distance from Inashiki Daichi to the city centre is approximately 52 km away and if a highway is constructed it would be accessible within an hour so that user benefit would not be greatly affected.

Around Tomisato Village, Chiba Prefecture

This location does not have many problems regarding the relationship with air traffic control concerning other airports. As for meteorological conditions, there is no particular issue in terms of fog or smog and calm wind condition allows direction of the runways to be deployed rather flexibly. Land conditions are even more flat than Inshiki Daichi, Kasumigaura, and diluvial formations provide favourable terrain conditions for construction engineering. Compared to Kasumigaura district, the distance to the city centre is slightly closer at 50 km.

In consolidating various conditions, Tomisato Village, Chiba Prefecture is the most appropriate location, and if there is satisfactory co-ordination with the Self Defence Agency, Kasumigaura region is another appropriate location. The offshore area of Urayasu is inappropriate mainly from the viewpoint of air traffic control.

Annex 5.2. "Size and location of Kansai International Airport"

Aviation Council, Ministry of Transport, 13 August 1974

(Provisional translation by the author)

Size and location

Location of Kansai International Airport, on condition that Osaka International Airport shall be abolished, should be offshore of Senshu in southeast part of the Osaka Bay, with a pair of 4 000 m runways (two parallel runways at least 300 m apart) which is considered as the minimum configuration of a reclaimed international airport, plus one cross-wind runway of at least 3 200 m as a supplementary runway. The exact location of the airport, however, should be determined based on detailed survey of the location.

Reasoning behind the decision

Consultation inquiry from the Minister to this Council was based on the understanding that Osaka International Airport alone cannot accommodate growing air transport demand of Kansai region and it is necessary to construct a new airport.

Since the consultation was initiated on 13 October 1971, the council took every possible effort in considering a new airport, particularly a new airport without pollution. We therefore spent considerable time in discussing basic issues regarding air space, environmental conservation, construction engineering, regional impacts, etc. We reviewed air traffic control and aircraft operation procedures as well as airport capacity based on environmental standard regarding noise level implemented in 1973. As a result, we reached the conclusion that if the new airport is located on the sea it is very well possible to construct a new airport without any pollution in the Kansai district.

During consultation, rapid change in economic and social situations in and out of the country has led to severe situation for air transport in Japan.

At Osaka International Airport, with the advent of turbo-jet aircrafts in 1964, severe noise issues had occurred, coupled with rapid urbanisation of the surrounding region. Strict regulation of frequencies, etc., had been introduced to accommodate voices of residents surrounding the airport, and this has led to unfulfilled obligation on the part of the Japanese government causing unfaithful responses to other nations. Noise issues were coupled with the decision of the primary court on residents' claim leading to further turmoil, and today, it has reach a point in which continuation of the airport operation is being questioned.

First, the council conceived that it is of great imminence to resolve the noise issue at Osaka International Airport and thus the new airport should be considered on condition that Osaka International Airport shall be abolished, so that the new airport should provide sufficient capacity to replace its function.

Second, the long-term national economic plan that serves as the basis of air transport demand forecast needs to be reviewed amid rising social concern on environmental issues and problems regarding raw material and energy including oil, etc. The central government is currently reviewing the plan. However, it is expected to take some time to reach a conclusion. It is, therefore, difficult to derive a reliable air transport demand forecast at this stage.

With the growing population and improving level of life, economic growth itself could not be undermined although the growth rate is difficult to predict. When we consider the importance of air transport and its public role on economic and cultural aspects, we cannot neglect the importance of airport function in the Kansai region.

Taking into account that, first, it is imperative to fundamentally resolve the noise issue at Osaka International Airport, and second, air transport demand would increase regardless of how the log-term national economic plan is going to be reviewed, etc., the council confirms that it is of imminent necessity to construct a new airport without any restriction from national or regional points of view. The council has thus conceived that the size and location of Kansai International Airport, on condition that Osaka International Airport shall be abolished, should be as follows.

As for the location, taking landscape, etc., of Kansai region into account, we initially identified four potential sites; off-shore Senshu, off-shore Kobe, Harimanada and Awajishima. Awajishima, however, was dropped because it was considered to have difficulty in solving noise issues. So the other three sites were considered and assessed for airport function, environmental concerns, regional plans, etc. Each of these potential sites has different characteristics and seemed to be appropriate, however, off-shore Senshu is considered as the best location for the new airport. Exact location of the airport, however, should be determined based on detailed survey of the location.

If the new airport is to be constructed at the site, issues regarding pollution would be avoided in the future. If the construction is conducted by taking both environmental conservation and interrelated development of airport and the adjacent region into account, co-ordinated prosperity in both sides would be achieved.

As for the size, it is difficult to discern whether one pair of runways is sufficient for air transport demand, the forecast of which is now being reviewed. It was decided however, that considering the imminent necessity of the airport, a pair of parallel runways plus one cross-wind runway would be the minimum requirement for the airport.

When the future air transport demand forecast is reviewed there may be a necessity to add a pair of runways but since it would be an issue to be discussed in a different time, we do not touch on the topic.

Annex 5.3. Calendar of events in Aviation Council regarding consultation of size and location of Kansai Airport

Date			Meetings etc.		Agenda	
1971	October	13	Aviation Council	29		Commission from the Minister of Transport
		27	Committee	1	1	Commission from the Minister of Transport
					2	Summary of past research
					3	How to proceed with consultations
	November	4	Committee	2	1	Noise issue regarding candidate sites
					2	Situation of air traffic control at candidate sites
					3	Necessity of Kansai Airport
		8	Noise survey #1			On-site aircraft noise survey (B747)
		18	Committee	3	1	Result of noise survey #1
					2	Necessity of Kansai Airport
		29	Noise survey #2			On-site aircraft noise survey (B727)
	December	1	Committee	4	1	Necessity of Kansai Airport
					2	Local situation of candidate sites
		6	Noise survey #3			On-site aircraft noise survey (B747)
		14	Committee	5	1	Result of noise survey #2, #3
						Summary of consultations
1972	January	26	Committee	6	1	Aircraft noise
	February	8	Committee	7	1	Construction engineering issues
					2	Construction method of underwater tunnel
		22	Committee	8	1	Construction engineering issues
					2	Connection of off-shore site to coastal zone
	March	6	Committee	9	1	Air pollution from airports
					2	Noise survey at Tokyo Bay
		14 - 16	Noise survey at Tokyo Bay			On-site aircraft noise survey
		21	Committee	10	1	Five-year national airport plan
					2	Interim report on noise survey at Tokyo Bay
					3	Airport planning and meteorological issues
					4	Meteorological condition at candidate sites
	April	4	Committee	11	1	Possibility of separating off-shore RW and terminal location
					2	Result of air transport demand survey

	May	9	Committee	12	1	Summary of three on-site noise survey
					2	Result of air transport demand survey
					3	Issues on underwater tunnel
		31	Committee	13		Construction method of Kansai Airport
	June	13	Committee	14		Airport access
		20	Committee	15	1	How to proceed with consultations
					2	Local situation of candidate sites
	July	4	Committee	16	1	Fishery at Osaka Bay and Harimanada
					2	Issues related to harbour & port planning and vessel traffic
		15, 16, 17	Noise survey at Chitose Airport			On-site aircraft noise survey
	August	1	Committee	17	1	Construction methods (land-fill, pier, floating)
					2	Result of noise survey at Chitose Airport
					3	Plan for on-site aircraft noise survey #4
					4	Plan of hearings from relevant regional representatives
		9	Noise survey #4			On-site aircraft noise survey (B747)
		15	Committee	18	1	Result of noise survey #4
					2	Effect of airport construction on sea current and water quality in Osaka Bay
		29, 30	Committee	19		Hearings from relevant regional representatives
	September	12	Committee	20	1	Air route and space for Kansai Airport
					2	Noise abatement measures at Itami Airport
					3	Summary of hearings on 19th Committee
	October	11	Committee	21	1	Plan for on-site aircraft noise survey #5, #6
					2	Air route and space for Kansai Airport
					3	Comparison of candidate sites
		24	Noise survey #5			Early-morning on-site aircraft noise survey (B747)
		25	Noise survey #6			Early-morning on-site aircraft noise survey (B747)
		31	Committee	22	1	Result of noise survey #5, #6
					2	Effect of airport on vessel operation
					3	Result of air quality survey (Environment Agency)
					4	Airport access

					5	Additional comments from relevant regional representatives
					6	Comparison of candidate sites
	November	21	Committee	23	1	Air duct from under-water tunnel
					2	Comparison of candidate sites
	December	5	Committee	24		Under-water tunnel (for off-shore Kobe)
			Inform discussion	1		How to proceed with consultations
1973	March	9	Inform discussion	2		How to proceed with consultations
	April	17	Inform discussion	3	1	Procedure of consultations
					2	Future of Itami Airport
					3	Noise standard and flight path
	May	29	Committee	25	1	Effect of airport access on air transport demand (1)
					2	Procedure of consultations
					3	Evaluation procedure of candidate sites
					4	Establishment of Subcommittee on General Affairs
	August	22 - 31	Air quality survey			On-site air quality survey at the three candidate sites
	October	26	Committee	26	1	Future of Itami Airport
					2	Effect of airport access on air transport demand (2)
					3	Regional plan surrounding the candidate sites
					4	Method of weighting importance of criteria
					5	Interim report of on-site air quality survey at the candidate sites
	November	6	Subcommittee	1	1	Election of chairman
					2	How to deal with Itami Airport
					3	Air navigation issues regarding Kansai Airport
		16	Site tour by Committee members			Site tour of Awajishima
		22	Subcommittee	2	1	Schedule of consultation
					2	Evaluation of candidate sites
					3	Weight of criteria
	December	4	Site tour by Committee members			Helicopter tour of the four candidate sites
		5	Site tour by Committee members			Tour of adjacent regions of Senshu and Harimanada

		12	Subcommittee	3		Aircraft noise environmental standard
		13	Inform discussion	4		Aircraft noise
1974	February	21	Subcommittee	4	1	Report from Environment Agency on aircraft noise environmental standard
					2	Noise contour of the candidate sites
		26	Inform discussion	5		Flight path and noise contour
	April	9	Subcommittee	5	1	Schedule of consultation
					2	Method of comparing candidate sites
					3	Contents of the Council Report
		24	Subcommittee	6	1	Skelton of the Council Report
					2	Attachments to the Council Report
	May	1	Subcommittee	7	1	Skelton of the Council Report
					2	Attachments to the Council Report
		22	Subcommittee	8		Draft of the Council Report
		29	Inform discussion	6	1	Schedule of consultation
					2	Draft of the Council Report
	June	12	Subcommittee	9		Draft of the Council Report
	July	12	Subcommittee	10		Draft of the Council Report
		17	Subcommittee	11		Subcommittee draft of the Council Report and explanatory documents
		17	Committee	27	1	Voting of pro rata ratio of the criteria and evaluation of candidate sites
					2	Selection of the best location through deriving each candidate's total points from the voting result
					3	Subcommittee draft of the Council Report and explanatory documents
		30	Committee	28		Committee draft of the Council Report and Proposition
	August	13	Committee	29	1	Committee draft of the Council Report and Proposition
					2	Report of Committee draft to the Council
		13	Council	32	1	Final Council Report
					2	Proposition regarding Kansai Airport

Chapter 6. Lisbon new international airport site selection criteria

Introduction

In recent years Portugal along with most other countries has seen an increasing emphasis on sustainability in decisions on transport infrastructure whereby environmental and social criteria are considered equally with economic criteria. This is particularly relevant in decisions concerning the construction of new airports or the expansion of its capacity provided its long-term implications with for economic growth, well-being and regional development processes.

This chapter addresses the case of the strategic environmental assessment of the new international airport for Lisbon, which was developed in 2007, and in particular the methodological aspects involved in using site selection criteria. Critical decision factors were identified to represent relevant sustainability themes for the decision, which were both strategic and integrated. Another particular aspect of the critical decision factors methodology is that all criteria have equal weighting, which enables environmental social and economic aspects to be considered with the same level of importance, thus avoiding inherent conflicts arising from preferences for short-term economic interests, often disregarding long-term environment and social aspects.

The chapter describes the methodological approach used to develop criteria for site selection as part of the strategic environmental assessment (SEA) developed in 2007. These criteria enabled the comparison of two potential sites for the new international airport in Lisbon in relation to its positive and the negative impacts. Lessons are drawn on advantages and disadvantages of this method.

The decision to build the airport was taken, at the time, in line with results achieved with the SEA. This may mean that the assessment was effective, and the criteria used were adequate, considering what was being discussed and assessed: optional locations for an international airport.

However, the unpredicted evolution of the European and world economy and political context after 2008 have led to the decision being postponed and the construction of the new Lisbon international airport being put on hold. By failing to incorporate uncertainty and other intangibles that go beyond technical and methodological considerations, the effectiveness of the SEA has been put into question.

This chapter has two purposes. The first is to share the methodology adopted and criteria used for site selection as part of the SEA. The second is to address the importance of strategic insight into the impacts of airports as major infrastructures of amplified relevance on the local and national economy.

Background

In the background of airport investment discussions there is the recognition that “decisions on expanding airport capacity are often controversial”, in particular due to economic versus environmental trade-offs, particularly in densely populated areas.

Transportation infrastructures can be structural to increasing productivity and economic growth. This rationale is adopted for most transport modes, on top of which there are restrictions associated with topographic and climatic factors, particularly in the case of airports and also seaports. A consequence of

this rationale has been the underestimation of both broad environmental and social aspects as relevant decision factors.

However, practice in the air transport sector has shown this rationale has not been fair, or correct, for two main reasons. First, having good air transport infrastructure does not necessarily imply better air transport services, which are equally a determinant of economic growth. And second, there is an increasing demand to include social and environmental considerations in the development process. This can perhaps be accomplished through improved environmental and social policies, but such socio-environmental demands are top priorities for citizens in general and residents who suffer from noise and air pollution, landscape degradation, loss of ecosystems, services, and safety issues in particular.

Decisions on new airports, or on the expansion of airport capacity, are highly complex decisions. Apart from multiple assessments which need to be considered, the policy maker also needs to consider uncertainties associated with global trends, national policies, constantly evolving consuming behaviours, technologies and changing nature of the airline business models. Dealing with such complexity requires systems and strategic thinking approaches to enable proceeding with decisions, which need to be carefully taken, and also monitored, allowing change if and when needed. There are no straightforward solutions.

The case of the new Lisbon international airport reveals a similar level of complexity. It has been, and still is, a difficult and controversial decision. Some detailed political aspects of the decision making process, between the 1960s and 2007, have been shared in Partidario and Coutinho (2011).

The decision to expand the Lisbon international airport was taken soon after the Lisbon city expansion engulfed the airport site. Several final decisions were reached at multiple moments throughout the years. However, they were questioned soon after, which indicates that this was a highly sensitive issue and, presumably, an insufficient rationale for the decision.

Multiple studies supported several decisions made over the years, starting with economic and accessibility studies, then incorporating increasingly environmental and social aspects after 1998. This reflects the evolving public conscience regarding environmental policies mentioned above, and the inevitability of its inclusion in decision-making. However, difficulties in reaching a decision result from limited strategic insight into the initiative, and lack for consideration for relevant, long-term significant aspects in a systematic and transparent way.

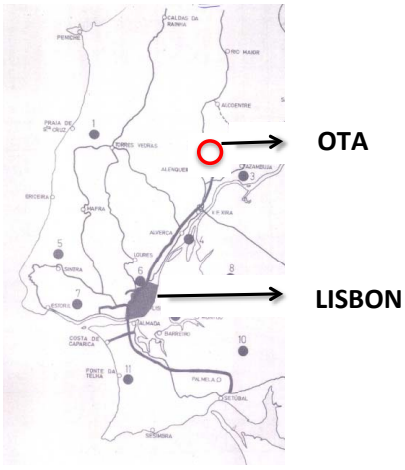
Throughout the years, the attempt to find the best location for the airport has been driven by the rationale “as close as possible and with the least costs”. There had been no attempts to consider a strategic rationale for the development of a transport service that could have a major impact on national and regional development patterns. There are many differences between these two rationales.

In the Lisbon case, each time a decision was to be taken only two or three site locations were tabled, and had very detailed studies developed. A site-specific analysis would normally be conducted for each specific location, rather than on a comparative basis, generating voluminous details and also multiple conflicting interpretations. Moreover, it would fail to capture the overall strategic dimension of the problem and lacked open and transparent debate, involving key stakeholders, who were driven by a common objective: if and how a new airport could increase productivity and economic growth while contributing to national and regional development.

Up to 2007, the choice of preferred sites was based on accessibility, costs and, after 1998, on the environmental, social and cultural impacts in the immediate vicinity of the physical location of the infrastructure. Studies developed independently for the two preferred sites at the time show how

environmental issues determined the decision in 2005 to build the airport at Ota, an optional location that was on the table since 1982.

Figure 6.1. **Ota location as the preferred site in 1999**



This decision was mostly based on two major aspects. First, the Rio Frio site, which was then the alternative location to Ota, was an important ecological corridor. It had the largest coverage of good ecological state cork trees in Portugal, a designated protected species as well as the related ecosystem (the *montado*). Second, Ota was preferred by a larger number of local authorities when compared to Rio Frio. Therefore, despite concerns related to limited potential for future potential for airport expansion, the government was particularly sensitive to the ecological impediments, and to the mayors lobby. Thus, a decision was taken to build the airport at Ota in 2005.

Following more than 40 years of economic and engineering studies, difficult debates, and many non-decisions, Ota was the site chosen. Consequently, while industry interests in the north and tourism interests in the south led a national debate against Ota, future development expectations at municipal and regional levels have since incorporated Ota into their planning. Until 2007, the government was set on the Ota option and opposed any change of location.

The Confederation of the Portuguese Industry (CIP – *Confederação da Indústria Portuguesa*), a private industry related organisation unhappy with the government's decision, proposed a more holistic approach to screen alternative locations while the environmental impact assessment (EIA) process was still in motion. This led to a new candidate site, revealing a possibly better option that had never been considered before. It was this step back, with an eye towards "the big picture" that placed the problem into context, and eventually led to a change of the government's decision.

Within one year, this discussion, and the subsequent strategic comparative assessments conducted by the government, with strategic insights into relevant, long-term, strategic issues that had not been considered before in a systematic and transparent way, caused the government decision to change. This process however had one major drawback. Only a comparative study was requested for the two potential airport locations: Ota and CTA (*Campo de Tiro de Alcochete*). The government commissioned a strategic environmental assessment (SEA) but the strategic exercise has been hindered by the limited location options. This helps to explain a more recent debate on the expansion of the Lisbon airport, addressed later in this chapter.

A strategic approach to the new airport location decision

In 2007, two separate initiatives contributed to a strategic approach to the decision on the location for the new airport. The option of building a new airport was not on the table and no studies or analyses were conducted to strategically question that need.

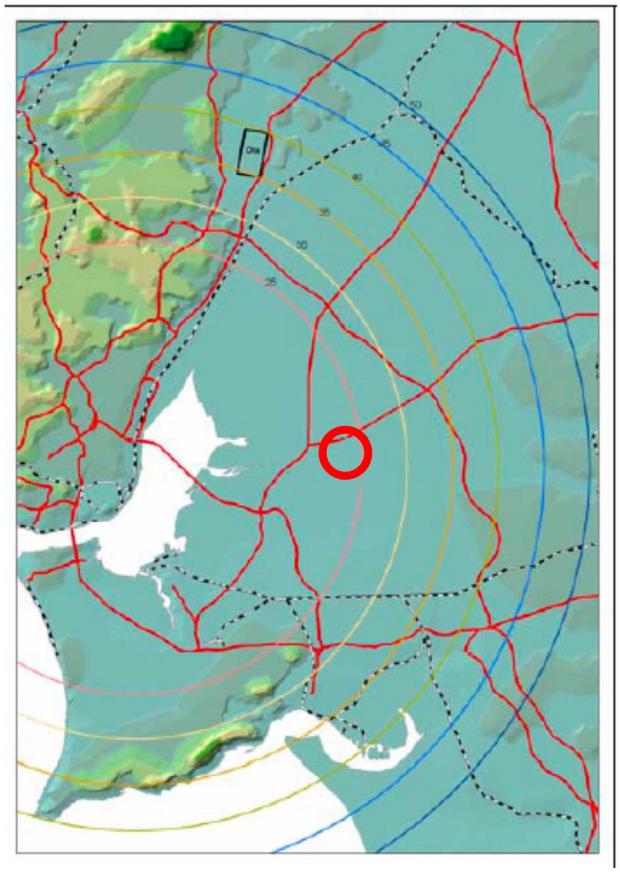
The first initiative was the CIP screening study above mentioned. CIP commissioned IDAD (Instituto do Ambiente e do Desenvolvimento) to study potential locations by screening the whole surrounding area up to 50 km from the centre of Lisbon, assisted by Geographical Information Systems (GIS) (Table 6.1). The objective of the IDAD study was to verify if it was possible to identify any new feasible sites by applying the same assumptions used in previous studies with new technological tools and recent environmental data, using various viewpoints.

With this screening exercise a new site was identified (CTA), a Portuguese Air Force facility that had never been considered in previous studies, which could avoid many of the topographic, climatic problems, and consequently additional costs, identified at the Ota site.

Table 6.1. **IDAD screening study criteria for site identification**

Selection of screening area:	GIS overlapped themes
• 50 km linear from Gare Oriente • Avoid high slopes • Avoid overlap with natural designated areas • Increase distance to the ecological corridor defined by Tagus-Sado • Minimise effects on cork trees (montado) area • Minimise effects on wetlands • Minimise population affected	• Geology and geomorphology • Hydrogeology • Areas of natural interest • Forestry areas • Population distribution • Archaeological, cultural heritage • Legally protected areas
Site selection viewpoints: • International connections • Regional development of the Lisbon metropolitan area • Relevance for tourism and industrial development • Ecological sensitivity • Physical features and infrastructures • Population and mobility	

Figure 6.2. **Ota and CTA site selection based on IDAD study**



Source: LNEC, 2007.

Confronted with the results of the CIP initiative, in June 2007 the government commissioned a Strategic Environmental Assessment (SEA) to the National Laboratory of Civil Engineering, to help decide between the two optional sites (Ota and CTA). It was to be delivered within six months. This was the second initiative of the strategic approach.

According to the SEA legal requirements in Portugal, under the framework of the European Directive 2001/42/CE, the SEA should deliver an environmental report with the assessment of the potential environmental effects of the two locations, Ota and Rio Frio. This remains true even though the available information for each site was quite different, considering there had been multiple studies conducted on Ota over the previous eight years. This traditional approach was however recognisably insufficient to consider the economic and social dimensions together with the environmental dimensions in a more strategic perspective.

Given the more than 40 years of history surrounding the decision, and the strategic relevance of the airport expansion for national and regional development, the government decided to use a more strategic methodological framework (Partidario, 2007). This methodology allowed the analysis to look beyond the environmental effects of building an airport in two alternative locations. Instead, the SEA explored the sustainable development conditions that would enable a decision considering the environmental, social, economic, territorial, financial, political and cultural aspects altogether.

This methodological approach to SEA (Partidario, 2007, 2012) starts by understanding the strategic context and objectives, including what matters to the main actors, including those that have no decision power but should also be beneficiaries, even if indirectly. This enables defining the problem in a broad and holistic sense, which accounts for the policy and institutional contexts. It establishes an assessment framework that is underpinned by success factors required for a sustainable future, the Critical Decision Factors. The assessment framework is structured by assessment criteria for each critical decision factor. It uses indicators as the metrics of the assessment, and applies to the assessment of strategic alternative options for airport expansion. The rationale is therefore to assess opportunities and risks of pursuing certain strategic options and longer-term priorities. It also has the advantage of issuing guidelines for future planning and management of airport expansion activities.

The critical decision factors represent what is crucial for decision-making. The critical decision factors define the core concerns which are to be addressed in the strategic assessment. As such, the critical decision factors must recognise the intertwining of multiple dimensions – technical, policy, sectoral, regional, environmental and other. In addition, they must bridge (or facilitate the bridging of) different actors' perspectives on aspects relevant to planning and assessment of the initiative from early stages. In order to keep the strategic focus, no more than seven critical decision factors should be identified (preferably between three and five).

The objective of the SEA was therefore to support a strategic decision, which accounts for the risks and opportunities of two alternative locations, and not to demonstrate negative effects of site occupation. This SEA was instrumental in establishing criteria for site selection; the critical decision factors and assessment criteria were the tools used for that purpose. The object of assessment in the SEA was the strategic location of a major infrastructure asset given its strategic relevance for national and international development.

The methodological approach adopted in this SEA included five main steps:

1. establishment of the assessment framework – identification of critical decision factors and of assessment criteria and indicators for comparative assessment of the two location sites

2. scenario development considering possible futures, the future role of the airport for national and regional development, considering the international context and future trends, and the intended options for airport masterplan and governance model

3. a strategic diagnosis, looking into past and future trends, using indicators (quantitative and qualitative) and also separating between descriptive indicators (general diagnosis, sometimes including details for the two locations) and explanatory indicators (the more strategic indicators), to ensure a strategic perspective

4. assessment of risks and opportunities of the different site locations, considering the different scenarios, inherent uncertainties and needs, and the options that could better enable sustainable development of the project

5. establishment of guidelines to support the follow-up process concerning various airport expansion planning and management activities, further studies to address uncertainties, as well as guidelines for operational management and monitoring that need to be further considered in environmental impact assessment (EIA).

The following sections will provide details on the site selection criteria adopted in this SEA, the scenarios adopted as well as how the SEA and cost-benefit analysis were used together.

The assessment method

Site selection criteria

Considering the major issues and concerns in the debate that surrounded the airport since 1999, a focus exercise with selected multidisciplinary experts was conducted. This led to the identification of seven critical decision factors that, together with assessment criteria, defined the assessment framework (Table 6.2). Consultation with a larger group of stakeholders, including the government, consolidated these critical decision factors as the main strategic viewpoints that were relevant for, and should be taken into account in the decision. Table 6.2 identifies the seven critical decision factors, its scope and purpose, as well as the associated assessment criteria used in the SEA assessment framework.

Table 6.2. **Site selection criteria in the new international airport in Lisbon - Critical Decision Factors and assessment criteria**

Critical decision factor		Assessment scope and purpose	Assessment criteria
1	Air safety and management	Meteorological and climatic conditions, bird collision, obstacles, operational efficiency and capacity	• Meteorological and climatic conditions (visibility, low clouds, wind, instability and turbulence) • Operational efficiency and capacity • Bird collision risk • Intrusive obstacles
2	Natural resources and risk management	Water resources: natural drainage pattern, flood control and erosion risks	**Fresh water criteria** • Modified hydrologic regime • Drainage conditions • Works needed • Water streams deviation • Pollution risks
		Underground water: vulnerability, productivity, protection areas	**Underground water criteria** • Availability • Recharge - productivity • Protection area • Pollution risk
		Geotechnical: seismic risk and construction costs	**Geotechnics criteria** • Volume, excavation conditions, landfills and reuse of excavation materials • Movement and treatment of soils • Works management and materials for infrastructure platform • Construction timing **Seismic risks criteria** • Seismic occurrence, local effects and possibility of condensation phenomena

		Noise: Population and sensitive uses	**Noise risks criteria** • Exposed population and sensitive uses
3	Nature protection and conservation	Ecological value and degree of disturbance of habitats and protected species	• Ecological Value of the Territory • Habitats and protected species
4	Accessibility	Road and rail transports systems (existing and projected), integration with high speed train, operational costs, travel time and reliance	• Transport systems (Integration with high speed train, rail network and modal share) • Operation costs of road component and externalities • Passengers time spent • Reliability of access times in road accesses to Lisbon
5	Spatial planning and regional development	Demography, land use and urban dynamics (population and business)	• Demographic dynamics • Land use • Economic and business dynamics • Urban dynamics
6	Competitiveness and social and economic development	Airport-city model, economic internationalisation, strategic positioning and competitiveness, growth and employment, and project development economic and financial conditions	• City-airport model • Strategic positioning - competitiveness • Economic-financial conditions for the development of the project • Internationalisation of the economy • Growth and employment
7	Financial assessment	To assess financial investment feasibility, project net added value	• NAV (Net actual value) (Ota-CTA) • Return internal rate differential

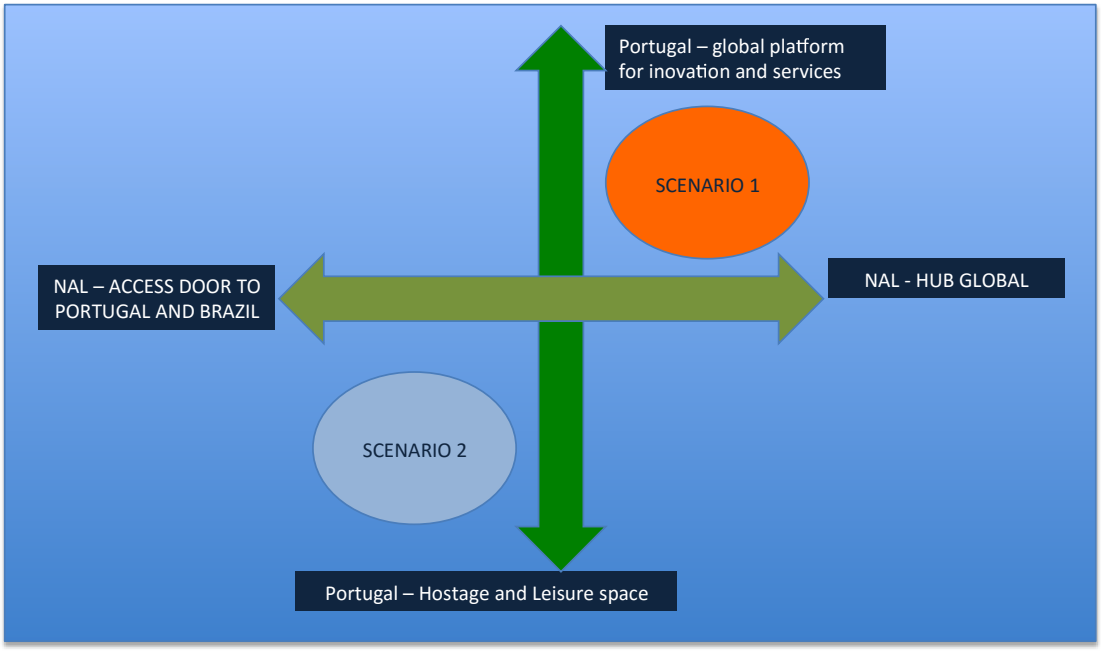
Scenarios considered

Different scenarios were developed right at the outset to contribute to a long-term perspective concerning future international trends in the air transport business, technology, as well as in relation to future development options in Portugal. Scenarios had a key role in strategic discussions that influenced many choices made throughout the assessment process concerning the purpose of the airport, the role it should play, and what type of airport model would best fit plausible scenarios. Ultimately two main scenarios were considered (Figure 6.3):

- **Scenario 1** – Lisbon as an international hub for east-west and north-south air traffic, with high capacity, connected to the development of high value-added services (aircraft maintenance, logistic activities, business support services, hotels, etc.).

- **Scenario 2** – Growth of endogenous traffic, tourism driven, competitive with Madrid but with lower capacity.

Figure 6.3. **Scenarios considered in the SEA of the new international airport in Lisbon**



Note: NAL = new airport location

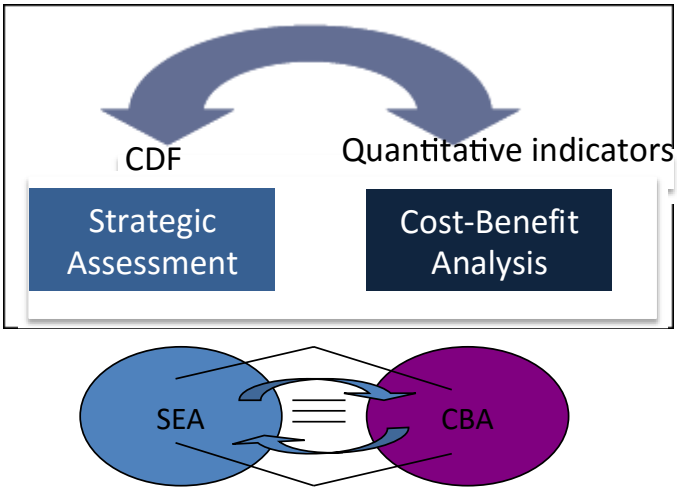
Source: LNEC, 2007.

Strategic environmental assessment and cost-benefit analysis

The original mandate for the assessment of the two locations Ota and Rio Frio was to conduct the strategic environmental assessment (SEA) and the cost-benefit analysis (CBA) separately. In order to avoid conflicts at a later stage, an alignment of the two instruments was attempted from the outset to enable some coherence and comparability in the interpretation of the respective outcomes. This alignment was made by:

- allowing SEA to establish the critical decision factors, and respective criteria and indicators, including economic and financial components
- ensuring CBA would use the quantifiable indicators created within the SEA
- ensuring the results of SEA and CBA could be cross-analysed

Figure 6.4. **SEA and CBA alignment**



Assessment team and method

The assessment team involved in the SEA and CBA included over 40 different experts with different multidisciplinary expertise. These experts were organised in critical decision factors teams, plus another team for the CBA. In critical decision factors 2 - Natural Resources and Risk Management, five different sub-teams were established and presented concerns regarding fresh and underground water, geo-techniques and seismic risks, and noise. For these more physical themes it was considered necessary to include different expertise that would allow a more detailed analysis for the comparison of the two locations, albeit less relevant from a strategic perspective.

A common, yet very simple, metrics for the assessment of risks and opportunities was established and adopted by all critical decision factors teams, thus enabling consistency and comparability of assessment outcomes (Table 6.3). As previously mentioned all seven CFD were given the same weight.

Table 6.3. **Common metrics for all critical decision factors**

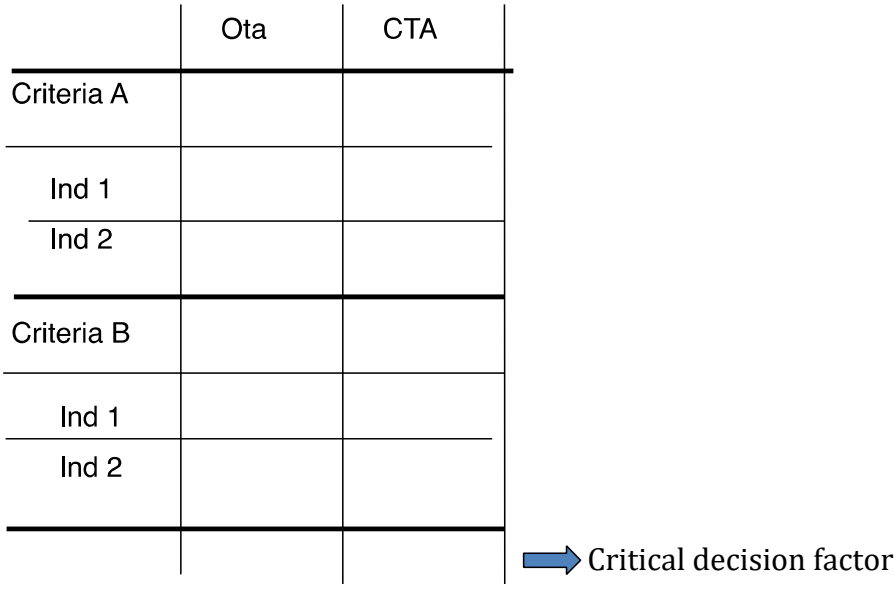
Opportunities	Risks
High – generation of new or high development opportunities and wealth creation for the country and region; high benefits **Average** – advantages or opportunities of average importance **Low** – Low or insignificant benefits **Null** – not applicable	**High** – loss of resource or irreversible damage of quality; high costs **Average** – loss of resource or damage of quality that demands application of guidelines; average costs **Low** – loss of resource or damage of quality not very relevant or one that can be mitigated; low costs **Null** – not applicable

Using SEA and CBA meant that many indicators were common and that both quantifying and qualifying indicators were used to compare the two locations in relation to broadly speaking environmental issues as well as costs and benefits.

It turned out that the two locations were rather indifferent from a CBA perspective, and therefore decision would finally be fully based upon the results of the SEA.

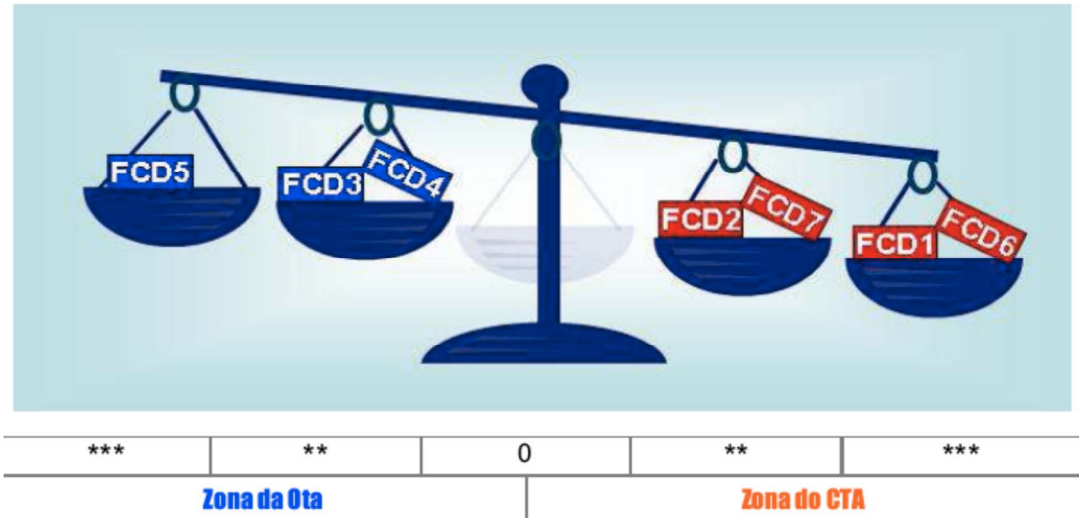
A systematic use of indicators and assessment criteria per location, to assess risks and opportunities considering scenarios and uncertainties, was enabled in the SEA by using a matrix type diagram (Figure 6.5).

Figure 6.5. **Matrix layout for the assessment of risks and opportunities, per critical decision factors**



This allowed the comparison of the two locations – Ota and Rio Frio – to the extent they were more favourable, less favourable, unfavourable or indifferent to the development of the international airport. For the purpose of communicating final results of the assessment, the diagram represented in Figure 6.6 illustrates how each location would be favoured by the different critical decision factors. The assessment was clearly in favour of the CTA location in four out of seven critical decision factors.

Figure 6.6. **Assessment results, figuratively illustrated, per critical decision factors**



*** More favourable,** Less favourable, 0 Indifferent.
Source: LNEC, 2007.

Based on the assessment outcomes, the SEA further developed guidelines and recommendations for different future activities concerning the airport. These guidelines and recommendations addressed the operational management of the airport infrastructure, the EIA studies that would need to be developed, but also the spatial planning in municipalities that would be directly or indirectly affected by the development of the airport, as well as ancillary infrastructures (including accessibility). A monitoring programme was also established to enable the follow-up of options made in accordance with the outcomes and recommendations of the SEA.

Challenges and difficulties

The case described faced several challenges largely related to its complexity. As mentioned in the beginning of this chapter, decisions on the expansion of airport capacity are highly complex. This is because of the multiple aspects and scales involved, but mostly because of the uncertainty and the multiple perspectives, and pressures, associated. Rather than attempting to adopt cognitive-analytical approaches, complexity theory suggests using multiple and flexible approaches to the problem, recognising mutual dependent actors, functions and activities, addressing linkages whereby solutions to problems result from interactive situations and from a sequence of strategic actions. This calls for appropriate strategic approaches, and methodologies, that can address and deal with complexity, while acknowledging uncertainty.

The SEA was coupled to the development of future scenarios to open up perspectives into major challenges that needed to be taken into consideration in the strategic decision. Multiple geographical scales, from local, regional or national perspectives provided an important context to the assessment.

There is, however, not much practice using strategic thinking approaches in environmental or sustainability assessment, which created some difficulties. The EIA places significant pressure on developing detailed, site-specific studies that do not help facilitate a strategic understanding of the decision. There were misunderstandings and multiple expectations in relation to supposed outcomes, which were further fuelled by the media. Strategic studies and site studies created an information

imbalance: insufficiencies on certain aspects and too much detail on others. And only two site locations were compared, instead of using the opportunity to strategically assess a much larger span of possible options.

Despite such difficulties the SEA generated robust outcomes and conclusions. It legitimated the decision to build the airport at CTA. The set of critical decision factors and assessment criteria represented the major concerns of the key stakeholders. Critical decision factor 1, Air safety and management, was particularly indicated in supporting the decision.

With the 2008 world economic and financial crisis the decision to build the new airport was again put on hold. Subsequently, in line with continuous improvement of the existing airport to respond to increasing demand, a new terminal is now being considered to expand the airport capacity. The leading option appears to be opening a new low-cost terminal across the river from Lisbon, in Montijo municipality, using an existing Portuguese Air Force facility. Montijo municipality is enthusiastic, but perhaps not so much the Montijo population and neither are the neighbouring municipalities.

The option for the CTA international airport, while not questioned as a possible site for an airport in a scenario of expanded economy, is considered too expensive provided the uncertainty in current markets, the political and economic situation in Europe and the continued economic crisis in Portugal.

Interestingly the Montijo site had historically been considered as a possible site in previous years (namely in 1969, 1982 and 1994), but never included in the studies developed in 1999 or in 2007. If, at the time of doing the SEA in 2007 the Montijo site would have been considered along with Ota and CTA, and possibly other options (including Portela+1), then by now the Portuguese government could have a consistent strategic basis for decision making. They would have used the same site selection criteria to consider challenges, risks and opportunities of developing the airport, possibly not using many more resources than those used to compare Ota and CTA. But as said, limiting the assessment to two locations only hindered the potential of the 2007 SEA. An opportunity was lost to create a strategic decision-making context for this difficult decision, even though the site selection criteria seem quite adequate.

Conclusions and lessons learned

The case presented attempts to demonstrate the merits of using strategic approaches to complex problems, such as those involved in decision-making for airport capacity expansion.

A relevant lesson learned with the case of the Lisbon international airport relates to the successful focus of the SEA on a few most relevant assessment criteria and indicators, underpinned by seven critical decision factors with equal weighting. Additionally, the case demonstrated the benefits of transforming multiple descriptive indicators into one or two explanatory indicators, making them more targeted and to the point.

A second lesson relates to the achieved legitimacy with the set of seven critical decision factors used to establish the assessment framework. The integrated seven themes reflected the themes of concern of many stakeholders, making them more robust. Subsequently, most public comments supported the decision for the CTA. The critical decision factors captured even the political interest, revealed when mentioned by the Prime Minister in his deliberation.

The opportunities created by the SEA are amplified when a meaningful range of possible options are included, rather than when restricting the alternatives to those that sound more attractive to current

decision-makers each time an assessment is done. In complex problems, engaging multiple perspectives and options increases the potential for a sound basis to legitimate decisions.

Finally, the case also shows that different tools, such as SEA and CBA, can be combined to deliver consistent results. SEA provided the structure for analysis while CBA contributed indicators to be used in the SEA. However, the SEA proved to deliver a more complete response to the issues at stake where CBA became rather indifferent.

The particular story of the decision-making process for the new Lisbon international airport provides a good example on the capacity of Strategic Environmental Assessment (SEA) to influence decision-making. SEA delivered a sound and sustainable based justification to support the decision for the airport location, by enabling the necessary site selection criteria but also by engaging multiple perspectives, multiple spatial and time scales and establishing a framework that can enable successive strategic actions.

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Airport Site Selection

In 2015, the Korean Government's Ministry of Land, Infrastructure and Transport (MOLIT) launched a feasibility study for increasing airport capacity in the Youngnam Region of Korea, the southeast quarter of the country. The Ministry appointed a consortium formed by the Korea Transportation Institute (KOTI) and ADPI (Aéroport de Paris Ingenierie, member of the Aéroports de Paris Group) to develop the methodology for deciding at which site airport expansion should take place.

In the framework of that work, the Korean Government requested that a roundtable be organised by the International Transport Forum to review the methodology developed for site selection and the criteria employed with a view to ensuring that the exercise undertaken for the Korean Government reflects current international best practice. This report is a product of this roundtable, organised in Paris in February 2016.

The review is based on examination of methodologies used for selecting airport expansion sites in four different ITF member countries: Australia, Japan, Portugal and the United Kingdom.

The report is part of the International Transport Forum's Case-Specific Policy Analysis series. These are topical studies on specific issues carried out by the ITF in agreement with local institutions.

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