For Information
On 1 December 2015

Legislative Council Subcommittee to Follow Up Issues Relating to the Three-runway System at the Hong Kong International Airport

Issues Raised at the meeting on 3 November 2015

Introduction

In discussing LC Paper No. CB(4) 143/15-16(01) at the meeting on 3 November 2015, Members gave invaluable comments on the Three-Runway System ("3RS") project. In the course of the discussion, a number of issues were raised by Members whereby the Airport Authority Hong Kong ("AAHK") and the Government undertook to provide the information requested. This paper sets out the information requested by Members.

Follow Up on Issues Raised at the meeting on 3 November 2015

A. Breakdown of the projected overall economic benefits of the 3RS

2. Members noted that the overall economic benefits of the 3RS were projected to be around $1,046 billion (2012 dollars) over the 50-year period from 2012 to 2061. A member asked about details on how the projected overall economic benefits were arrived at, including the assumptions made for coming up with the projection.

3. As explained at the meeting, AAHK commissioned an independent consultant – Enright, Scott & Associates ("ESA") – to conduct an Economic Impact Study in 2011 to assess the potential impact of airport expansion on Hong Kong's economy as part of the Hong Kong International Airport ("HKIA") Master Plan 2030 ("MP2030"). In early 2015, ESA updated the Economic Impact Study of the 3RS ("the Study") in accordance with the latest economic data, traffic demands and costs.

4. In general, an investment's economic impact is measured by its direct, indirect, and induced contributions to the economy, usually expressed in terms of "value added"[1] and percentage contribution to gross domestic product ("GDP") in a certain year. This approach is commonly adopted in the aviation industry[2].

5. To estimate the economic impact of HKIA –

(a) ESA first estimated the "Direct" value added and employment generated by the aviation sector in Hong Kong, including the direct operation of the airport, such as airlines, air cargo terminal operators, catering operators, aircraft maintenance and other services operators, and the AA, etc., as well as non-aviation businesses at HKIA, including retail, food and beverage, hotels and convention and exhibitions.

(b) ESA then estimated the "Indirect" value added and employment generated by the suppliers of goods and services to the direct activities of the aviation sector in Hong Kong and non-aviation businesses at HKIA, such as utilities suppliers, fuel suppliers, construction and cleaning companies, food and retail goods suppliers, etc.

(c) Finally, ESA estimated the "Induced" value added and employment generated through the spending of incomes by the direct and indirect employees on local goods and services, such as spending of airline employees, utilities supplier employees, AA employees, etc.

(d) With the above mentioned direct, indirect and induced economic contributions estimated for 2012, projections were made till 2061[3] for both the Two-Runway System ("2RS") and 3RS. A 4% discount rate[4] is used to discount the projected economic

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1 "Value added" is defined as the value of gross output less the value of intermediate consumption (the value of goods and services used up in the course of production).

2 International Civil Aviation Organization ("ICAO") has published a report in 2005, "Economic Contribution of Civil Aviation", which assessed the contribution of civil aviation in the global economy and also aimed to provide guidance for States on assessment methodologies (ICAO Circular 292-AT/124). While the core recommended approach involved the typical inclusion of direct, indirect and induced impacts, the "expanded" approach involved assessment of catalytic impacts typically affecting tourism and trade.

3 50-year timeframe is typical for assessing infrastructure investments. In the case of HKIA, a 50-year life span is assumed.

4 The discount rate for evaluating Government investment projects purports to reflect the community's desired inter-temporal trade-off in economic benefits against the resources/costs

contributions to 2012 dollars to generate the Economic Net Present Value ("ENPV") for both the 2RS and the 3RS.

6. A summary of the 2015 economic impact analysis results is shown below.

	2012 (Actual)	2030	
		2RS	3RS
Economic contribution (Direct + Indirect + Induced)	HK$ 94 billion	HK$ 133 billion	HK$ 184 billion
% of GDP	4.6%	3.6%	4.9%
Direct employment	63,000	89,000	123,000
Indirect + induced employment	85,000	119,000	165,000
		2012-2061	
ENPV	—	HK$ 591 billion	HK$ 1,046 billion

Note: Economic contribution in 2012 dollars
Source: Enright, Scott & Associates Ltd (2015)

7. Detailed explanation of the methodology adopted in the economic impact study can be found in Chapter 3 and Appendix A of both the 2011 and 2015 reports, which are available on AAHK's website at http://info.threerunwaysystem.com/pdf/en/ESA.pdf and http://info.threerunwaysystem.com/pdf/en/economic_impact_study_of_the_three_runway_system.pdf respectively. Relevant sections of the 2015 report are attached at **Annex A**.

B. Projected Increase in Air Traffic Movements ("ATMs") at the HKIA upon Commissioning of the Third Runway

8. In noting that HKIA's annual traffic demand is projected to reach 102.3 million passengers and 8.9 million tonnes of cargo by 2030, a member requested information on how the projection were arrived at.

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incurred in undertaking the projects. The discount rate for Government projects in Hong Kong is assumed by the Government at 4% in real terms for conducting economic cost-benefit analysis and is adopted for the current economic impact studies. The 4% discount rate has been used for various projects in the past in Hong Kong (e.g. Hong Kong Disneyland, the Express Link of Hong Kong). It should be noted that that the Treasury of the UK Government has adopted a 3.5% real discount rate for the first 30 years in evaluating a project, and European Commissions recommend a discount rate of 3% or 5% for major projects (depending on the status of the economies).

9. In 2008, AAHK commissioned IATA Consulting[5] to produce a set of preliminary forecasts up to 2030 to facilitate the preparation of the MP2030. At that time, there were a lot of uncertainties around the economic outlook so the forecast tended to be very conservative. In 2012, IATA Consulting fine-tuned the traffic forecast by taking into account the latest actual traffic figures, the capacity constraint and short-term outlook to reflect market conditions.

10. The model adopted for the 20-year, long-term traffic forecast is an econometric model based on GDP regression. Past data have confirmed Hong Kong's passenger traffic bears a close relationship with Hong Kong's GDP, while cargo traffic is closely correlated to world GDP. While the baseline forecast is GDP-driven, adjustment factors [6] including runway capacity constraint have been considered through relevant research, benchmarking and interviews by IATA Consulting. This forecasting approach is proven and follows airport forecasting best practices. Similar approach has been used by airports around the world and institutions such as International Civil Aviation Organisation ("ICAO"), Airports Council International ("ACI"), Boeing and Airbus.

11. After taking into account the relevant adjustment factor considerations, the passenger and cargo forecasts of HKIA are estimated to grow at a Compound Annual Growth Rate ("CAGR") of 3.4% and 4.5% respectively, from 56.5 million passengers and 4.0 million tonnes of cargo in 2012, to 102.3 million passengers and 8.9 million tonnes of cargo by 2030.

C. Measures to Enhance the Capacity of HKIA before the Commissioning of the Third Runway in 2020 and the Full Implementation of the 3RS in 2024

12. Members noted that HKIA would soon reach its designed capacity in 2016/17. Before the 3RS is up and running, AAHK has engaged an independent consultant to explore ways to increase the capacity of the existing two-runway system ("2RS") in the interim. Members asked for information about the study.

13. AAHK has commissioned a study to identify possible means to stretch the runway capacity at HKIA before the full commissioning of the 3RS.

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[5] IATA Consulting, the commercial arm of IATA, is a highly regarded organization in providing traffic forecast for aviation clients.

[6] Adjustment factor is any abrupt change in market environment, airline and airport strategies and the anticipated development of the competitive intensity.

As a key task of the study, assumptions adopted for the previous Airspace and Runway Capacity Study for HKIA[7] would be reassessed and adjusted based on the latest operational data and observation of key performance metrics of the ATM operation. The study will review many aspects of the air traffic operation, including airspace design and management; departure and arrival control; runway modes of operation; ground control and airfield infrastructures etc. In addition, the possibility of increasing night-time capacity declaration (i.e. from 10:00 pm to 7:00 am) as well as noise management measures associated with recommendations on means to increase the existing airport capacity will also be studied. The study will cover both the existing 2RS scenario and the Interim 2RS scenario (i.e. when the new runway and the existing South Runway are used while the Central runway is closed for construction). AAHK will brief the Legislative Council ("LegCo") on the subject of 2RS capacity once ready.

D. Proposed Noise Charge Scheme

14. Members noted that AAHK is contemplating a proposal to introduce a noise charge and asked for further information.

15. The Government and AAHK are conscious of the effect that night-time aircraft operations may have on local communities. Consequently, AAHK has undertaken to conduct a study to develop a noise charge scheme as a means of encouraging airlines to use quieter aircraft types. The study is still on-going. In developing the scheme, AAHK has made reference to :

(a) the ICAO principles;
(b) global practices; and
(c) HKIA's situation.

16. According to the ICAO principles, noise-related charges should be-

(a) levied only at airports experiencing aircraft noise problems;
(b) designed to recover no more than the costs incurred for the alleviation or prevention of the noise problems (i.e. "cost neutral);
(c) associated with the landing fee;
(d) non-discriminatory; and
(e) not to be established at prohibitively high levels.

17. In practice, noise-related charging schemes adopted by different

[7] The Airspace and Runway Capacity Study for HKIA was commissioned by AAHK and conducted also by NATS in 2008.

airports around the world vary in forms and shapes. While the main purpose of noise-related charges is to recover the costs of mitigation measures; and/or to provide a financial incentive to encourage airlines to switch into quieter aircraft, the form of charging can vary significantly depending on the airport's local context and noise control requirements. Examples of noise-related charges imposed by some overseas airports are set out in **Annex B**.

18. In principle, AAHK considers that the proposed noise charge should :

(a) target flights that cause the most nuisance to the public, i.e. night flights between 2300-0700 for both landings and take-offs according to the noise data recorded by Civil Aviation Department's noise monitoring stations;
(b) be cost neutral; and
(c) be set at a reasonable level to cover AAHK's noise mitigation costs.

19. The LegCo will be briefed on the proposed noise charge in due course.

E. Airport Construction Fee ("ACF")

20. While members were generally supportive of the ACF regime with differential charging levels and considered the current levels reasonable, a member requested AAHK to provide information on the estimated number of years which AAHK would need to levy the ACF if the rate for short haul economy passengers and for long haul premium passengers were to set at $50 and capped at $500 respectively.

21. As set out in LC Paper No. CB(4) 143/15-16(01), without adversely affecting its credit ratings and borrowing capability in material terms, in devising the revised ACF regime, AAHK has assessed the feasibility of stretching its borrowing capacity further in the light of its excellent credit rating (i.e. AAA). The revised ACF regime, with differential charging levels, is derived at through optimizing AAHK's borrowing from the market.

22. Members were also advised that only about 2% of the passengers travel long haul premium (first and business classes) and that about 70% of all passengers, namely short haul origin/destination ("OD") and transfer/transit economy class departing passengers will be paying $90 or less for the ACF.

23. In the light of the request from the member, AAHK has conducted a quick desktop analysis on the possible impact of the ACF for short haul economy passengers and for long haul premium passengers to be set at $50 and capped at $500 respectively. If the ACF for short-haul economy passengers were to be capped at $50 and on the assumption of some changes to the existing travelling pattern, the ACF for long-haul premium passengers would have to be adjusted upward to an unreasonably high level of about $2,000, in order that the overall borrowing level of AA could be maintained at the same level. Such a high level of charges is way beyond international practices; and putting a disproportionate burden on an extremely small sector of traffic (only 2% of our total traffic) will subject the entire financial package to unnecessary risks.

24. If the ACF for long-haul premium passengers were capped at $500 at the same time, the ACF revenue collected would fall short of the target revenue collection under AAHK's current financial arrangement proposal and AAHK would be pushed to borrow beyond the practical borrowing limit during the 3RS construction period. Hence, any further extension of the collection period of ACF cannot meet the overall cashflow requirement.

F. Environmental Impact Assessment Engagement

25. Members noted that AAHK had organized about 700 engagement activities on EIA from 2012 to 2014. AAHK was requested to provide information on the stakeholders engaged.

26. A breakdown by the major stakeholder groups engaged [8] is appended below.

Stakeholders	Number of Engagement Activities Organized
1. Universities, secondary and primary schools, education sector	261
2. Political parties, district councils, resident groups	163
3. Professional bodies, industry and business associations, business partners	95
4. Media	71
5. Green groups	34

[8] The above breakdown of information has taken into account the large number of engagement activities conducted and privacy considerations.

Stakeholders	Number of Engagement Activities Organized
6. Academia, think tanks and opinion leaders	33
7. Fisherman groups	17
8. Consultative bodies	15
9. Technical briefing groups	12
10. General public	7
Total	**708**

G. Judicial Review ("JR")

27. Two JR cases were filed in February 2015 to review the decisions of the Director of Environmental Protection to approve the 3RS Environmental Impact Assessment ("EIA") report and to grant the relevant Environmental Permit to AAHK to implement the 3RS project. AAHK is an interested party for the cases above. Another three JR applications were filed in mid-June 2015 to challenge the decision of the Chief Executive in Council in "approving" the 3RS project and the relevant financial arrangement plan, and in two of these three cases, the applicants also challenge AAHK's "decision" to expand the HKIA into a 3RS. The first two EIA-related JR cases will be heard by Court in early July 2016 whereas the Court will consider the leave application for the other three cases in March 2016. AAHK is an interested party in one of the three cases, and co-respondent in the others. The sixth JR case was filed on 9 September 2015 to challenge the Town Planning Board procedure concerning the making of representations and comments on the relevant draft Outline Zoning Plan on ground of unfairness.

28. AAHK will proceed with the implementation of 3RS project as far as legally permissible.

H. Press Releases Issued by the Civil Aviation Department of Hong Kong

29. The press releases issued by the Civil Aviation Department of Hong Kong in relation to issues concerning Pearl River Delta Airspace are attached at **Annex C**.

I. Information on Accidents Caused by Marine Construction Works with

respect to the Hong Kong-Zhuhai-Macao Bridge Project

30. Information provided by the Highways Department is attached at **Annex D**.

J. Other Information

31. AAHK is highly transparent with its work and most of the information related to the 3RS is available on its website. A list of the publicly available information is consolidated in **Annex E** for easy reference of members.

Advice Sought

32. Members are invited to note the issues covered in this paper. The remaining issues raised at the meeting on 3 November 2015 would be followed up in the subsequent meetings as appropriate.

Airport Authority Hong Kong
November 2015

3. Methodology note

This Study uses variations of traditional economic impact techniques that are tailored to the particular situation of Hong Kong. Economic impact analysis attempts to quantify the impact that an investment, event, or decision can have on a given economy. It is frequently used in order to determine whether capital investments should be made. Below is a general description of the economic impact methodology. A detailed description including data sources for individual items is provided in Appendix A. Some caveats associated with economic impact analyses can be found in Appendix C.

3.1. General economic impact methodology[12]

Economic impacts are measured in terms of direct impact, indirect impact, induced impact, and catalytic impact. Each level of impact attempts to quantify in a different way the benefits that are likely to accrue to a specific economy as a consequence of capital investment. The impact from a capital investment that requires construction will flow in two stages. During the first stage, impacts arise from the construction activity itself. During the second stage, impacts are derived from the on-going operation of the facility or asset that has been built.

3.1.1. Direct impact estimates

All economic impact methodologies start with projections of the direct economic impacts of a given investment, usually in terms of output, employment, and / or value added. These projections come from estimates of throughput, capital costs, and other features associated with the investments in question. The methodologies then differ in terms of how they develop indirect, induced, and catalytic economic impact projections.

3.1.2. Indirect and induced impacts

In order to develop indirect and induced economic impact projections, most economic impact studies involving airports worldwide use what is called the “Input-Output Approach.” In this approach, regional input-output models are used to generate multipliers for each industry affected by the airport that show the ripple effect of an expansion or contraction of each industry on the entire economy. The direct impact for a new investment in terms of numbers employed (or number of jobs or employees), output, and value added is then projected. The appropriate multipliers are then applied to these projections to generate projections of the indirect and induced effects.

While this approach has great appeal, in part due to its simplicity, it has a number of shortcomings. The first is that the multipliers generated through the analysis of the input-output tables are most valid for marginal changes in the direct impact projections, as they do not take into account the potential for shortages to develop in some inputs or for the potential that a large investment could bid up salaries and input costs in the local models generally do not take potentially diminishing returns into account.[13] A second shortcoming

[12] We note that there is no single universally accepted methodology for carrying out airport or aviation -related economic impact analyses. The process identified in this section and in Appendix A was developed from best practice guidelines provided by the Airport Authority of Hong Kong and tailored to the Hong Kong context by ESA.

[13] Economists would generally refer to the basic shortcoming as failure to account for general equilibrium effects.

is that this method requires the existence of relatively detailed up-to-date input-output tables, which are not available for many economies.

A second approach to generating indirect and induced economic impact projections uses closed multi-sectorial macroeconomic models to generate economic impacts. Such models not only have input-output relations embedded within them, but also take into account the effect of increases in demand in one sector on wages and costs across the economy. Projections of the direct economic impacts are generated and then entered into the models, which then produce estimates of the indirect and induced impacts of an investment over the specified range, rather than just linear multipliers that may be valid over a relatively small range of input values or for a relatively short period of time. The advantage of this approach is that it overcomes some of the shortcomings of the multiplier approach. The disadvantages are that this approach has substantial data requirements as well as requiring the construction (or existence) of a suitable macro-model for the economy in question. It is therefore more costly and in many cases not feasible to implement.

Unfortunately, in some locations, there are no widely accepted, detailed input-output tables or suitable detailed macroeconomic models available for the economy. This makes it impossible to generate a complete set of multipliers or carry out macroeconomic model analysis in the same way as is possible in many other places in the world. The result is that economic impact analysis in such economies is often carried out by adopting “rule of thumb” multipliers derived from those used in similar settings elsewhere, or based on the judgment of the researcher to generate indirect and induced impacts from the direct impact figures. The problem with this latter method, of course, is that the multipliers generated may have little to do with the target location, and its economy. Thus it is important to choose economies as close in structure to the target economy’s as is possible if this method is used, and to liaise with government economists who have worked on related issues to ensure that the multipliers used seem reasonable for the local context.

3.1.3. Catalytic impacts

The direct, indirect, and induced benefits of an airport are related to the total revenues, value added, and employment of the aviation-related businesses and additional lines of business at the airport (direct), their expenditures on outputs from other industries (indirect), and the portion recycled by the spending of employees of the direct and indirect lines of business (induced). Catalytic benefits involve spillovers and other benefits that cannot be captured by tracing the flows of cash from aviation and airport-related businesses. The presence of an airport will have ripple effects throughout an economy. In particular, it will influence inward investment, business development, trade, and tourism activity.

While some of the catalytic effects are recognisable and quantifiable (the impact on tourism and trade, for example), others (such as the impact on inward investment, business development, and productivity throughout the economy) usually are not. For the latter group of effects, it can be extremely difficult to separate out the impact of an airport from other influences on the development of an economy.

These effects are sometimes projected through the use of large-scale surveys of businesses on the impact of an airport on their own businesses. Business survey results tend to address whether survey respondents believe the airport is important to their

business, but these results can be difficult to link directly to economic activity. The difficulties associated with business surveys involve the time and expense of generating usable datasets and the challenge of relating the results to economic impacts.

A second approach is through detailed econometric investigations of relationships between air travel and investment, productivity, and other variables. The econometric investigations, where they can be done, tend to use cross-section comparison of multiple regions with airports, estimating the catalytic impacts of air travel across cities rather than within a single city. The difficulties with econometric investigations involve the requirements for detailed datasets across multiple, otherwise similar, cities, and the time necessary to build the relevant models.

A third approach is a more eclectic one that takes several pieces of information into account and tries to weave a picture that allows rudimentary estimates of catalytic impact. This would include information from existing business surveys as to the importance of air transportation to their businesses, growth rates of key sectors that rely upon aviation services, comparisons of growth in aviation services to key economic variables (GDP, trade, and employment, for example), and results from other locations combined with judgments as to the portion of the results that can be attributed to aviation services.

We note that catalytic effects also have their direct, indirect, and induced components. For example, many economic impact studies of aviation include the impact of the spending on retail, hotel, food and beverage, and transportation of foreign visitors outside the airport that is catalysed or facilitated by air travel on output, value added, and employment (direct catalytic effects); the impact of the spending of industries upstream of retail, hotel, etc. (indirect catalytic effects); and the impact of the spending of employees of the indirect and direct tourism-related industries (induced catalytic effects). For other catalytic effects, some studies only take the direct catalytic impact into account in an effort to be conservative.

3.2. Methodology for the present Study

The methodology of the present Study followed the general economic impact methodology described above. The specifics involved the use of specific data sources for the present direct impacts, the use of specific projections and forecasts to estimate the future direct impacts, the use of Hong Kong-specific multipliers to project indirect and induced impacts, the use of Hong Kong-specific information to generate quantifiable catalytic impacts, and the compilation of suggestive Hong Kong-specific information with a bearing on non-quantifiable catalytic impacts. The details of the methodology may be found in the Appendices to this document.

In the present Study, direct revenues, value added, and employment figures for aviation-related businesses in Hong Kong were obtained from data supplied by the AA and the Hong Kong Census and Statistics Department (HKCSD). Direct revenue and employment data for construction in each scenario and the operational non-aviation businesses at HKIA were obtained from the AA. Value added estimates were generated by applying the ratio of value added to revenue from HKCSD data for the relevant lines of business. Indirect and induced multipliers were calculated from a combination of ratios derived from data available from HKCSD and economic multipliers provided by the Economic Analysis and Business Facilitations Unit, Hong Kong Financial Secretary's Office (FSO), as broad working assumptions for use in the Economic Impact Study.

While most studies of catalytic tourism impacts of aviation only take spending entering an economy due to inbound tourism into account, an increasing number also take potentially lost spending by outbound travellers into account. This Study generated economic impact estimates incorporating inbound tourism only (analogous to most studies) and incorporating the effects of both inbound and outbound tourism for sake of completeness. Direct inbound and outbound tourism revenues related to air travel were estimated from data published by the Hong Kong Tourism Board, the World Tourism Organisation, and HKCSD. Direct value added and employment estimates were generated by applying the ratio of value added and employment to revenue for the relevant industries from HKCSD data. Indirect and induced impacts of tourism were estimated by using multipliers and Hong Kong economic ratios in a similar fashion to that described above for aviation-related businesses in Hong Kong and non-aviation businesses at HKIA.

The catalytic impact of aviation-facilitated trade on Hong Kong's economy was estimated by first setting direct revenue equal to the total value of Hong Kong's trade by air, as calculated from HKCSD data. Direct value added and employment estimates were generated by applying the ratios of value added and employment to revenue from HKCSD data multiplied by the conventional trade ratio. Indirect and induced impacts of aviation-facilitated trade were estimated by using multipliers and Hong Kong economic ratios in a similar fashion to that described above.

In order to generate future economic impact projections, it was necessary to obtain passenger and cargo traffic forecasts and to generate scale factors that could be used to project the various lines of business and their impacts into the future. Future projections for passenger and cargo traffic were generated by the AA's Consultants. Scale factors were generated by linking the aviation-related businesses in Hong Kong, the non-aviation businesses at HKIA, the catalytic tourism impacts, and the catalytic trade impacts to passenger, cargo, and work load unit (WLU defined as one WLU = one passenger or 100 kilograms of cargo) throughput in the most recent year for which data was available.

The economic cost-benefits (net benefits) of each scenario were analysed by taking the "Economic Net Present Value" (ENPV) and Economic IRR (EIRR) of the projected net benefits of each scenario (equal to the net value added generated by each scenario minus the costs of operations). The net benefits were estimated using projections in 2012 dollars. For the ENPV an economic discount rate of 4 percent was provided by the Economic Analysis and Business Facilitations Unit, Hong Kong Financial Secretary's Office (FSO) for use in this study.

In addition, IRR (EIRR) assumes that all the benefits from the project under review are re-invested at the internally generated rate of return, yielding further returns at this same rate in the following period(s). However, if the magnitude of the returns exceeds the amount that can be re-invested in the project and the IRR is high by comparison to rates of return available in the market, then the assumption that all the returns can be re-invested at the same rate as the IRR is false and the estimated IRR may not be a good measure for project evaluation. In any case, if the IRR (EIRR) and the NPV (ENPV) give different answers in the evaluation of mutually exclusive projects, the correct answer is by NPV (ENPV).

As indicated, a more complete explanation of the methodology is in the Appendices to this document.

Appendix A. Methodologies and data sources

This Section describes the details of how the economic impact analysis is implemented in the present Study. First, it describes the methods behind the estimation of the current economic impact of HKIA and related businesses on Hong Kong's economy. Second, it describes how future economic impacts and the specific case for the Investment Scenario are addressed. Third, it describes the methods used to carry out the net economic-cost benefit analysis.

The economic impact of HKIA is estimated for year 2012 to correspond with the AAHK study brief and currently available economic data. For future economic impact projections, year 2012 is used as the base year from which projections are scaled. Note Hong Kong statistical data for year 2012 now follows *Hong Kong Standard Industrial Classification (HSIC) Version 2.0*, and the data used is coded to this revised standard. All data inputs are updated to that available in May 2014. For the year 2012 and onwards all dollar values are quoted in 2012 dollars.

A.1. Present HKIA economic impact

The present economic impact consisted of five major components. First, the direct, indirect, and induced impacts of aviation-related industries in Hong Kong are estimated. Second, estimates are made of the direct, indirect, and induced impacts of other businesses at HKIA (on Chek Lap Kok, the airport island). Third, estimates are made for the impact of aviation- facilitated tourism, both for inbound tourism and net tourism. Fourth, estimates are developed for the impact of trade facilitated by HKIA. Fifth, areas of additional, but non-quantifiable impacts are identified and rough indicators of their importance to the Hong Kong economy are described where possible.

A.1.1. Aviation businesses in Hong Kong and non-aviation businesses at HKIA direct impacts

A.1.1.1. Aviation-related businesses in Hong Kong

Direct impacts from aviation-related businesses in Hong Kong result from the revenues, value added, and employment in aviation-related sectors in Hong Kong. The core assumption made is that these businesses would not exist without the presence of the Hong Kong International Airport (HKIA). The direct aviation-related businesses identified for the present Study correspond with the Hong Kong Census and Statistics Department (HKCSD) category "Air Transport and Incidental Services." This category includes Hong Kong-based airlines and helicopter companies, the local representative offices of overseas airline companies, air cargo forwarding services, and supporting services to air transport (including HKIA). The revenue, value added, and employment figures for this category will be taken directly from HKCSD data. [52] It should be noted that a significant portion of the activities of the aviation-related businesses take place outside of HKIA itself.

[52] Hong Kong Census and Statistics Department, direct communication.

As Exhibit A1.1 shows, the years 2008 and 2009 were atypical for Hong Kong's air transport sector when compared to the years immediately preceding. In 2008, revenue rose substantially, but value added fell, due in part to high fuel prices. In 2009, in the midst of a global economic slowdown, revenue and value added fell to approximately 2005 levels. A spike in fuel prices is again observed for 2011 and 2012, this time however revenues increased with fuel prices giving similar ratios of value added to revenue and employment to revenue as those observed pre 2008.

Exhibit A1.1. Air Transport and Incidental Services Statistics in Hong Kong

Air Transport	**2005**	**2006**	**2007**	**2008**	**2009**	**2011**	**2012**
Revenue (HK$mn)	177,985	189,351	206,055	223,835	173,085	225,207	222,209
Value added (HK$mn)	39,410	38,360	41,868	27,116	38,182	48,532	49,028
Number of employees (persons)	47,233	49,912	54,742	56,988	56,115	55.696	56,694
Compensation of employees (HK$mn)	16,582	17,699	19,331	20,353	20,382	24,156	25,655
Fuels (HK$mn)	18,223	22,953	24,829	47,018	17,438	42,771	43,706
Crude Oil (US$ average per barrel)	50.0	58.3	64.2	91.5	53.5	87.0	86.5
Proportion of Revenue							
Value added	22%	20%	20%	12%	22%	22%	22%
Compensation of employees	9%	9%	9%	9%	12%	11%	12%
Fuels	10%	12%	12%	21%	10%	19%	20%

Note: Industry code 7170, 7171, 7172, and 7182 (for HSIC v1.1) in year 2000 to year 2008, and industry code 5101, 5102, 5109, 5223, and 522901 (for HSIC v2.0) in year 2009

Source: Direct communication with HKCSD,http://www.inflationdata.com.

A.1.1.2. Non-aviation businesses at HKIA

In addition to aviation-related businesses, there are a number of other businesses at HKIA and on Chek Lap Kok. These include retail, food and beverage, and hotels at the airport itself, as well as the exhibition and convention businesses at AsiaWorld-Expo. In order to estimate the direct impact of the retail and food and beverage businesses, data on the revenues and employment of the relevant businesses at HKIA is obtained from the AA. These figures are adjusted by removing estimates of the spending of Hong Kong residents (assumed to match the share of Hong Kong residents in passengers served by HKIA). The reason is that it can be argued that in the absence of HKIA, retail and food and beverage spending by Hong Kong residents at HKIA would go to retail and food and beverage outlets elsewhere in Hong Kong and therefore HKIA is not responsible for new spending accruing to Hong Kong by these passengers. To the extent that a full 100 percent of this expenditure would not actually occur in the absence of HKIA, the estimate will be conservative. Direct value added and employment for these sectors is estimated by applying the value added to revenue and employment to revenue ratios for these sectors reported by HKCSD [53] to the adjusted revenues at HKIA.

For hotels on the airport island, including the five-star Regal Airport Hotel and the five-star SkyCity Marriot Hotel, expected hotel revenue is calculated by multiplying the average occupancy rate for five-star hotels in Hong Kong by the five-star hotel average

[53] Hong Kong Census and Statistics Department, Website Table 90: Selected Statistics for All Establishments in the Industry Sections of Import/Export, Wholesale and Retail Trades, and Accommodation and Food Services.

annual revenue per room[54] and by the number of rooms in each hotel.[55] Value added and employment is estimated by applying to the estimated revenues the value added to revenue and employment to revenue ratios reported for the hotel industry by HKCSD.[56]

Revenues for the exhibition and convention business is taken to equal the industry organizer expenditure at AWE.[57] Expenditures by exhibitor and delegate staff attending the events is not estimated as we assume that these will be picked up in the hotel, retail, and food and beverage figures for HKIA as well as in the general catalytic tourism impacts described below. As HKCSD does not provide a specific category analogous to the exhibition and convention industry, value added and employment are estimated by using the ratios of value added to revenue and employment to revenue for HKCSD's "Administrative and support service activities" category.[58]

A.1.2. Catalytic "direct" impacts

Although the economic impacts of aviation-facilitated tourism and trade are properly termed "catalytic" impacts, these impacts also have their direct, indirect, and induced components.

A.1.2.1. Aviation-facilitated tourism impacts

Tourism can be classified into two categories, the export of tourism services (resulting from the spending of inbound visitors to Hong Kong), and the import of tourism services (resulting from the spending of outbound Hong Kong residents abroad). Tourism exports result in a revenue, value added, and employment gain to the Hong Kong economy, while imports result in a revenue, value added, and employment loss to the Hong Kong economy.

Many studies of the economic impact of airports focus on benefits to the local economy derived from the spending of inbound tourism facilitated by the airport (tourism exports) without reference to the impacts of spending that might be lost due to outbound tourism by local residents (tourism imports).[59] However, an increasing number of studies suggest that the proper measure of the economic impact of aviation-facilitated tourism should take into account outbound tourism (tourism imports) as well. The idea is that just as the presence of an airport facilitates inbound tourism and allows a location to receive the spending of inbound tourists, the airport also facilitates outbound tourism and spending by local residents in other locations. To the

[54] Hong Kong Hotels Association and Hong Kong Tourism Board, *Summary of the Hong Kong Hotel Industry Review,* 2012.
[55] Regal Airport Website and Airport Authority of Hong Kong,
[56] Hong Kong Census and Statistics Department, Website Table 90*, Selected Statistics for All Establishments in the Industry Sections of Import/Export, Wholesale and Retail Trades, and Accommodation and Food Services.*
[57] Exhibition and convention industry sources.
[58] Hong Kong Census and Statistics Department, Website Table 91: *Selected Statistics for All Establishments in the Information and Communications, Financing and Insurance, Professional and Business Services Sections*.
[59] Air Traffic Action Group, *The Economic and Social Benefits of Air Transport*, 2008, focuses on the benefits of aviation to the tourism sector globally. URS, *The Economic Impact of Growth at Sydney Airport*, 2008, notes the gains to Sydney's economy from tourists and tourist-related industries, but does not discuss the impact of outbound tourism. Campbell-Hill Aviation Group, *City of Houston Department of Aviation: 2030 Economic Impact Study*, 2004, estimated the economic impact of arriving visitors to Houston, but not the impact of outgoing visitors. Connecticut Center for Economic Analysis, University of Connecticut, *Bradley International Airport Improvements: An Economic Impact Analysis*, 2001, similarly focused on the spending from additional visitors to Connecticut, but did not account for additional spending by Connecticut residents outside the state that might result from airport improvements.

extent that this outbound tourist spending would otherwise be spent locally, there is less local spending and a loss to the local economy. Several studies suggest that the spending of outbound tourists as well as inbound tourists be taken into account by determining the impact of spending by inbound tourists arriving by air and the impact of lost local spending due to outbound tourists departing by air and then subtracting the latter from the former.[60] The result in some cases will be a negative net tourism impact.

Some analysts argue that the facilitation of outbound tourism actually creates a substantial benefit for the local economy in terms of the ability of its residents to travel to other locations and the ability of its businesses to interact with the rest of the world and therefore any loss of spending in the local economy should not be emphasised.[61] They claim that for locations with a negative tourism balance, this could lead to conclusions that air travel should be restricted rather than expanded. Other analysts argue that the gains and losses are gains and losses and should be reported as such without prejudice and that tourism gains claimed by studies that do not include the net benefit calculation overstate the potential gains from expanded aviation services.[62] In terms of GDP impact, it is increasingly common to factor both impacts in. Ignoring the outbound tourism is equivalent to assuming that the gains to the local economy in terms of consumer welfare and other potential positive business effects exactly offset the impact of lost spending in the local economy by outbound tourists.

We provide an estimate of both the inbound tourism (exports) economic impacts and the net tourism (exports minus imports) economic impacts.

A.1.2.1.1. Direct tourism export impacts

No single data source is available for revenue, value added, or employment generated by visitors that arrive in Hong Kong by air. Tourism revenue attributable to air transport is, therefore, calculated by taking the number of tourist arrivals by air from each major region, multiplying by the average spend in Hong Kong of tourists from each region, and summing the results.[63] Tourism revenue is further broken down into retail, food and beverage, hotel, and other expenditure based on the average spending breakdown for visitors from each region.[64] Value added and employment attributable to air visitors is estimated by taking the resulting revenue figures by industry and applying the value added to revenue and employment to revenue ratios from HKCSD and the Hong Kong Tourism Board for the relevant industries.[65]

[60] Reports that acknowledge a need to net tourism imports and exports in economic impact analyses include York Aviation, *The Economic and Social Impacts of Airports*, 2005; Oxford Economic Forecasting, *The Economic Contribution of the Aviation Industry in the UK*, 2006; Oxford Economic Forecasting, *The Economic Catalytic Effects of Air Transport in Europe*, 2002; CE Delft, *The economics of Heathrow expansion*, 2008; GLA, *Heathrow Economics Study*, 2006.

[61] See, for example, York Aviation, *The Economic and Social Impacts of Airports*, 2005; Oxford Economic Forecasting, *The Economic Contribution of the Aviation Industry in the UK*, 2006.

[62] See, for example, CE Delft, *The Economics of Heathrow Expansion*, 2008; GLA, *Heathrow Economics Study*, 2006.

[63] Hong Kong Tourism Board, *A Statistical Review of Hong Kong Tourism*, 2012.

[64] Hong Kong Tourism Board, *A Statistical Review of Hong Kong Tourism*, 2012.

[65] Hong Kong Census and Statistics Department, Website Table 90: *Selected Statistics for All Establishments in the Industry Sections of Import/Export, Wholesale and Retail Trades, and Accommodation and Food Services, and Hong Kong Tourism Board, A Statistical Review of Hong Kong Tourism, 2012.*

A.1.2.1.2. Direct tourism import impacts and net tourism impacts

Estimates of Hong Kong's total number of outbound visitors and their total spending are available from the World Tourism Organisation[66] and HKCSD.[67] No data is directly available on the import of tourism services by air (resulting from the spending of Hong Kong residents travelling abroad by air). However, this can be estimated from the breakdown of outbound spending by destination provided by HKCSD. As all destinations, with the exception of the Chinese Mainland and Macau, are too distant for the vast majority of Hong Kong travellers to make the journey except by air, we have assumed that all these journeys are by air. In the case of outbound visitors to Mainland China, this cannot be assumed due to the land border. However, HKCSD[68] produced a special report on Hong Kong residents' visits to Mainland China which gives the total number of passengers and the percentage of passengers by air and their per capita spending in 2012, from which tourism imports by air from Mainland China can be calculated.

From this figure, we subtract the estimated hotel expenditures of Hong Kong outbound travellers by air. The logic is that the assumption that 100 percent of what a Hong Kong outbound traveller by air spends abroad would be spent in Hong Kong if they did not travel is extreme and since they would not have to spend on hotel should they remain in Hong Kong this can be deducted to provide a reasonable approximation.

To estimate the direct value added and employment impact of outbound tourism spending, we take the adjusted outbound spending and assume that if the Hong Kong traveller had remained at home they would have spent the remaining amount in roughly the same pattern as the typical foreign visitor to Hong Kong except for hotels (i.e. on retail, food and beverage, and related items). The relevant revenue estimates were used to generate value added and employment estimates by reference to the revenue to value added and revenue to employment ratios in the relevant categories derived from HKCSD data.

The net tourism impacts on Hong Kong's economy are estimated by subtracting the tourism import impact estimates from the tourism export impact estimates.

A.1.2.2. Aviation-facilitated trade

The starting point for the estimate of the direct economic impact of aviation-facilitated trade is to sum up the value of domestic exports, retained imports, and re-exports that arrived or departed by air in order to generate a total trade value (direct revenue) by air for Hong Kong. This revenue figure is then multiplied by the value added to revenue ratio for the "Import- Export Trading" industry and the conventional trade ratio (excluding offshore trade) to generate a value added to Hong Kong's economy through trade by air. Employment is estimated by applying the employment ratio for the "Import-Export Trading" industry to the value added figure.

Note that there is no "net trade" analysis as the bulk of Hong Kong's imports come by sea or by land and it is not plausible to suggest that in the absence of air cargo

[66] http://stat.wto.org/StatisticalProgram/WSDBStatProgramHome.aspx?Language=E
[67] Hong Kong Census and Statistics Department, *Report on Hong Kong Trade in Services Statistics*, 2012.
[68] Socio-economic Characteristics and Consumption Expenditure of Hong Kong Residents Making Personal Travel to the Mainland of China, 2012

facilitated by HKIA that there would be more manufacturing in Hong Kong. Thus there is no analogous potential loss associated with inbound air cargo as there may be with spending by Hong Kong residents travelling abroad, some of which at least could be plausibly assumed would be spent in Hong Kong if they did not travel.

A.1.3. Indirect and induced impacts

Indirect impacts reflect the result of the purchases of the direct businesses. Induced impacts reflect the result of the spending of employees in the direct and indirect businesses in the wider economy. Indirect and induced multipliers were calculated from a combination of ratios derived from data available from HKCSD and economic multipliers (see Exhibits A1.2) for year 2011 (used for 2012 and subsequent years in the economic model). The multipliers relating Direct plus Indirect Value Added to business receipts are provided by the Economic Analysis and Business Facilitation Unit (EABFU), Hong Kong Financial Secretary's Office, as broad working assumptions. These are produced based on the observed linkages between sectors and the resultant pattern of intermediate consumption, import leakages of the various economic activities, gross margin of external trade, and the ratios of value added to gross-output and business receipts for the affected sectors in recent years. Since tourism- related industries dominate the non-aviation businesses at HKIA, the tourism multipliers are used for the larger category. In addition, EABFU provided multipliers for the link between consumer spending and value added in the Hong Kong economy. We take these latter values as the Induced Value Added to Revenue Multiplier, as induced spending is consumer spending by employees in direct and indirect industries.

Exhibit A1.2. Economic Multipliers 2011

Industry	Multiplier
Direct Revenue to Direct + Indirect Value Added Multiplier	
Air Transport	0.317
Tourism	0.501
Trade (re-exports)	0.134
Trade (retained imports)	0.090
Induced Revenue to Induced Value Added to Multiplier	0.547

Note: The direct and indirect value added multipliers for re-exports and retained imports have both excluded air transport related value added.

Source: Economic Analysis and Business Facilitation Unit, Hong Kong Financial Secretary's Office; Enright, Scott & Associates, Ltd.

For aviation-related businesses in Hong Kong, non-aviation businesses at HKIA, tourism- related businesses, and trade, the Indirect Value Added is estimated by first multiplying Direct Revenue by the relevant Direct + Indirect Value Added Multiplier and then subtracting the Direct Value Added obtained through methods described above.

Indirect Value Added = (Direct Revenue x Direct Plus Indirect Value Added to Revenue Multiplier) – Direct Value Added

For aviation-related businesses in Hong Kong, non-aviation businesses at HKIA, and tourism-related businesses, Indirect Revenue is estimated by subtracting Direct Value Added from Direct Revenue. This is the same as assuming that import

leakage in these businesses is balanced by the contribution of all of the local supply industries upstream of the focal industry. As there is no information available that allows either the import leakage or the contribution of the upstream local supply industries, this remains as an assumption. Since no other estimation depended on Indirect Revenues, and in the absence of a Hong Kong-specific multiplier for Direct to Indirect Revenue, this approximation is taken as the best available.

$$\text{Indirect Revenue} = \text{Direct Revenue} - \text{Direct Value Added}$$

In the case of trade, since the extremely high import leakage makes Direct Revenue – Direct Value Added a poor proxy for Indirect Revenue, an estimate is obtained by multiplying Indirect Trade Value Added by the economy wide ratio of Revenue to Value Added.

$$\text{Indirect Trade Revenue} = \text{Indirect Trade Value Added} \times (\text{Revenue/ Value Added})_{\text{Hong Kong}}$$

For all industries, Indirect Employment is estimated by multiplying Indirect Value Added by the economy-wide ratio of Employment to Value Added. The economy-wide ratio is used because it is not possible to reverse engineer all of the upstream industries that are involved from the multiplier.

$$\text{Indirect Employment} = \text{Indirect Value Added} \times (\text{Employment/ Value Added})_{\text{Hong Kong}}$$

Induced Revenue refers to the revenue generated by the purchases of people employed in the direct and indirect industries and is calculated from the following formula:

$$\text{Induced Revenue} = [(\text{Direct VA})_{\text{Industry}} \times (\text{Comp/ VA})_{\text{Industry}} \times (1 - \text{HK SR})] + [(\text{Indirect VA})_{\text{Industry}} \times (\text{Comp/ VA})_{\text{Economy}} \times (1 - \text{HK SR})]$$

Where $(\text{Direct VA})_{\text{Industry}}$ is the direct value added for the industry, $(\text{Comp/ VA})_{\text{Industry}}$ the compensation portion of value added in the industry, HK SR the Hong Kong economy-wide savings rate, $(\text{Indirect VA})_{\text{Industry}}$ the industry's indirect value added, and $(\text{Comp/ VA})_{\text{Economy}}$ the compensation portion of value added in the Hong Kong economy. (1-HK SR) or one minus the savings rate, is the portion of income that is spent by consumers in Hong Kong.

Induced Value Added is estimated by multiplying Induced Revenue by the Induced Value Added to Revenue Multiplier. Induced Employment is estimated by multiplying Induced Revenue by the ratio of retail trade Employment to Revenue for Hong Kong. The assumption here is that most induced spending will be on retail goods.

$$\text{Induced Value Added} = \text{Induced Revenue} \times \text{Induced Value Added to Revenue Multiplier}$$

$$\text{Induced Employment} = \text{Induced Value Added} \times (\text{Employment/Value Added})_{\text{Retail, Hong Kong}}$$

The methodology for calculating direct, indirect, and induced impacts is summarised in Exhibit A1.3

Exhibit A1.3. Economic Impact Method Summary

	Revenue	Value Added	Employment
Direct	**DREV from HKCSD data or AA**	**DVA from HKCSD or relevant VA/REV ratio from HKCSD**	**DEMP from HKCSD or relevant EMP/REV ratio from HKCSD**
Indirect	**INDIREV = DREV-DVA, except for trade INDIREV = INDIVA x EREV/EVA**	**INDIVA= DREV x MULTIPLER$_1$ – DVA**	**INDIEMP = INDIVA x EEMP/EVA**
Induced	**INDUREV = DVA x (DCOMP/DVA) x (1-HKSR) + INDIVA x (ECOMP/EVA) x (1-HKSR)**	**INDUVA = INDUREV x MULTIPLIER$_2$**	**INDUEMP = INDUVA x Retail EMP /Retail VA**

D = Direct, INDI = Indirect, INDU = Induced
REV = Revenue, VA = Value Added, EMP = Employment
E = Economy wide, COMP = Compensation
MULTIPLIER$_1$ = Direct + Indirect Value Added Multiplier for relevant industry
MULTIPLIER$_2$ = INDUREV to INDUVA Multiplier
HKSR = Hong Kong Savings Rate

A.2. Economic impact of capital investment

The expenditure on infrastructure construction and subsequent expenditure on infrastructure maintenance under the investment scenarios will generate direct, indirect, and induced economic impacts.

In order to calculate the direct construction impacts, data on the forecast material, labour and plant costs, together with the number of persons to be employed were obtained from the AA, in addition to details of the planned construction phases. A portion of the cost data provided was in nominal "Money of the Day" dollars (MOD), as all dollar values used in the economic model are in real 2012 dollars, each annual nominal cost figure was discounted back to its equivalent value in 2012 dollars using the following formula:

$$\text{Real}_{(2012\ \$)}\ \text{Cost}_{(\text{Year Y})} = \text{Nominal Cost}_{(\text{Year Y})} \times \text{Real}_{(2012\ \$)}\ \text{GDP}_{(\text{Year Y})} / \text{Nominal GDP}_{(\text{Year Y})}$$ [69]

The AA provided construction costs for the third runway as a single lump sum figure in 2012 dollars. As construction was planned to cover 8 years, without further information on cost allocation, a simple division of expenditure by 8 gave the average annual expenditure. The real 2012 annual expenditures were first inflated by the MOD inflation rate then deflated by the GDP deflator to give a 2012 dollar value that correctly accounts for the higher MOD inflation rate over the projected economy wide inflation rate. ESA was subsequently provided with an MOD total third runway construction cost, which closely matched that derived from a roughly even 8 year split.

$$\text{Nominal Cost}_{(\text{Year Y})} = \text{Cost in 2012 HK\$}_{(\text{Year Y})} \times (1+ \text{Gr}_{(\text{Year Y})}) \times (1+ \text{Gr}_{(\text{Year Y - 1})}) \times \ldots\ldots\ldots (1+ \text{Gr}_{(\text{Year 2013})})$$

Gr = Annual Nominal MOD inflation rate, as provided by HKAA

$$\text{Cost in 2012 HK\$}_{(\text{Year Y})} = \text{Nominal Cost}_{(\text{Year Y})} \times \text{GDP in 2012 HK\$}_{(\text{Year Y})} / \text{Nominal GDP}_{(\text{Year Y})}$$

Direct Revenue to the construction companies is equal to the projected total sum of material, plant, and labour costs for the project. Direct Value Added is calculated as projected labour costs minus projected labour import leakages plus the projected profit margin for the construction companies. Labour leakages were estimated with reference to figures for the construction of Chek Lap Kok airport which indicate that labour import percentages ran as high as 20 percent,[70] and in consultation with the AA. Given that the project continues over a longer period and is smaller than the initial construction of Chek Lap Kok, and there are likely to be fewer major projects going on in Hong Kong at the same time than was the case then, it seems likely that there will be less competition for labour than there was when Chek Lap Kok was built, and that the need

[69] Real and Nominal GDP forecasts came from IHS Forecasts, November 2014
[70] Legislative Council Brief, Special Importation of Labour Scheme for the New Airport and Related Projects, Education and Manpower Branch, 1993

for imported labour will be mainly limited to specialists in the technical and management aspects of airport runway construction. On this basis, an estimate of 5 percent labour leakage is considered reasonable and is assumed in the present case. The projected profit margin for construction companies is 6.2 percent. This was taken as the ratio of gross surplus to total revenue for the Hong Kong construction industry in 2012.

Direct Employment, measured in "person-years," was calculated using estimates of the average "person-days" to be worked on each of the various activities involved in the construction of each scenario. The AA provided the estimated average person-day construction works schedule. The impact on Direct Employment was adjusted to take into account estimated import leakages for labour which again were assumed to be 5 percent.

Indirect revenue was estimated by taking projected costs for material and plant and adjusting them by subtracting import leakages. Import leakages for materials were assumed to be 80 percent on the basis that the majority of goods that are imported into Hong Kong arrive in a finished, or close to finished, state. Plant import leakages were assumed to be 50 percent. Although all, or nearly all, of the plant is likely to be imported, the total cost of plant includes items such as setup, on-going maintenance work, and the management of leases relating to plant, and these items are estimated to reduce overall leakage to 50 percent.

Indirect Value Added was estimated by multiplying Indirect Revenue by the economy wide ratio of Value Added to Revenue. This ratio was calculated from HKCSD data.

Indirect Employment was estimated by multiplying Indirect Value Added by the economy wide ratio of Employment to Value Added. This ratio was calculated from HKCSD data.

Induced Revenue, Value Added, and Employment were calculated following the same method as used in estimating the economic impact from operations of HKIA. Accordingly, Induced Revenue was calculated from the following formula:

$$\text{Induced Revenue} = [(\text{Direct VA})_{\text{Industry}} \times (\text{Comp/ VA})_{\text{Industry}} \times (1 - \text{HK SR})] + [(\text{Indirect VA})_{\text{Industry}} \times (\text{Comp/ VA})_{\text{Economy}} \times (1- \text{HK SR})]$$

Where $[(\text{Direct VA})_{\text{Industry}}$ is the Direct Value Added for the industry, $(\text{Comp/ VA})_{\text{Industry}}$ is the compensation portion of Value Added in the industry, HK SR is the economy-wide Hong Kong savings rate, $(\text{Indirect VA})_{\text{Industry}}$ is the industry's Indirect Value Added, and $(\text{Comp/ VA})_{\text{Economy}}$ is the compensation portion of Value Added in the Hong Kong economy.

Induced Value Added is estimated using the multiplier on private consumption expenditure provided by the Economic Analysis and Business Facilitation Unit, Hong Kong Financial Secretary's Office for the value added to consumer spending ratio for Hong Kong. Induced Employment was estimated by multiplying estimated Induced Value Added by the ratio of retail trade Employment to Value Added calculated from HKCSD data. Implicit in this is the assumption that employment in the retail sector per dollar of value added is broadly comparable to employment in the other spending

categories per dollar of value added.

AA provided estimated maintenance expenditure for each scenario from years 2012 to 2046. Maintenance expenditure will have a different mix to construction with lower expenditure on plant and material but higher expenditure on labour. No data is available on this expenditure mix and so we have assumed the same mix as used for construction.

A.3. Future projections

The economic impact analysis for the present provides a basis for estimates of future economic impacts. However, a number of additional assumptions and methods are necessary to project these impacts. We separate these into assumptions and methods that affect base economic impact projections and those specific to the projection of the economic impact of each scenario at HKIA.

A.3.1. Base projections

To generate future economic impact projections, it was necessary to obtain throughput or traffic forecasts for HKIA, and to generate scale factors that link future economic impact to the number of passengers and the amount of cargo handled by HKIA. The traffic projections were generated by AA's Consultants for the Status Quo Situation, Scenario 1, and Scenario 2. These projections indicated that Hong Kong residents would be served even if capacity were constrained at HKIA, with transit passenger then foreign visitor traffic bearing the brunt of the capacity limitations. Thus we project all Hong Kong resident demand is served through 2030 and that the ratio of Hong Kong resident to foreign visitor to transit and transfer passengers remains constant thereafter.

Scale factors for each major line of business were generated based on year 2012 data, and the relevant passenger and cargo throughput information. For businesses that are likely to scale with passenger numbers (retail, and food and beverage, for example), the most recent revenue per passenger was calculated and applied to projected passenger numbers. For businesses most likely to scale with cargo (cargo related services, for example), revenue per tonne of cargo throughput was calculated for the most recent year for which data was available and then applied to the projected cargo throughput numbers. For businesses where it was not possible to separate passengers and cargo (for example, the HKCSD "Air Transport and Incidental Services" category), the future projections were scaled by work load unit (WLU) as defined in Exhibit A3.1.

Exhibit A3.1 identifies each of the major line items in the analysis and whether the future projections are based on projected passenger numbers, cargo throughput, or workload unit.

Exhibit A3.1. Economic Model Industry Line Items Scale Factors

Industry	Scale Factor
Aviation-related Business in Hong Kong	
Air Transport and Incidental Services - (i) Air Transport & Cargo	Work Load Unit (WLU)
Non-aviation Business at the HKIA	
Total Retail, Food, and Beverage	Visitors arriving by air and Transit passengers
Hotel	Fixed at 2012 occupancy rate
Exhibitions and Conventions	Cargo weight
Tourism	
Tourism Exports	Visitors arriving by air
Tourism Imports	Hong Kong residents departing by air
Trade	
Hong Kong Trade Services	Cargo weight

Note: One WLU equals one passenger or 100 kg of cargo

Source: Enright, Scott & Associates, Ltd. research.

A.3.2. The economic impact of Scenario 1 and Scenario 2 at HKIA

The initial estimates of the economic impact of the investment programs associated with Scenario 1 and Scenario 2 at HKIA on Hong Kong's economy were generated by taking the economic contribution of HKIA projected in Scenario 1 or Scenario 2 and subtracting from this the economic contribution of HKIA projected in the Status Quo Situation with the net difference being the economic impact of Scenario 1 or Scenario 2. We have performed this calculation and the results are described in this Report as a separate analysis for construction and maintenance and airport operations.

A.4. Economic cost benefit analysis

Beyond estimating and projecting the net economic impacts of each investment scenario in nominal dollars, it is useful to assess the size of the economic return on investment to Hong Kong from each investment scenario in turn.

This can be expressed in the form of an Economic Internal Rate of Return (EIRR) and also as an Economic Net Present Value (ENPV). The EIRR and ENPV calculations are similar to the more commonly performed Internal Rate of Return (IRR) and Net Present Value (NPV) calculations, the main difference being that the "returns" or "inflows" used in doing an EIRR / ENPV are typically larger than the projected cash inflows that are used in doing a traditional IRR / NPV analysis because they may include broader economic benefits such as indirect impacts stemming from the suppliers providing goods and services to the direct activities in the project, and induced impacts from the spending of income generated by the direct and indirect activities. The capital costs or "outlay" expenditures are the same as those that would be used in a regular IRR / NPV calculation and represent the actual cost

of the project.

For the present project, the ENPVs were calculated assuming a discount rate of 4 percent provided by the Economic Analysis and Business Facilitation Unit of the Hong Kong Financial Secretary's Office, understood to be the rate that is commonly taken as the imputed discount rate used for capital budgeting purposes for projects that are government funded in Hong Kong.

The AA have provided cash flow estimates for construction and maintenance out to the first quarter of 2047. As some of the cash flow components were in financial year periods (April to March) these were converted to calendar year periods (January to December). By 2024 all expenditures are projected to be maintenance expenditure at the airport, we have assumed that maintenance expenditure for 2047 to 2061 remain at the 2046 levels.

For the various scenarios and cases investigated, we report the EIRRs and ENPVs for the direct benefits, direct plus indirect benefits, and direct plus indirect plus induced benefits. We also report results that include only the direct catalytic benefits, as well as the direct plus indirect plus induced catalytic benefits.

For each of the cases estimated, a 50 year period from 2012 to 2061 was taken as the relevant project timeline for the purpose of estimating EIRR and ENPV. The 50 year period was taken with reference to the time periods used in estimating the economic benefits of other major infrastructure projects, such as the Hong Kong-Shenzhen Western Express Line (WEL), which use 50 years as the projected period of time over which economic benefits may reasonably be estimated. The analysis assumes a zero terminal value for the investments of both Scenario 1 and Scenario 2. This is likely to be conservative.

For each of the cases estimated, the projected costs of each scenario were taken as being equal to the construction and maintenance costs from 2012 to 2046 as described in Section A.2. The annual cost flows for each scenario up to 2046 are given in Exhibits A4.1 and A4.2.

The projected economic benefits of airport expansion were taken as being equal to the incremental value added for each scenario. This was calculated by subtracting the projected value added for the Status Quo Situation from the projected value added in the Scenario 1 or Scenario 2. For each scenario, after 2030 the annual value added from operations in each year is assumed to remain constant at the 2030 level. The annual value added flows for each scenario up to 2046 are given in Exhibits A4.1 and A4.2.

The projected economic cost was subtracted from the projected economic benefit in each year to determine a net economic benefit for each year which was then discounted to present value terms using the 4 percent discount rate giving the estimated ENPV for each scenario. The discount rate that would give an estimated ENPV for each scenario that is equal to zero was then calculated for each of the estimated cases, this rate being the estimated EIRR for each scenario.

The EIRR and ENPV values can be found in Exhibit A4.3. In each case, the first three rows of results only take into account aviation-related businesses in Hong Kong and non-aviation businesses at HKIA, the fourth row includes the direct impact of aviation-facilitated tourism and trade, and the fifth includes the direct, indirect, and

induced impacts of aviation- facilitated tourism and trade. Note that only results for the “Net Tourism” cases are shown.

We note that the high EIRRs are due in part to the fact that significant leverage can be achieved with the existing asset and benefits can be readily realized from the second year of investment. In addition, IRR (EIRR) assumes that all the benefits from the project under review are re-invested at the internally generated rate of return, yielding further returns at this same rate in the following period(s). However, if the magnitude of the returns exceeds the amount that can be re-invested in the project and the IRR is high by comparison to rates of return available in the market, then the assumption that all the returns can be re-invested at the same rate as the IRR is false and the estimated IRR may not be a good measure for project evaluation. In any case, if the IRR (EIRR) and the NPV (ENPV) give different answers in the evaluation of mutually exclusive projects, the correct answer is by NPV (ENPV).

We note that for the EIRR calculation we assumed that all capital expenditures (cash outflows) occurred at the beginning of a year and all benefits were obtained at the end of a year. If we assumed both expenditures and benefits were made evenly through the year, then the net of expenditure and benefits was positive, even in the first year, yielding infinite EIRR estimates. The time shift will yield conservative EIRR estimates.

Exhibit A4.1. Costs and Economic Benefits Cash Flows for Scenario 1, HK$ mn

Year	Costs	Direct		Direct + Indirect		Direct + Indirect + Induced		Direct + Indirect + Induced + Catalytic Direct Only		Direct + Indirect + Induced + Total Catalytic	
		VA	Net	VA	Net	VA	Net	VA	Net	VA	Net
2012	(2,288)	5,726	3,43	8,511	6,223	10,284	7,995	18,507	16,219	31,087	28,799
2013	(3,864)	5,502	1,63	8,226	4,362	9,937	6,073	15,747	11,883	23,318	19,454
2014	(3,712)	5,639	1,92	8,430	4,718	10,184	6,472	16,137	12,424	23,898	20,186
2015	(2,352)	6,768	4,41	10,076	7,724	12,174	9,822	21,174	18,822	34,525	32,173
2016	(3,514)	10,080	6,56	14,952	11,438	18,066	14,552	34,002	30,488	59,338	55,824
2017	(5,245)	12,140	6,89	17,974	12,729	21,719	16,474	42,389	37,144	76,099	70,854
2018	(3,698)	12,995	9,29	19,232	15,534	23,239	19,541	45,698	42,000	82,547	78,849
2019	(1,674)	14,633	12,959	21,635	19,961	26,143	24,469	52,438	50,765	96,028	94,354
2020	(1,003)	15,402	14,399	22,765	21,762	27,509	26,506	55,480	54,477	102,032	101,029
2021	(742)	16,840	16,098	24,868	24,126	30,051	29,309	61,648	60,906	114,705	113,962
2022	(515)	17,483	16,968	25,823	25,308	31,205	30,690	63,761	63,245	118,317	117,801
2023	(284)	17,922	17,638	26,478	26,194	31,996	31,712	65,017	64,733	120,248	119,964
2024	(132)	18,417	18,285	27,210	27,078	32,880	32,748	66,806	66,674	123,552	123,420
2025	(207)	18,832	18,625	27,821	27,614	33,619	33,412	68,370	68,163	126,523	126,316
2026	(288)	19,027	18,739	28,121	27,833	33,981	33,694	68,498	68,210	126,041	125,753
2027	(314)	19,529	19,216	28,862	28,549	34,877	34,563	70,375	70,061	129,618	129,304
2028	(314)	19,871	19,557	29,377	29,063	35,498	35,184	71,174	70,860	130,539	130,225
2029	(295)	20,411	20,116	30,164	29,869	36,450	36,155	73,581	73,285	135,623	135,327
2030	(291)	20,794	20,503	30,734	30,443	37,138	36,847	74,788	74,497	137,621	137,329
2031	(321)	20,794	20,474	30,734	30,413	37,138	36,818	74,788	74,467	137,621	137,300
2032	(547)	20,794	20,247	30,734	30,187	37,138	36,592	74,788	74,241	137,621	137,074
2033	(800)	20,794	19,995	30,734	29,934	37,138	36,339	74,788	73,988	137,621	136,821
2034	(1,008)	20,794	19,786	30,734	29,726	37,138	36,131	74,788	73,780	137,621	136,613
2035	(1,191)	20,794	19,603	30,734	29,543	37,138	35,947	74,788	73,597	137,621	136,430
2036	(1,252)	20,794	19,542	30,734	29,482	37,138	35,886	74,788	73,536	137,621	136,369
2037	(1,172)	20,794	19,622	30,734	29,562	37,138	35,966	74,788	73,616	137,621	136,448
2038	(1,089)	20,794	19,705	30,734	29,645	37,138	36,049	74,788	73,699	137,621	136,531
2039	(1,001)	20,794	19,793	30,734	29,732	37,138	36,137	74,788	73,786	137,621	136,619
2040	(956)	20,794	19,838	30,734	29,778	37,138	36,182	74,788	73,832	137,621	136,665
2041	(1,030)	20,794	19,764	30,734	29,703	37,138	36,108	74,788	73,758	137,621	136,590
2042	(1,216)	20,794	19,578	30,734	29,517	37,138	35,922	74,788	73,571	137,621	136,404
2043	(1,450)	20,794	19,345	30,734	29,284	37,138	35,689	74,788	73,338	137,621	136,171
2044	(1,675)	20,794	19,119	30,734	29,059	37,138	35,463	74,788	73,113	137,621	135,945
2045	(1,893)	20,794	18,901	30,734	28,841	37,138	35,246	74,788	72,895	137,621	135,728
2046	(1,993)	20,794	18,801	30,734	28,741	37,138	35,146	74,788	72,795	137,621	135,628
2047-2061	(1,993)	20,794	18,801	30,734	28,741	37,138	35,146	74,788	72,795	137,621	135,628

Note: VA = value added, Net = VA – Costs. Dollar values are in 2012 dollars.

Source: Enright, Scott & Associates, Ltd. analysis.

Exhibit A4.2. Costs and Economic Benefits Cash Flows for Scenario 2, HK$ mn

Year	Costs	Direct		Direct + Indirect		Direct + Indirect + Induced		Direct + Indirect + Induced + Catalytic Direct Only		Direct + Indirect + Induced + Total Catalytic	
		VA	Net	VA	Net	VA	Net	VA	Net	VA	Net
2012	(2,288)	5,726	3,437	8,511	6,223	10,284	7,995	18,507	16,219	31,087	28,799
2013	(3,864)	5,502	1,638	8,226	4,362	9,937	6,073	15,747	11,883	23,318	19,454
2014	(3,805)	5,639	1,834	8,430	4,625	10,184	6,379	16,137	12,331	23,898	20,093
2015	(3,318)	6,768	3,450	10,076	6,758	12,174	8,856	21,174	17,856	34,525	31,207
2016	(19,145)	10,080	(9,065)	14,952	(4,193)	18,066	(1,079)	34,002	14,857	59,338	40,193
2017	(20,708)	12,140	(8,567)	17,974	(2,733)	21,719	1,011	42,389	21,681	76,099	55,392
2018	(18,606)	12,995	(5,611)	19,232	627	23,239	4,634	45,698	27,092	82,547	63,941
2019	(16,705)	14,633	(2,072)	21,635	4,930	26,143	9,438	52,438	35,734	96,028	79,323
2020	(16,369)	15,702	(666)	23,173	6,804	28,003	11,634	58,128	41,759	109,033	92,664
2021	(16,493)	16,430	(63)	24,220	7,727	29,269	12,776	62,026	45,533	117,923	101,430
2022	(16,651)	17,130	480	25,264	8,614	30,531	13,880	64,131	47,480	121,230	104,579
2023	(16,758)	22,332	5,573	32,941	16,183	39,808	23,049	83,313	66,555	157,184	140,426
2024	(132)	27,020	26,889	39,864	39,732	48,173	48,041	100,530	100,398	189,310	189,178
2025	(207)	31,633	31,426	46,678	46,471	56,408	56,201	117,280	117,073	220,306	220,099
2026	(288)	35,708	35,421	52,698	52,411	63,683	63,395	132,024	131,736	247,630	247,342
2027	(314)	39,395	39,081	58,134	57,821	70,252	69,938	145,824	145,511	273,804	273,491
2028	(323)	42,950	42,627	63,375	63,052	76,585	76,262	159,185	158,862	299,225	298,902
2029	(327)	46,211	45,884	68,173	67,846	82,383	82,056	171,836	171,509	323,806	323,479
2030	(352)	49,444	49,091	72,932	72,579	88,134	87,782	184,312	183,960	347,924	347,571
2031	(428)	49,444	49,016	72,932	72,504	88,134	87,706	184,312	183,884	347,924	347,496
2032	(678)	49,444	48,766	72,932	72,254	88,134	87,457	184,312	183,634	347,924	347,246
2033	(970)	49,444	48,473	72,932	71,961	88,134	87,164	184,312	183,342	347,924	346,954
2034	(1,204)	49,444	48,240	72,932	71,728	88,134	86,931	184,312	183,108	347,924	346,720
2035	(1,434)	49,444	48,009	72,932	71,497	88,134	86,700	184,312	182,878	347,924	346,490
2036	(1,597)	49,444	47,847	72,932	71,335	88,134	86,538	184,312	182,715	347,924	346,327
2037	(1,769)	49,444	47,675	72,932	71,163	88,134	86,366	184,312	182,543	347,924	346,155
2038	(1,942)	49,444	47,502	72,932	70,990	88,134	86,192	184,312	182,370	347,924	345,982
2039	(2,092)	49,444	47,352	72,932	70,840	88,134	86,043	184,312	182,220	347,924	345,832
2040	(2,754)	49,444	46,689	72,932	70,178	88,134	85,380	184,312	181,558	347,924	345,170
2041	(3,397)	49,444	46,046	72,932	69,534	88,134	84,737	184,312	180,915	347,924	344,527
2042	(3,796)	49,444	45,648	72,932	69,136	88,134	84,338	184,312	180,516	347,924	344,128
2043	(3,956)	49,444	45,488	72,932	68,976	88,134	84,179	184,312	180,356	347,924	343,968
2044	(3,935)	49,444	45,509	72,932	68,997	88,134	84,200	184,312	180,377	347,924	343,989
2045	(3,836)	49,444	45,608	72,932	69,096	88,134	84,298	184,312	180,476	347,924	344,088
2046	(3,764)	49,444	45,679	72,932	69,167	88,134	84,370	184,312	180,548	347,924	344,159
2047-2061	(3,764)	49,444	45,679	72,932	69,167	88,134	84,370	184,312	180,548	347,924	344,159

Note: VA = value added, Net = VA – Costs. Dollar values are in 2012 dollars.

Source: Enright, Scott & Associates, Ltd. analysis.

Exhibit A4.3. Economic Internal Rate of Return and Economic Net Present Value for a 50 Year Return, Scenario 1 and 2

Impact	EIRR (percent)	ENPV (HK$ mn)
Scenario 1		
Direct	106%	314,739
Direct + Indirect	211%	482,969
Direct + Indirect + Induced	285%	591,214
Direct + Indirect + Induced + Catalytic Direct Only	626%	1,213,343
Direct + Indirect + Induced + Catalytic Total	1,164%	2,243,271
Scenario 2		
Direct	27%	525,722
Direct + Indirect	179%	841,521
Direct + Indirect + Induced	269%	1,045,637
Direct + Indirect + Induced + Catalytic Direct Only	623%	2,309,927
Direct + Indirect + Induced + Catalytic Total	1,163%	4,447,187

Note: The "Direct," "Direct + Indirect," and "Direct + Indirect + Induced" lines include only aviation-related businesses in Hong Kong and non-aviation businesses at HKIA. The "Direct + Indirect + Induced + Catalytic Direct Only" line adds in the direct benefits of aviation-facilitated tourism and trade. The "Direct + Indirect + Induced + Catalytic Total" line adds in the direct, indirect, and induced benefits of aviation-facilitated tourism and trade. All dollar values are in 2012 dollars.

Source: Enright, Scott & Associates, Ltd. analysis.

On economic grounds, the results suggest that Scenario 2 would be far more beneficial to Hong Kong than Scenario 1.

A.5. Cost of delay

The present report has assumed that there will be no delay in the start to construction and the final opening date for the third runway under Scenario 2. To estimate the cost of delaying the opening of a third runway, ESA calculated the ENPV for Scenario 2 assuming that the costs and benefits of the third runway construction would be delayed by one year, two years, three years, four years, and five years. To provide an "apples to apples" comparison, ESA allowed for an extension of the cash flows beyond 2061 for each year of delay. The cost of delay was then estimated by taking the difference between the ENPV in the no delay case and that for the delay cases. The results of this analysis are reported in Appendix G.

Annex B

Examples of Noise-Related Charges in Overseas Airports

1. Majority of airports with noise-related charges do not associate their noise charges with the landing fee. Some airports adopt independent formula on the basis of aircraft weight, noise level, etc (e.g. Frankfurt, Munich, Taipei) while others establish the level of noise charges with reference to landing fee (e.g. Seoul Gimpo, Paris CDG, Tokyo Narita). In some cases, combinations of formulae are used (e.g. Amsterdam Schiphol[9], London Heathrow[10]).

2. Majority of airports impose noise charges on landings only (e.g. Munich, Zurich, Seoul Gimpo), while some impose noise charges on both landings and take-offs (e.g. Frankfurt, Dusseldorf, Budapest).

3. A number of airports use noise measurement equipment installed around the airport to determine the categorization of noise charges (e.g. Munich, Zurich, Dusseldorf), while others charge airlines on the basis of ICAO aircraft noise certifications[11] (e.g. Amsterdam, Paris, Narita, Frankfurt).

4. The level of noise charges implemented at airports generally represent around 2-3% of their total aeronautical charges[12]. Depending on the airport's local conditions and aircraft types, the noise charge imposed on the noisiest aircraft versus the quietest can vary substantially (from 1-2 times to over 60 times). Some airports also introduce a higher night noise charge versus day time.

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[9] In Amsterdam Airport, the landing and take-off charge is differentiated by aircraft noise categories. It also has a Noise/Insulation Levy that is payable to the Amsterdam government and charged based on an independent formula. It is specifically in place to fund the cost of noise insulation for houses or other noise-sensitive buildings (Source: "Schiphol Airport Charges and Conditions" 1 April 2015).

[10] For Heathrow, apart from having noise charge schemes implemented according to ICAO principles, aircrafts exceeding noise limits can be penalized following guidelines directly set by the government (Department for Transport) which is outside the Noise Charge regime as set out according to ICAO principles. (Source: "Aviation Policy Framework" presented to Parliament by the Secretary of State for Transport by Command of Her Majesty March 2013)

[11] ICAO aircraft noise certification classifies aircraft into several broad categories referred as "chapter standards" (e.g. Chapter 3 aircraft is considered "noisier" than Chapter 4 aircraft). To allow airports to have a more sophisticated tool for rating aircraft noise based on ICAO Annex 16 certification, ACI Governing Board recommended the use of ACI Aircraft Noise Rating Index (ANRI) in October 2002 (modified in 2010) which provides a sub-division of aircraft noise categories within an ICAO "chapter standard".

[12] Based on "Aeronautical Charges Study" conducted by LeighFisher in 2013.

Annex C

Press Releases relating to PRD Airspace between 2004 – 2015 (Civil Aviation Department of Hong Kong)

Exhibit No.	Date	Title
C1	February 22, 2004	High-level Meeting to Enhance Air Traffic Management in PRD
C2	August 12, 2011	New handover point through Pearl River Delta Region (with photo)
C3	September 1, 2011	Pearl River Delta Region Air Traffic Management Planning and Implementation Supervisory Group meeting
C4	June 18, 2012	Pearl River Delta Region Air Traffic Management Planning and Implementation Supervisory Group Meeting (with photo)
C5	March 10, 2015	CAD's statement to media reports on PRD airspace
C6	April 2, 2015	Constraints on HKIA Dual-runway Operation and Airspace Issue (Translation of Op-ed by DGCA)
C7	Oct 20, 2015	CAD and CAAC reach agreement on new air routes for traffic to and from eastern part of the Mainland

C1. High-level Meeting to Enhance Air Traffic Management in PRD

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The Director-General of Civil Aviation, Mr Albert Lam, will participate in a high-level meeting with his Mainland and Macao counterparts to map out the future Air Traffic Management (ATM) Plan in the Pearl River Delta (PRD) area.

As a continuous effort to ensure the safety and efficiency of air traffic management in one of the busiest airspaces in the world, Mr Lam will lead a team of air traffic and engineering professionals to participate in the 1st PRD ATM Planning and Implementation Working Group Meeting in Dalian beginning Wednesday (February 25).

The meeting will be chaired by the Director-General of Air Traffic Management Bureau, General Administration of Civil Aviation of China (CAAC), Mr Su Langen. Other senior CAAC officials from Beijing will also join the two-day meeting.

Amongst the issues to be covered are the development of a working model on the strategic planning and implementation of air traffic control (ATC) procedures in PRD, means to further enhance the efficiency of ATC operations in PRD, and introduction by CAAC of flight procedures of the new Guangzhou Baiyun International Airport scheduled to commence operations in mid-2004 in Huadu.

"I am very pleased to be able to participate in this meeting to join hands with the ATC experts in the Mainland and Macao to devise a long-term and comprehensive ATM plan for PRD. This area, which commands a strategic location in Asia Pacific region, is experiencing rapid growth in air traffic," Mr Lam said.

He noted that the overall air traffic volume in PRD was steadily on the rise despite some unfortunate setbacks caused by the September 11 incidents and the outbreak of SARS.

"The aviation market in PRD has tremendous potential for stronger growth. I hope that through the joint efforts with my Mainland and Macao counterparts, we will further enhance the use of airspaces and air traffic management in this area. In so doing, we can better promote the development of the aviation sector in PRD and ensure its continuous growth in a wholesome manner," Mr Lam added.

Mr Lam will also visit the Middle and Southern Administration of CAAC in Guangzhou and meet with its Director-General, Mr Wang Jiwu and other senior officials of the Administration before returning to Hong Kong.

22 February 2004

C.2 New handover point through Pearl River Delta Region (with photo)
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The civil aviation authorities of the Mainland, Hong Kong and Macao have made concerted efforts in establishing an additional handover point between the Hong Kong and Guangzhou Flight Information Regions (FIRs). Named "LANDA", the new handover point will deal with flights transiting through Hong Kong FIR and landing at Shenzhen with effect from September 22, thus achieving a further step in the continuing enhancement of the Pearl River Delta (PRD)'s airspace management.

Through the tripartite co-operation platform, the Civil Aviation Department (CAD) will continue working with the Mainland and Macao civil aviation authorities in formulating improvement measures, with a view to gradually enhancing the PRD's peripheral flight route structure and actively promoting co-operation and exchange in regional air traffic management to rationalise flight routes and flight procedures design. This will further enhance efficiency in the use of PRD airspace to cater for the ongoing rapid growth in the volume of air traffic across the region.

Presently, these flights for Shenzhen are transiting through the busiest airspace around Hong Kong International Airport (HKIA). As the new handover point and its associated air routes are located away from this airspace sector, traffic complexity around the HKIA will be significantly reduced, thereby enhancing air traffic management efficiency.

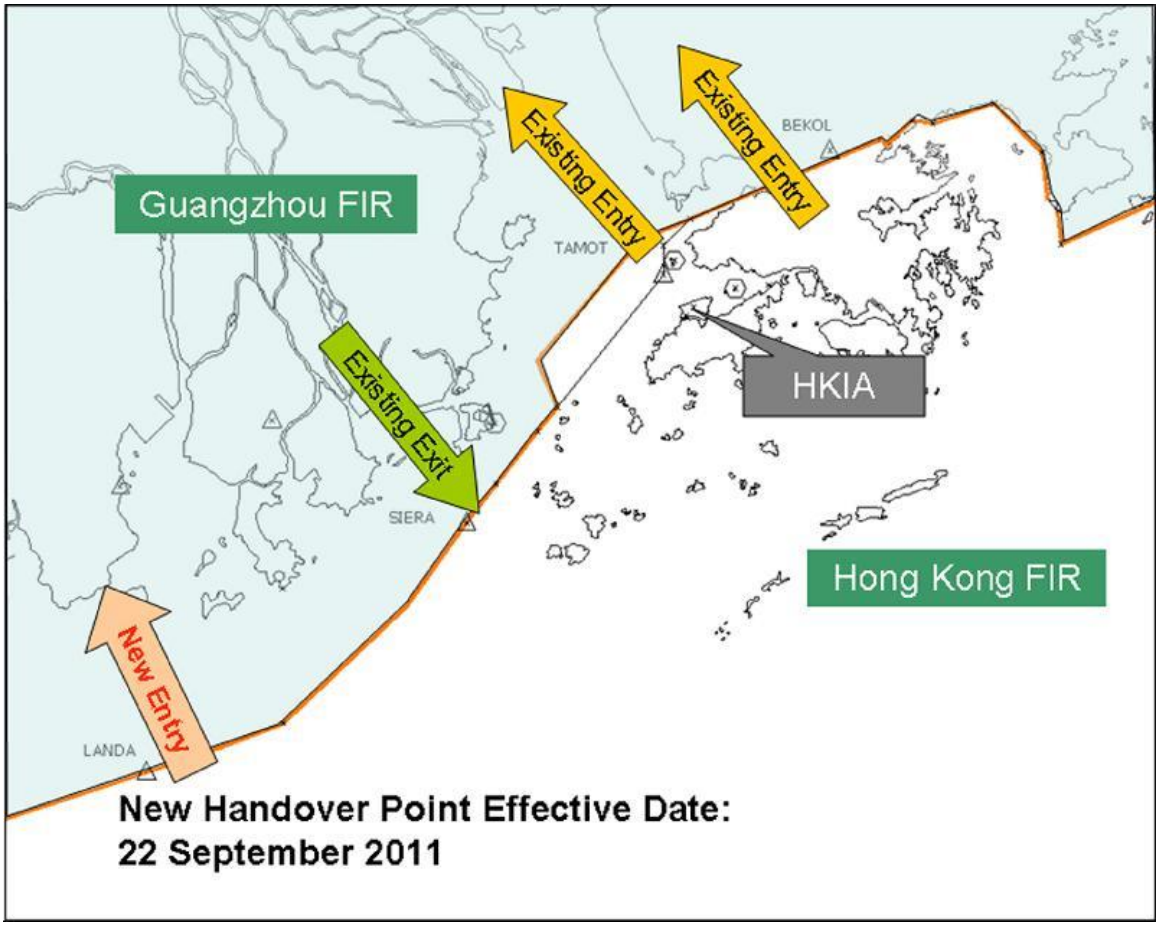
After the introduction of this new handover point, the total number of handover points for flights operating through the PRD airspace will increase from the existing two entries (from Hong Kong to the Mainland) and one exit (from the Mainland to Hong Kong) to three entries and one exit (please refer to the attached photo). The new handover point will alleviate the burden on the existing handover points and around 18 per cent of the route capacity will be released for use by flights originating from Hong Kong for the Mainland. This is conducive to the continued growth of air traffic between the Mainland and Hong Kong.

The civil aviation authorities of the Mainland, Hong Kong and Macao will continue to study and implement enhancement measures to further rationalise the airspace design and management of the PRD region.

Moreover, with effect from July 1 this year, the traffic spacing requirement between flights on air route M750/B576 transiting through the Hong Kong and Taipei FIRs for South Korea has been reduced from the original 10 minutes to five minutes with a significant increase in the route's capacity.

CAD will continue to enhance airspace management efficiency and increase the capacity of air routes within the Hong Kong FIR so as to provide a safe and efficient service to the travelling public.

Ends/Friday, August 12, 2011



C.3 Pearl River Delta Region Air Traffic Management Planning and Implementation Supervisory Group meeting

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The Pearl River Delta (PRD) Region Air Traffic Management Planning and Implementation Supervisory Group, which was jointly established by the Civil Aviation Administration of China, Civil Aviation Department Hong Kong, and Civil Aviation Authority of Macao, held its latest meeting in Zhuhai on August 31, to further discuss enhancement measures regarding the PRD's air traffic control procedures and airspace structure.

At the meeting, the fruitful outcomes of collaborative efforts made by the tripartite meeting in recent years were summarised. A number of airspace enhancement measures have been implemented, including the establishment of peripheral flight routes in the PRD region and the adjustment of the Zhuhai Terminal Area boundary. An additional handover point (with associated flight routes) will also be established between the Hong Kong and Guangzhou Flight Information Regions with effect from September 22 to further enhance air traffic management in the PRD region.

The meeting also formulated a work plan for the next stage of work in accordance with the principles of joint airspace planning, use of common standards and harmonised flight procedure design to enhance airspace planning and air traffic management in the region. Taking the actual operational needs into full consideration, the three sides agreed to further study the enhancements to the planning proposals of the Guangzhou and Southern PRD Terminal Areas. The three sides also agreed to expedite the development of the related ancillary systems and to strengthen co-ordination at the operational level for the implementation of continued enhancement measures to address operational needs. A feasibility study will also be conducted on the use of common standards in the operational environment in the Southern PRD Terminal Area and the implementation arrangements. These measures will further enhance the efficiency in the use of the PRD's airspace to cater for the continued growth in the air traffic volume of the region in the future.

The civil aviation authorities of the Mainland, Hong Kong and Macao will continue to study and implement other enhancement measures to further rationalise the airspace design and management of the PRD region. These relevant enhancement measures would adequately cater for the future development of the airports in the region, including the operating mode at the Hong Kong International Airport if a third runway is built, i.e. 102 movements per hour and an estimated 620,000 landing and take-offs per year.

Ends/Thursday, September 1, 2011

C.4 Pearl River Delta Region Air Traffic Management Planning and Implementation Supervisory Group Meeting (with photo)

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The Pearl River Delta Region Air Traffic Management Planning and Implementation Supervisory Group, which was jointly established by the Civil Aviation Administration of China, the Hong Kong Civil Aviation Department (CAD) and the Civil Aviation Authority of Macao, held its latest meeting in Macao today (June 18) and finalised the way forward in respect of air traffic control procedures and airspace enhancements to meet future air traffic demand, and to increase the efficiency of air traffic operations in the Pearl River Delta (PRD) region.

The Supervisory Group reviewed the rationalised PRD flight procedures and air routes, as well as related ancillary systems provision that will enhance collaboration among the three sides and improve airspace utilisation and air traffic management in the PRD region, following the medium- and long-term targets and work plan previously set by the Group. Consensus was reached to push forward the removal of airspace constraints within the PRD region to progressively establish a Southern PRD Terminal Area encompassing all PRD airports in Hong Kong, Macao, Shenzhen and Zhuhai. This will increase regional air transport capability and achieve the ultimate objectives of realising joint airspace planning, use of common standards and harmonised flight procedure design by 2020 as planned.

At the meeting, the CAD introduced the Hong Kong International Airport Master Plan 2030 to the other two civil aviation authorities. Members of the Group expressed full support for the Hong Kong International Airport (HKIA) adopting the three-runway system as the future development option, and to the CAD using such a proposal for airspace management and planning purposes. Full consideration had been given to the future development of all airports in the PRD region. The Group pledged to work in collaboration to study and implement enhancement measures of PRD airspace design and management. These enhancement measures would adequately address the future development of airports within the region, including the three-runway mode of operations at the HKIA, which would handle a maximum of 102 aircraft movements per hour and about 620 000 landings and take-offs per year.

Ends/Monday, June 18, 2012

Picture shows (from left) the Director-General of the Air Traffic Management Bureau of the Civil Aviation Administration of China (CAAC), Mr Wang Liya; the President of the Civil Aviation Authority of Macao, Mr Simon Chan; the Director-General of the Office of Air Traffic Management of the CAAC, Mr Su Langen; the Director-General of Civil Aviation of Hong Kong, Mr Norman Lo; and the Director-General of the Air Traffic Management Bureau of Middle and South Region of the CAAC, Mr Chen Songlin, discussing air traffic control procedures and airspace enhancement measures during the Pearl River Delta Region Air Traffic Management Planning and Implementation Supervisory Group Meeting held in Macao today (June 18).

C.5 CAD's statement to media reports on PRD airspace

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In response to media reports concerning Pearl River Delta (PRD) airspace issues, a spokesperson for the Civil Aviation Department (CAD) today (March 10) gave the following statement:

In order to meet the rapid growth of the aviation industry and the need for future expansion of the five airports (Hong Kong, Shenzhen, Macau, Zhuhai and Guangzhou) in the PRD region, CAD, Civil Aviation Administration of China and Civil Aviation Authority of Macao jointly established the PRD Region Air Traffic Management Planning and Implementation Tripartite Working Group (TWG) in 2004. The objective of the TWG was to enhance the overall flight handling capacity of PRD airspace. During the period of 2004 to 2007, the TWG convened 10 meetings. Through the meticulous evaluation of fast time simulation and based on the principles of joint airspace planning, use of common standards and harmonised flight procedure design, the three sides jointly established the "Pearl River Delta Region Air Traffic Management Planning and Implementation Plan (Version 2.0)" (the Plan) in 2007. The Plan, which clearly stipulated the short, medium and long term optimisation targets and measures to be achieved and implemented before 2020, has taken into consideration the needs for additional runways, associated flight procedures and airspace design of all the airports in the region, which included the Three Runway System (3RS) at Hong Kong International Airport (HKIA) and its compatibility with the development plan of neighbouring airports. The three sides had also agreed to optimise the use of airspace resources in PRD region through shared use of airspace and adoption of common units of measurement in a mutually beneficial manner. Enhancement measures in the Plan including new peripheral air routes in the PRD area, additional handover points between Air Traffic Control units and adjusted Zhuhai Terminal Airspace have been successfully implemented. The Plan aims to enhance the overall air traffic handling capacity of the PRD airspace. Under the principle of shared use of airspace, although the flight procedures of both sides (the Mainland and Hong Kong) will make use of a small portion of each other's airspace, both sides will utilise different flight altitude layers to facilitate air traffic control. Therefore, the ownership of the concerned airspace still belong to the original air traffic control unit and there is no intention for Hong Kong to expand its airspace up to Guangzhou or manage military flights. The most vital task for CAD is to continue the discussion with the Mainland and Macau aviation authorities through the TWG platform in order to take forward the enhancement items in the Plan in a progressive manner, and to tie over the development of the 3RS of the HKIA.

Regarding the reports concerning Performance-based Navigation (PBN), as the objective of implementing PBN is to improve the flexibility of air traffic management through the enhancement of flight navigation accuracy and flight procedure efficiency, it does not lead to

reduction of the approach or departure separation standard between aircraft or enhancement of runway capacity. In this regard, CAD has been implementing PBN procedures progressively in accordance with the guidance issued by the International Civil Aviation Organisation. In fact CAD has fully implemented PBN departure and arrival procedures at HKIA since January 2013. Currently most of the aircraft operating at HKIA are capable to conduct PBN procedures. PBN procedures are also implemented at Guangzhou and Shenzhen airports.

Ends/Tuesday, March 10, 2015

C.6 Constraints on HKIA Dual-runway Operation and Airspace Issue

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Mr Norman Lo, Director-General of Civil Aviation April 2, 2015

Recently some members of the public have challenged the planning of the three-runway system (3RS) at the Hong Kong International Airport (HKIA) on two issues: (1) whether the current capacity of two-runway system (2RS) can be expanded (and hence, the third runway would be unnecessary); and (2) whether the airspace issue can be resolved.

The maximum capacity of the existing two runways

Various studies had been conducted in the past to assess the capacity of the 2RS. The latest study was the Airspace and Runway Capacity Study commissioned by the Airport Authority of Hong Kong (AAHK) and carried out by National Air Traffic Services (NATS) in 2008, which was based on the latest air traffic control technology and international standards. According to this study, in full compliance with the safety standards/requirements of the International Civil Aviation Organization (ICAO), the maximum practical capacity that can be achieved with the existing 2RS would be 68 movements per hour.

Can the maximum capacity of the existing 2RS be further increased?

The capacity of the existing 2RS is constrained by two factors in which the ICAO has strict requirements and standards: (1) the need for spacing between aircraft due to the spiral air turbulence generated by operating aircraft (known as wake turbulence); and (2) the surrounding terrain near the runway.

Wake turbulence

Strong wake turbulence can cause the following aircraft to lose balance, thus affect flight safety. Therefore, the ICAO requires that a minimum spacing be maintained between aircraft during takeoff and landing. The heavier the aircraft, the stronger the wake turbulence and the larger the spacing would be required. Consequently, the capacity of a runway is limited.

Terrain constraints

The report of New Airport Master Plan (NAMP) in 1992 from the former Provisional Airport Authority, pointed out that, a pair of parallel runways under different modes of operation could in theory achieve different capacity ranging from 52 to 86 movements per hour (See table below). However, the NAMP report made clear that due to the mountains on the nearby Lantau Island, in order to achieve higher runway capacity, it would not be possible to operate

in compliance to relevant ICAO standards on flight procedure, hence such operation was neither safe nor practicable.

Mode of Operation	Practical Hourly Capacity Estimate
(a) Single-runway system	43 movements
(b) Dual-runway system with Segregated Operation (i.e. one runway used exclusively for approaches and the other exclusively for departures)	52 movements
(c) Dual-runway system in Mixed Operation	
(i) Dependent Mixed Modes: departures and approaches on one runway must take into consideration an aircraft landing or departing on the parallel runway. The possible modes are as follow:	
(a) Dependent Approaches and Departures	69 movements
(b) Independent Approaches and Dependent Departures; and	71 movements
(c) Dependent Approaches and Independent Departures	79 movements
(ii) Independent Mixed Mode: Operation on one runway can take place completely separately and without interference from the parallel runway, as if the two runways were two different airports.	86 movements

The consultant commissioned by the Civil Aviation Department (CAD) in 1994 also pointed out that, due to the constraints from surrounding terrain, the maximum capacity of the 2RS could only be about 63 movements per hour. As previously mentioned, in 2008 NATS had conducted a thorough review of runway capacity of HKIA and confirmed that after implementing some 40 improvement recommendations, in full compliance to ICAO safety standards/requirements, the maximum runway capacity of 2RS could be increased to 68 movements per hour.

Some comments suggested that if the peak of Tai Yam Teng (610 feet) and Fa Peng Teng (810 feet) which are located at the North East of Lantau were removed, the runway capacity of the 2RS could be further increased. These comments claimed that removal of Tai Yam Teng and Fa Peng Teng were suggested in the 1992 NAMP report. In fact, the suggestion in the NAMP report was made in connection with possible options to enhance the climb gradient of contingency departure procedures for departing aircraft on engine out during initial climb (i.e. to reduce restriction on the aircraft engine out climb performance). In order to attain the theoretical maximum runway capacity outlined in the NAMP report, i.e. 86 movements per hour, and conforming to the safety standards/requirements of the ICAO, most of the high peaks on Lantau Island, including Lantau Peak, Sunset Peak and other high

mountains, would have to be levelled. Major infrastructure and landmarks like Ngong Ping Cable Car, Big Buddha and Po Lin Monastery would also be affected, not to mention that most of these areas fall within the boundaries of the Lantau Country Parks. . Therefore, the proposed removal of high peaks is neither practical nor feasible.

The "Air wall" issue

There have also been concerns on the constraints imposed by the so-called "air wall". In fact this is not an appropriate term as in reality there is no "wall"-type segregation between different airspaces. To ensure that aircraft in adjacent airspaces can operate concurrently in a safe and efficient manner, every aircraft must reach a certain altitude and geographic location before an air traffic control (ATC) unit may hand over control of that aircraft to another ATC unit. This is to ensure that aircraft in adjacent airspace flying in opposite directions can fly at various altitudes and prevent collisions. This air traffic management arrangement of "Transfer of control point" aims to safeguard flight safety, and is commonly applied at busy airports all over the world, including those in London and New York.

Airspace issue

The Tripartite Working Group (TWG), set up by the Civil Aviation Administration of China (CAAC), CAD of Hong Kong and the Civil Aviation Authority of Macao (CAAM), drew up the "Pearl River Delta Region Air Traffic Management Planning and Implementation Plan (2007 Plan)" after three years of work and more than 10 rounds of meetings at various working levels. The maximum capacity of 102 movements per hour under the 3RS operation at HKIA as proposed by AAHK is based on this 2007 Plan.

2007 Plan

The 2007 Plan has clear objectives and contents. As per the press release issued by the CAAC on 15 February 2007, the Plan "aiming at strengthening the synergy of collaborative operations between all three parties, taken into consideration of terminal airspace structure, ATC operation standards and ATC operation procedures, defined three phases of the planning and development of Pearl River Delta (PRD) air traffic management. With the use of state-of-the-art computer-simulation and evaluation techniques, technical experts from the three parties conducted analysis and concluded that the Plan could generally satisfy the development needs of aviation industry in the PRD region in 2020".

At the TWG meeting held on 18 June 2012, all parties expressed their support for HKIA adopting the 3RS as the future development option, and to the CAD using such a proposal for air traffic management and planning purposes. The Central Government has always

supported Hong Kong in cementing its position as an international aviation hub and developing the 3RS. We strongly believe that the Mainland, Hong Kong and Macau will be able to implement, in accordance with the 2007 Plan, all enhancement and collaborative measures conducive to the development of the five major airports in the PRD region.

C.7 CAD and CAAC reach agreement on new air routes for traffic to and from eastern part of the Mainland

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Through the co-operation platform of the Pearl River Delta (PRD) Region Air Traffic Management Planning and Implementation Working Group, the Civil Aviation Department (CAD) of Hong Kong today (October 20) reached an agreement with the Air Traffic Management Bureau of the Civil Aviation Administration of China (CAAC) in which new air routes for the eastern part of the Mainland and an associated additional handover point between the Hong Kong and Guangzhou Flight Information Regions (FIRs) called LELIM would be established for flights operating between Hong Kong, Macau and the eastern part of the Mainland with effect from January 7, 2016.

At present, flights departing from the Hong Kong or Macau airports, as well as those from Southeast Asia, Australia and New Zealand transiting the Hong Kong FIR, to and from the eastern part of the Mainland are going into and out of the Mainland FIRs on one single air route. The increase in air traffic volume led to the overloading of the existing flight path while the busy airspace also increased the complexity in flight handling.

The launching of new air routes for the eastern part of the Mainland was one of the key enhancement measures set out by the PRD Region Air Traffic Management Planning and Implementation Plan (Version 2.0). To achieve it, the CAD has been in close liaison with the CAAC and has held several co-ordination meetings to exchange views on technical arrangements. This measure aims to optimise the efficiency of the air routes for the eastern part of the Mainland, on the premise that the safety, order and efficiency of its implementation can be safeguarded.

The introduction of the new air routes and handover point will split the flights departing from Hong Kong and Macau, and those transiting the Hong Kong FIR. This will help ease the traffic load of the existing air routes. Furthermore, this may enhance the airspace capacity and air traffic flow, as well as the air traffic management efficiency to cater for the ongoing growth in the volume of air traffic between Hong Kong and the Mainland.

The CAD, as in the past, will continue to proactively promote exchanges on PRD region air traffic management co-operation. It will also study and implement other measures to further rationalise the airspace management in the region to cope with the rapid growth in the volume of air traffic in future.

Ends/Tuesday, October 20, 2015

Annex D

Information on Accidents Caused by Marine Construction Works with respect to the Hong Kong-Zhuhai-Macao Bridge Project

A total of 35 accidents caused by marine construction works of the Hong Kong-Zhuhai-Macao Bridge local related projects (including the Hong Kong Boundary Crossing Facilities, the Hong Kong Link Road and the Tuen Mun-Chek Lap Kok Link) occurred between January 2012 and June 2015. The numbers of persons injured and dead in these accidents were categorised as follows:

Type of Accidents	2012		2013		2014		First half of 2015		Total	
	No. of injuries	No. of deaths	No. of injuries	No. of deaths	No. of injuries	No. of deaths	No. of injuries	No. of deaths	No. of injuries	No. of deaths
Trapped in or between objects	0	0	2	0	0	0	1	0	3	0
Injured whilst lifting or carrying	0	0	1	0	2	0	0	0	3	0
Slip, trip or fall on same level	1	0	7	0	7	0	0	0	15	0
Fall of person from height	0	0	1	0	1	0	1	0	3	0
Striking against fixed or stationary object	0	0	2	0	0	0	0	0	2	0
Striking against moving object	1	0	3	0	1	0	0	0	5	0
Stepping on object	0	0	0	0	0	0	0	0	0	0
Struck by moving or falling object	0	0	0	0	0	0	0	0	0	0
Struck by moving vehicle	0	0	0	0	0	0	0	0	0	0
Drowning	0	0	0	0	0	2	0	0	0	2
Others	0	0	0	0	2	0	0	0	2	0
Total	2	0	16	0	13	2	2	0	**33**	**2**

Annex E

Information on 3RS available to the public

Information	URL
A. Publication	
3RS Infokit	http://info.threerunwaysystem.com/pdf/en/3rs_infokit.pdf
Economic Impact Study of the Three-runway System (Update, 2015)	http://info.threerunwaysystem.com/pdf/en/economic_impact_study_of_the_three_runway_system.pdf
3RS Bulletin (Issues 1-6)	http://www.threerunwaysystem.com/en/Information/Publications.aspx
B. EIA and EP	
Environmental Permit	http://www.epd.gov.hk/eia/chi/register/permit/latest/ep4892014.htm
Expansion of Hong Kong International Airport into a Three-Runway System (Further information submitted under section 8(1) of the EIA Ordinance)	http://www.epd.gov.hk/eia/register/report/eiareport/eia_2232014/further_info/pdf/index.html (Only in English)
EIA Report	http://www.epd.gov.hk/eia/register/report/eiareport/eia_2232014/html/index.htm
Public Forum on the EIA for the 3RS – Presentation Material	http://info.threerunwaysystem.com/pdf/en/public_forum_20140627.pdf
Study Brief (EIA) (Only in English)	http://www.epd.gov.hk/eia/register/study/latest/esb-250.pdf
Further Information Concerning Project Profile	http://www.epd.gov.hk/eia/register/profile/latest/esb250/further/further.pdf

Information	URL
Project Profile (Only in English)	http://www.epd.gov.hk/eia/register/profile/latest/esb250/esb250.pdf
Carbon Emission Study (Only in English)	http://info.threerunwaysystem.com/pdf/en/hkia_carbon_emissions_study_airport_emissions_management_report_executive_summary.pdf
C. HKIA Master Plan 2030	
Report on Consultation Result	http://www.threerunwaysystem.com/en/Information/consultation_results_report.aspx
HKIA Master Plan 2030	http://www.threerunwaysystem.com/en/Information/Airport_master_plan_2030.aspx
HKIA Master Plan 2030 (Summary)	http://info.threerunwaysystem.com/pdf/en/mp2030_leaflet.pdf
HKIA Master Plan 2030 (Technical Report)	http://www.threerunwaysystem.com/en/Information/Tech_report.aspx
Consultancy Reports	http://www.threerunwaysystem.com/en/Information/Consultancy_reports.aspx
D. Video clips related to 3RS	
HKIA Master Plan 2030– Stakeholders' Views (24 videos)	http://www.threerunwaysystem.com/en/Information/Videos.aspx
HKIA Master Plan 2030– Video Series (16 videos)	http://www.threerunwaysystem.com/en/Information/Videos.aspx
Three-runway System Project (20 videos)	http://www.threerunwaysystem.com/en/Information/Videos.aspx
E. Articles on various topics related to 3RS	
Articles published by AA (23 pieces)	http://www.threerunwaysystem.com/en/Information/Articles.aspx

Information	URL
F. Others	
3RS dedicated website	http://www.threerunwaysystem.com/en/
Dedicated website for environmental monitoring data and submissions	http://env.threerunwaysystem.com/en/index.html
3RS Facebook	https://www.facebook.com/threerunwaysystem
G. Press Releases related to 3RS	
Press releases (13 pieces)	http://www.threerunwaysystem.com/en/Information/Press_release.aspx