



Development of the Hong Kong International Airport

IN06/14-15

1. Introduction

1.1 The Hong Kong International Airport ("HKIA"), located on Chek Lap Kok, commenced operation in July 1998. At its inception, only the first runway – the South Runway – was used. One year later, the second runway – the North Runway – came into operation. Between 1999 and 2014, the total air traffic movements (or flight movements) at HKIA grew by 134% to 391 000 movements. At present, HKIA is the world's busiest cargo airport and one of the world's busiest international passenger airports.

1.2 To maintain HKIA's position as a leading international and regional aviation hub, the Airport Authority Hong Kong ("the Airport Authority") prepares a 20-year Master Plan every five years to guide the development of HKIA. The Airport Authority has so far published three Master Plans, namely the Master Plan 2020 in 2001, the Master Plan 2025 in 2006 and the Master Plan 2030 in 2011. The latest Master Plan 2030 outlines two development options for HKIA's future expansion. One is to maintain the existing two-runway system with enhancements to airport facilities so as to cater for the air traffic demand up to 2020. The other is to expand HKIA into a three-runway system to meet the demand until 2030 and beyond, and the project will involve a land reclamation of about 650 hectares.

1.3 A public consultation exercise was carried out during June-September 2011 to gauge public views on the Master Plan 2030. About three-quarters of respondents supported the proposal to expand HKIA into a three-runway system. In December 2011, the Airport Authority recommended to the Government to adopt the three-runway system, which subsequently received the Executive Council's in-principle approval to take it forward for planning purposes.

1.4 The Panel on Economic Development and the Panel on Environmental Affairs held two joint meetings on 30 September 2014 and 7 October 2014 respectively to solicit public views on the three-runway system project. At the meeting to be held on 23 March 2015, the Panel on Economic Development will further discuss issues relating to the project. This information note aims to provide the development of HKIA since its opening in 1998 with respect to its air traffic growth, aircraft deployment, runway capacity, airspace constraints and airport enhancements. It also highlights major concerns and views on the implementation of the three-runway system project.

2. Air traffic growth

2.1 HKIA has seen notable growth in air traffic since its opening in July 1998. Between 1998 and 2014, the passenger traffic grew by an annual average of 5.1% to about 63 million of passengers. Over the same period, air cargo throughput increased by an annual average of 6.4% per annum to 4.4 million tonnes (**Table 1**). Reflecting the growth in both passenger traffic and cargo throughput, the number of air traffic movements surged from 163 200 in 1998 to 391 000 in 2014.

Table 1 – Passengers traffic, cargo throughput and air traffic movements, 1998-2014

Year	Passenger traffic ⁽¹⁾ ('000 passengers)	Cargo throughput ⁽²⁾ ('000 tonnes)	No. of air traffic movements ⁽³⁾
1998	28 631	1 629	163 200
1999	30 394	1 974	167 400
2000	33 374	2 241	181 900
2001	33 065	2 074	196 800
2002	34 313	2 479	206 700
2003	27 433	2 642	187 500
2004	37 142	3 094	237 300
2005	40 740	3 402	263 500
2006	44 443	3 580	280 000
2007	47 783	3 742	295 000
2008	48 585	3 627	301 000
2009	46 167	3 347	279 000
2010	50 923	4 128	307 000
2011	53 904	3 938	334 000
2012	56 467	4 025	352 000
2013	59 903	4 127	372 000
2014 ⁽⁴⁾	63 343	4 376	391 000

Notes: (1) Passenger traffic includes originating, terminating, transfer and transit passengers. Transfer and transit passengers are counted twice.

(2) Cargo throughput includes import, export and transshipment cargo. Transshipment cargo throughput is counted twice.

(3) Air traffic movements include civil international passenger flights, cargo flights and non-revenue flights (e.g. private aircraft). Military and local flights are excluded.

(4) 2014 figures are provisional figures.

Source: Airport Authority.

Traffic demand forecast

2.2 In 2009, the Airport Authority commissioned the International Air Transport Association¹ to conduct a study on the long-term air traffic demand at HKIA up to 2030 as input for its formulation of the Master Plan 2030. The study was completed in 2010, but the subsequent rapid growth in air traffic demand has rendered the study an underestimate of the future demand. For example, the base-case forecast for the passenger numbers to be increased to 57 million by 2015 was already reached in 2012, three years ahead of schedule. Against this, the International Air Transport Association revised its traffic demand forecast in 2012 after taking into account Hong Kong's latest economic performance and other factors (**Table 2**).

Table 2 – Traffic demand forecast

Year	Passenger traffic (million passengers)		Cargo throughput (million tonnes)		No. of air traffic movements	
	Original forecast	Revised forecast	Original forecast	Revised forecast	Original forecast	Revised forecast
2015	57	-	4.4	-	347 100	-
2020	68	70	5.6	5.8	421 200	420 000
2025	82	86	7.2	7.3	508 700	505 000
2030	97	102	8.9	8.9	601 970	607 000

Sources: International Air Transport Association (2010) and Airport Authority (2014b).

3. Airport connectivity and aircraft mix

3.1 When HKIA was opened in 1998, it offered services from about 60 airlines to 120 destinations. Currently, there are over 100 airlines connecting HKIA to 180 destinations worldwide which include 44 Mainland cities. The number of airlines and connecting destinations has a bearing on the aircraft mix at an airport, and the use of wide-bodied aircraft with more seats to increase passenger load is considered as a way to raise the airport's efficiency.

¹ The International Air Transport Association is the trade association for the airlines, representing some 250 airlines worldwide or 84% of total air traffic. It offers a range of services to the aviation industry including consultation, training and business intelligence.

3.2 At the old Kai Tak airport, there was a predominance of wide-bodied aircraft (over 80%). However, since its commissioning in 1998, HKIA has seen an increasing deployment of narrow-bodied aircraft with less than 200 seats by airlines, in particular on routes that have not yet matured. According to the Airport Authority, about 36.7% of the aircraft using HKIA were narrow-bodied aircraft and 63.3% were wide-bodied aircraft in 2012.²

3.3 There are views that a greater deployment of wide-bodied aircraft should be encouraged at HKIA in order to improve the airport's efficiency. In response, the Airport Authority has indicated that adoption of aircraft mix is the business decision of airline operators based on the market needs, and that it has no right and does not intend to interfere with the airlines' deployment.³

4. Runway capacity

4.1 Runway capacity is defined by the International Civil Aviation Organization⁴ as the number of flight movements which aeronautical authorities determine can be safely operated. It is usually stated as the number of landings and take-offs per hour, which is affected by various factors such as the standard separation between aircraft, peripheral airspace, operating environment, airport's infrastructure and aircraft mix.⁵

4.2 The current two-runway system at HKIA is operated in a segregated mode, with the South Runway dedicated for departures and the North Runway for arrivals.⁶ In early 1990s when the HKIA construction project was at the planning stage, the Government commissioned two consultancy studies, namely the New Airport Master Plan Study and the Airspace Design Study, to determine the airport development requirements and related issues (including the maximum handling capacity). After the opening of HKIA, the Government commissioned another capacity study in 2007 to identify issues constraining capacity and make recommendations to further enhance the runway capacity.

² The Research Office has written to the Airport Authority for providing the information on the proportion of wide-bodied and narrow-bodied aircraft used at HKIA since its commissioning in 1998. As at the publication of this information note, the Airport Authority has not responded to the request.

³ See Airport Authority (2015).

⁴ The International Civil Aviation Organization, a specialized agency of the United Nations, was established in 1944 to promote the safe and orderly development of international civil aviation. It works with its Member States and global aviation organizations to develop international standards and recommended practices.

⁵ See Gov.HK (2014).

⁶ However, cargo flights and the Government Flying Service's aircraft will, due to operational reasons, normally use the South Runway for landing.

New Airport Master Plan Study

4.3 In 1990, the then Provisional Airport Authority commissioned the New Airport Master Plan Study to prepare a comprehensive and environmentally acceptable scheme for the planning and implementation of HKIA. The study was released in 1992 and it projected the practical runway capacity of HKIA that could be achieved by 2040 under different modes of operation: (a) single runway, (b) dual runways in segregated mode of operation, and (c) dual runways in dependent/independent mixed modes of operation. The description of the different modes of operation and projected capacity are given in **Table 3**.

Table 3 – Runway capacity under different modes of operation

Mode of operation	Practical hourly capacity estimated
(a) Single runway	43 movements
(b) Dual runways in segregated mode of operation – one runway is used exclusively for aircraft approaches and the other runway exclusively for departures	52 movements
(c) Dual runways in mixed mode of operation <ul style="list-style-type: none">(i) Dependent mixed modes – an approaching or departing aircraft on one runway must take into consideration a similar operation being performed on the parallel runway. The following are the scenarios:<ul style="list-style-type: none">• dependent approaches and departures;• independent approaches and dependent departures; and• dependent approaches and independent departures.(ii) Independent mixed mode – one runway functions completely independently without interference to the parallel runway, as if two runways were two different airports	<ul style="list-style-type: none">69 movements71 movements79 movements86 movements

Sources: Provisional Airport Authority Hong Kong (1992) and Audit Commission (2014).

4.4 While there was no constraint in using the segregated mode and dependent mixed mode of operation, the New Airport Master Plan Study pointed out the constraints envisaged when implementing independent mixed mode of operation.⁷

Airspace Design Study

4.5 Based on the above study, the Civil Aviation Department commissioned another study on the airspace design at HKIA in 1994. The study made use of airspace and runway simulations, and estimated that the maximum capacity of the dual-runway system under the segregated mode of operation was 56 movements per hour, and the maximum capacity under the mixed mode of operation was 63 movements per hour.

2007 runway and capacity study

4.6 After about a decade of HKIA operation and as part of the groundwork for the Master Plan 2030, the Airport Authority commissioned the United Kingdom-based aviation consultancy, National Air Traffic Services, in 2007 to assess the practical maximum capacity of the two-runway system. The study was completed in 2008 covering both the segregated and mixed modes of operation.

Practical maximum capacity under the segregated mode of operation

4.7 According to the 2007 study, it was estimated that the maximum runway capacity of HKIA under the existing segregated mode of operation could be increased to 68 movements per hour, subject to successful implementation of the recommended operational and airspace changes, including the upgrading of infrastructural facilities and air traffic control system. On the basis of 68 movements per hour, the estimated practical maximum aircraft movements were about 1 200 per day and 420 000 per year. The estimates were subsequently endorsed by the Civil Aviation Department.

⁷ Under independent departures, the required flight path of aircraft departing from the South Runway might be blocked by the two peaks in the Tai Yam Teng and Fa Peng Teng areas of the Lantau Island. Under independent approaches, in the event of a missed approach, the aircraft approaching the South Runway would have to make a south turn. However, due to the terrain of Lantau Island, the aircraft could not make such a turn. See Audit Commission (2014).

Practical maximum capacity under the mixed mode of operation

4.8 The 2007 study further assessed the capacity gain if the dual-runway system were converted from the segregated mode of operation to the mixed mode of operation. It concluded that, due to environmental constraints, the dual-runway system at HKIA could only support dependent mixed mode of operation, i.e. aircraft approach and departure procedures on both runways have to be coordinated with one another.

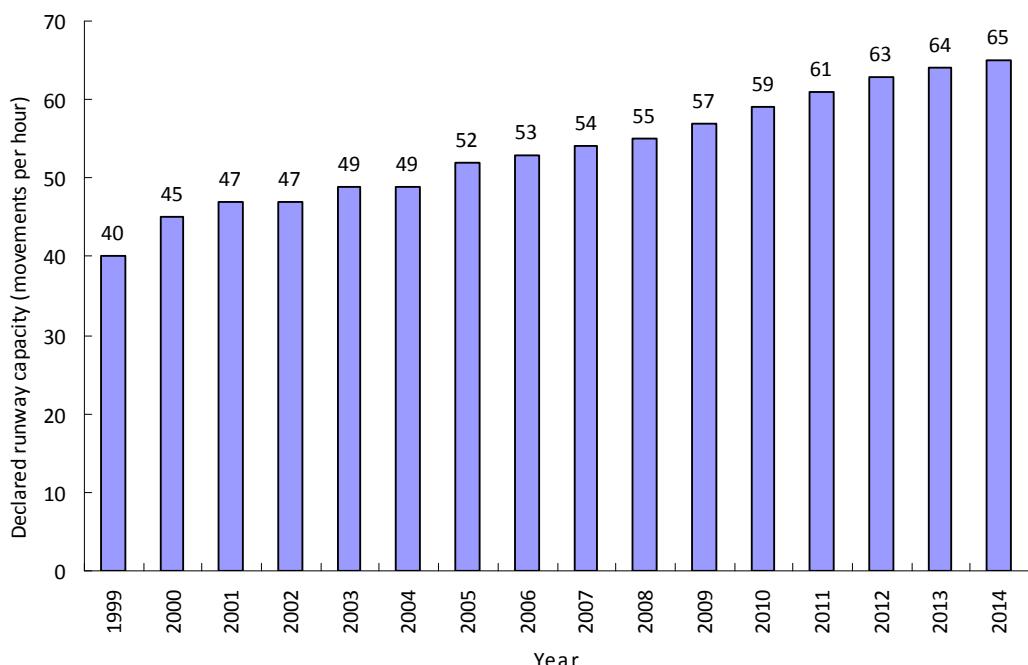
4.9 Yet, even under the dependent mixed mode of operation, the study estimated that the practical maximum runway capacity achievable was only 34 movements per hour for each runway, or 68 movements for both runways. In other words, there was no overall capacity gain by adopting the dependent mixed mode of operation.⁸

Rising trend of dual-runway capacity

4.10 At present, the two runways at HKIA are normally operated in a segregated mode. According to the Civil Aviation Department, HKIA's dual-runway capacity has been on the rise since 1999 when both North and South runways came into operation (**Figure 1**). It increased from 40 movements in 1999 to 65 movements in 2014. The rising trend was attributable to factors such as the improvement of the flight procedures and operations, increase in the manpower of air traffic controllers, optimization of the airspace structure, and upgrading of the infrastructural facilities. The Civil Aviation Department has announced its plan to increase the capacity to the practical maximum level of 68 movements per hour by 2015, translating into a handling capacity of 74 million of passenger and 6 million tonnes of cargo per year.

⁸ See Airport Authority (2011a).

Figure 1 – Dual-runway capacity



Sources: Civil Aviation Department and Financial Secretary's Office.

5. Airspace constraints

5.1 The airspace utilization of Hong Kong is not only subject to the environmental constraints, but also other factors such as the location of the airports in the Pearl River Delta ("PRD") region⁹ and the orientation of these airports' runways. Given the proximity between HKIA and the Shenzhen airport, the use of PRD airspace by aircraft departing from HKIA is subject to the requirement that they must reach the designated altitude of 15 700 feet before entering the Mainland's airspace. This altitude requirement constitutes the so-called "air wall".¹⁰ According to the Airport Authority, there are currently about 23% of aircraft flying to or from HKIA using the PRD airspace.

⁹ The PRD region consists of HKIA and four other major airports: the Guangzhou Baiyun International Airport, Macau International Airport, Shenzhen Baoan International Airport, and Zhuhai Airport.

¹⁰ The altitude requirement also applies to aircraft flying from the Mainland into Hong Kong's airspace. Since 2005, the handover altitude has been reduced from 15 700 feet to 12 800 feet during specified non-peak hours from 11:00 pm to 7:00 am the following day.

5.2 There are concerns that the altitude requirement has lengthened flight times and prevented the existing two-runway system of HKIA from optimising its operational efficiency, thus affecting air traffic movements. According to the Government, the airspace separated by altitude aims to ensure flight safety and is commonly applied by busy airports all over the world, such as those in London and New York. Such arrangement is, thus, not relevant to runway capacity. Instead, the constraints of runway capacity are the time interval and space separation between successive runway movements. In addition, as there is a 10-minute flying distance between the HKIA runways and the "air wall", the runway operation will not be affected by the altitude requirement.¹¹

5.3 In anticipation of the traffic growth of the PRD airports and the need to enhance the PRD airspace that can be used by the PRD airports, the Civil Aviation Department has been working with the Civil Aviation Administration of China and the Macao Civil Aviation Authority since 2004. A three-phase development plan has been devised to progressively enhance the PRD airspace structure by 2020. The plan covers the measures to rationalize airspace design, enhance flight levels allocation, standardize units of measurements, unify air traffic control procedures, establish additional civil air routes, etc.

6. Airport enhancements

6.1 Over the years, HKIA has carried out major enhancement works as discussed below to expand and upgrade the airport facilities to cope with the growing traffic demand.

Passenger terminals

6.2 During 2006-2010, the passenger Terminal 1 building was expanded and refined at a project cost of HK\$1.5 billion. The expansion works included widening the central concourse area, enhancing the baggage handling system capacity, and increasing the security channels and immigration counters. Besides, the passenger Terminal 2 building (including two office buildings), which cost HK\$2.8 billion to build, started to operate in 2007.

¹¹ See Airport Authority (2014d).

Airfield facilities

6.3 The airfield facilities at HKIA were improved with an investment of HK\$3 billion. Completed in 2010, the project included constructing the North Satellite Concourse and 10 bridge-served stands for narrow-body aircraft, upgrading aircraft parking stands, and resurfacing the runways and taxiway pavements. Ten additional cargo stands were constructed and the taxiway shoulders were widened for the operation of giant A380 aircraft.

Cross-boundary ferry terminal

6.4 The Airport Authority has invested HK\$1 billion in constructing a permanent cross-boundary ferry terminal, namely the SkyPier¹², located at the eastern tip of the airport island. The SkyPier commenced service in 2010 to convey passengers between the PRD ports and HKIA. It is equipped with airline check-in counters and security screening channels, and is connected to the passengers terminals by the Automated People Mover system. The SkyPier can handle a maximum capacity of eight million passengers annually. International passengers and PRD residents making air-to-sea or sea-to-air transfers are not required to go through immigration and customs formalities at HKIA.

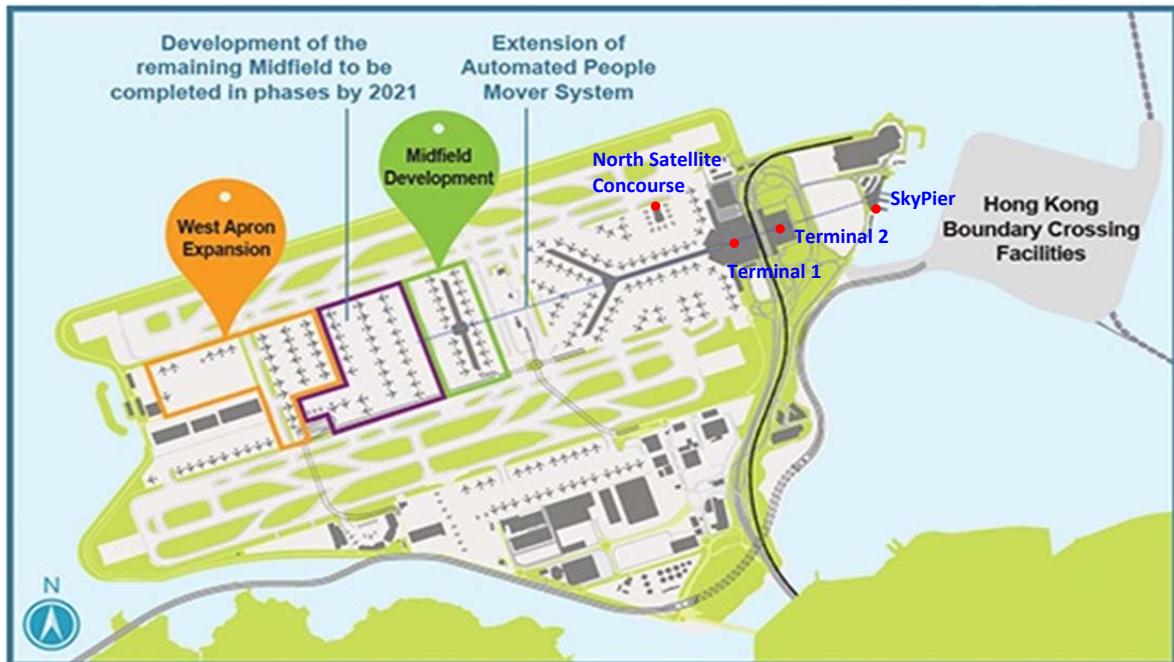
Midfield development and West Apron expansion

6.5 In 2011, the Airport Authority started the first phase of the development project at Midfield area located to the west of the Terminal 1 building and between the two runways (see **Figure 2**). It comprises building a passenger concourse with a capacity to accommodate 10 million passengers a year, additional 20 aircraft parking stands and other facilities. The project is scheduled for completion by end-2015, which will enable HKIA to meet the anticipated air traffic demand up to 2020. The second-phase and remaining Midfield development is currently under planning.

¹² A temporary SkyPier ferry pier in a smaller scale had been in operation since 2003 and until the launch of this permanent one in 2010.

6.6 In addition, the Airport Authority commenced the expansion of West Apron in 2012, which is located in the western side of the airport and adjacent to the Midfield (see **Figure 2**). The estimated project cost amounts to HK\$2.5 billion, covering the construction of 28 aircraft parking stands and a vehicular tunnel connecting the West Apron to the cargo area in the south. The expanded West Apron is ready to commence full operations.

Figure 2 – Midfield development and West Apron expansion



Source: Airport Authority.

Air traffic control system

6.7 In 2007, the Government obtained a funding approval of HK\$1.57 billion from the Legislative Council for the replacement of the air traffic control system of the Civil Aviation Department to enhance the air traffic control handling capacity. The new system was originally targeted for commissioning in 2012, but there has been delay in the implementation. It is estimated that the new system could only be ready for full operation in the first half of 2016.¹³

¹³ See Audit Commission (2014) and public hearing of the Panel on Public Accounts Committee of the Legislative Council (2015).

7. Three-runway system project

7.1 The three-runway project involves a number of major works, namely (a) formation of approximately 650 hectares of land, (b) construction of the third runway and the associated passenger concourse, (c) construction of apron, taxiways and areas for support facilities and utilities, (d) expansion of the existing Terminal 2 building, (e) provision of a new Automated People Mover system and maintenance depot, and (f) provision of a new baggage handling system.

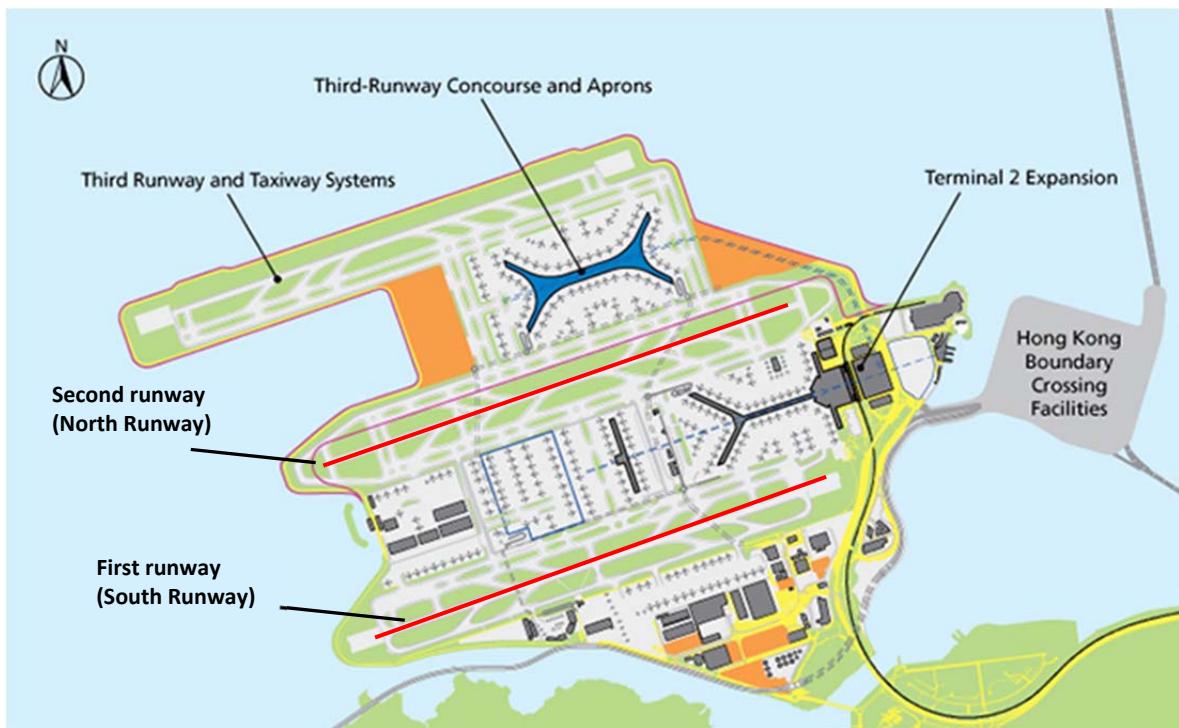
7.2 The third runway is set to be parallel to and north of the existing two runways (see **Figure 3**). Land is required to be formed through land formation. The three-runway system is expected to be able to support a practical maximum runway capacity of 102 air traffic movements per hour (**Table 4**), which is translated into about 1 800 movements per day and 620 000 movements per year.

Table 4 – Total capacity of the three-runway system

Runway	Proposed operating arrangement	Maximum capacity (no. of air traffic movements)
Third runway	Arrivals	33 movements per hour
Second runway (North Runway)	Departures	35 movements per hour
First runway (South Runway)	Both arrivals and departures	34 movements per hour
		102 movements per hour

Source: Airport Authority (2011a).

Figure 3 – Airport layout plan of the three-runway system



Note: □ Proposed reclamation layout for the proposed airport expansion.

Source: Airport Authority.

Major concerns and views

7.3 The three-runway system project is expected to help strengthen Hong Kong's competitiveness amid the growing competition from the neighbouring PRD airports. In addition, the Master Plan 2030 envisages that the project can contribute HK\$167 billion to Hong Kong's Gross Domestic Product in 2030. However, there have been intense discussions about the environmental, value-for-money¹⁴ and engineering issues arising from the implementation of the three-runway system project. Major engineering issues include airspace constraints in the PRD region and possibility of lower-cost alternatives to raise the capacity of the current dual-runway system.

Airspace constraints in the PRD region

7.4 Some stakeholders and concern groups have pointed out that the air routes for aircraft taking a missed approach¹⁵ under the proposed third runway

¹⁴ According to the Master Plan 2030, the three-runway system project is expected to cost HK\$136.2 billion (at money-of-the-day prices).

¹⁵ A missed approach is a procedure that will take place under certain conditions, for instance, when it is judged that a standard approach or landing of an aircraft is not safe.

might overlap with certain air routes at the Shenzhen airport. As a result, certain aircraft procedures could not be supported by the third runway in order to avoid the route conflicts and meet the international safety standards. This may result in limited utilization of the third runway, which will in turn affect the cost-effectiveness of the project.

7.5 According to the Government, relevant authorities have been working together to redesign the airspace structure in an effort to meet the expansion need of the airports in the PRD region.¹⁶ These authorities include the Civil Aviation Department, the Civil Aviation Administration of China and the Macao Civil Aviation Authority. They have formulated a plan containing the short, medium and long term optimization targets and measures to be achieved and implemented before 2020. Scanty information is available in the public domain about the details of the plan and the steps the Government plans to take to achieve the maximum capacity of the three-runway system.

Alternatives to the three-runway system project

7.6 There have been suggestions for the Government to further enhance the airport facilities, such as passenger terminals, to increase the airport capacity instead of constructing a third runway. However, the Airport Authority has responded that the bottleneck is lying in the runway but not ground facilities at HKIA. In particular, expansion of the passenger terminals alone would not help address the long-term capacity constraints.

7.7 Apart from the above, there have also been suggestions that the Government should revisit the recommendation in the New Airport Master Plan Study published in 1992 regarding terrain removal. In the Master Plan Study, it stated that "consideration should be given to terrain removal of two peaks in the Tai Yam Teng and Fa Peng Teng areas of northeast Lantau Island later in the planning period (2005 to 2015) when operational demand requires increased capacity provided by independent departures".¹⁷ However, the Airport Authority has responded that the recommendation in the Master Plan Study was aimed to reduce the climb gradient of the contingency departure flight procedure under parallel departures' situation, and that it was not related to the improvement of the dual-runway capacity.

¹⁶ See GovHK (2015).

¹⁷ See Provisional Airport Authority Hong Kong (1992).

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17 March 2015
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