A Preliminary Investigation on the Feasibility and Implications of the HKIA-SZA Fast Rail Link

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(9/10/2008)

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1. Introduction and Objectives of the Study

In large metropolitan cities such as London, New York, Paris, San Francisco and Hong Kong, the demand for air traffic is so high that there are usually more than one airport serving them. The Pearl River Delta (PRD) region (including both Hong Kong and Macau) has five airports: Hong Kong International Airport (HKIA), Guangzhou New Baiyun Airport (GZA), Shenzhen Bao'an Airport (SZA), Macao International Airport and Zhuhai Airport. Using HKIA as a reference point, three of the surrounding airports are within 65km, and GZA is about 140km away.

The PRD region represents more than 10% of China's GDP, 28% of her trade and 18% of her direct foreign investment. The significant size of these figures implies the need for an efficient and reliable air transport system to support the region's prosperity and development.

The market dynamics of a particular multi-airport system are very different from those of a single airport. Good planning of a metropolitan multi-airport system requires a deep understanding of the competitive market dynamics existing among the constituent airports. These will affect their growth and shape their business opportunities. Due to the peculiar competitive nature among airports within a system, it would be difficult to achieve a precise traffic demand forecast for a particular airport.

HKIA is an integral part of the PRD multi-airport system. The Hong Kong S.A.R (HKSAR). Chief Executive, Donald Tsang, in his 2007 Policy Address, unveiled a plan to construct a high-speed rail link between HKIA and SZA with a journey time of about 20 minutes. For the two airports to achieve a "win-win" situation, it is necessary to evaluate the financial feasibility and economic benefits of the Project carefully [HKSAR, 2007].

Recently, the Governments of the HKSAR and Shenzhen have established a joint task force on Airport Cooperation. In its first meeting the Task Force established two expert groups to examine the feasibility of the rail link and other business cooperation between the airports. A consultancy study will be commissioned subsequently and is

scheduled to be completed by the end of 2008. The public has asked many questions about the rail link but the Government has provided little information on the subject.

This Project will be very important for the future development of aviation in Hong Kong and the PRD region. This will be an expensive Project as well, amid several other major cross-border infrastructure projects (including the Guangzhou-Shenzhen-Hong Kong Express Rail and Hong Kong-Zhuhai-Macau Bridge). It is vital to have a better understanding of the financial and economic feasibility of the Project and its impact on Hong Kong's position as an international aviation hub. Furthermore, other policy options should also be explored. In this preliminary policy-oriented research, we attempt to study the following:

(a) literature review on airport choices within a multi-airport system;
(b) market dynamics of the HKIA-SZA-GZA system;
(c) financial viability of the Rail Link project;
(d) enhancement of SkyPier between HKIA and SZA;
(e) impact of other PRD infrastructure projects on the Rail Link; and
(f) preliminary findings and suggestions for further research.

2. The Nature of Multi-Airport Systems

Airports can generally be divided into five major categories: *international hub, international/domestic gateway airport*, *regional airport*, *domestic airport* and *business & general aviation airport.* The categories varied from country to country. Airports may fulfill more than one of these roles. The structure of a modern multi-airport system often consists of: a primary international hub and/or gateway airport (serving the demanding international and regional air services of the catchment area), with one or more secondary airports (providing short-haul to medium-haul international and regional routes) and further surrounded by smaller regional airports (supporting minor domestic, regional routes and private aviation). Table 1 outlines the perceived roles of different airports within the PRD multi-airport system.

However, recent air transport developments have moved some airports into a grey area. For example, low cost carriers (LCCs) have been expanding significantly

worldwide as a result of deregulation. LCCs prefer to use smaller regional airports near major cities due to lower operating expenses and the lack of prime slots at major hubs. Airports like London Stansted, London Luton and Macau indicate that LCCs have brought in new business and transformed them into semi-international airports.

Historically, airlines have had limited choice of airports because of bilateral agreements between national governments. Major airports are still commonly criticized as monopolistic in their operation. However, airports are nowadays more competitive in their operations and airport authorities are more proactive in pursuing new opportunities in the fast changing business environment. Policies such as 'Open-skies' have created new opportunities for secondary airports as well.

Nonetheless, it does not mean that it is easy for a smaller airport or a new airport to become a hub. Graham (2003) observed that hub airports have been very much dependent on the strategies of major airlines. They are still dominated by 'legacy' carriers. While many medium- and large-sized airports have aspirations of becoming a hub the chances are slim. In fact, concentration within the airline industry has been increasing, through mergers, cross-ownership, global alliances and code-sharing.

The PRD's multi-airport system is unique in nature. Politically, Hong Kong is part of the People's Republic of China and is administered as a Special Administrative Region. This allows her to manage the air transport industry independently (both in terms of airport development and negotiation of Air Services Agreements) by the appropriate Government bodies. The same is true for Macau. Additionally, there are three different air traffic control centers using different standards. Unlike most of the multi-airport systems, like London (majority owned by BAA) and New York (majority owned by Port Authority of New York), each of the airports in the PRD region is owned by a separate operator (majority owned by their local governments respectively). Such political arrangements and boundary restrictions could have resulted in planning and co-ordination inefficiencies within the system.

Airport	Major Roles
Hong Kong International Airport	International and regional gateway and hub
Guangzhou New Baiyun International Airport	One of China's 'Big Three' hubs and the PRD's largest domestic hub
Shenzhen Bao'an Airport	Regional and domestic traffic with small numbers of LCCs and international routes. 5th largest airport in China serving Southern China and Hong Kong traffic. An upcoming general cargo airport in Southern China.
Macau International Airport	Regional airport with growing traffic levels due to the growing dominance of LCCs. However, these traffic levels are still extremely small and unlikely to have any major impact in, at least, the medium term.
Zhuhai Airport	Domestic feeder services and general aviation & training activities

Table 1. Five Airports of the PRD Multi-Airport System

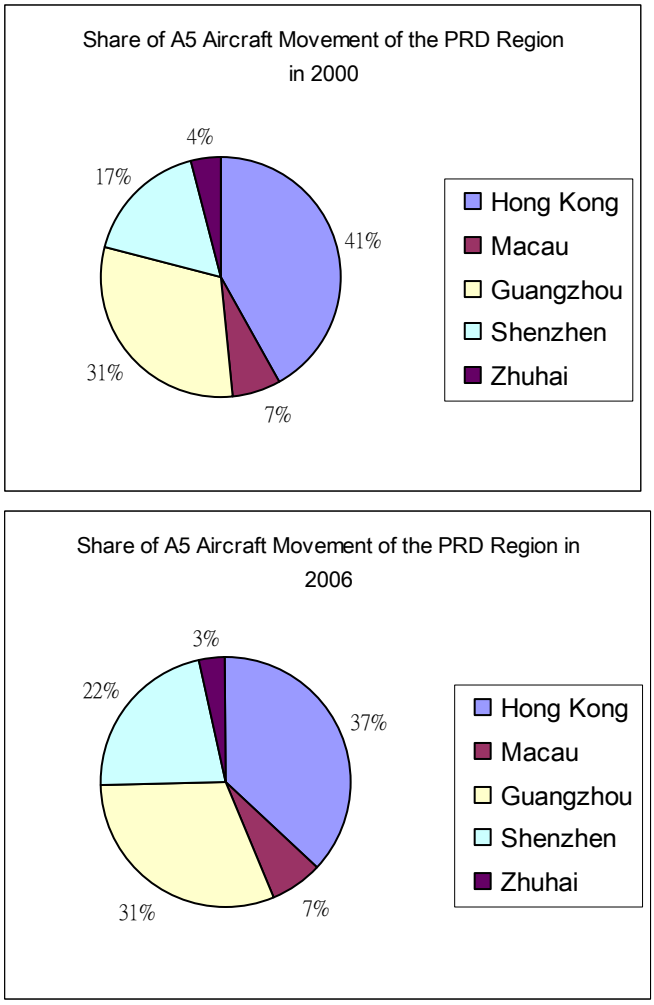


Figure 1. Aircraft Movements of the PRD region in 2000 and 2006

The charts on the left hand side show the share of aircraft movements of the five PRD airports in 2006 compared with the share in 2000. We can see that HKIA still holds the majority of the market share of the PRD multi-airport system. However, that market share is less in 2006 than in 2000, with a drop from 41% to 37%. The market share captured by Guangzhou, Macau and Zhuhai does not fluctuate much. On the other hand Shenzhen experienced an increase in aircraft movements from 17% to 22%. If we look at the five different airports as a whole and compared the change of aircraft movements between Hong Kong and Shenzhen, it could imply that Shenzhen has managed to attract some portion of traffic away from HKIA. However, this inference is tenuous given the growth in the total market and the lack of defining statistics.

3. Literature Review on Airport Choices within a Multi-Airport System

(see Appendix I)

Travelers' choices within a multi-airport system have attracted more attention from researchers recently. However, the development of a systematic understanding of airport choices is still at a relatively early stage. Authors like *de Neufville* have looked at the multi-airport systems in greater detail. *de Neufville* identified that patterns of airport usage were determined by both passengers and airlines. He argued that for short-haul flights, the attractiveness of an airport would be largely determined by its access distance. But a high flight frequency could overcome the disadvantage of poor access. He observed that with new business models such as low-cost and integrated cargo carriers, the importance of frequency had diminished and geographical considerations had become more important. At some point, secondary airports

received substantial traffic because they were in fact more convenient.

The author also used Hong Kong as an example. Despite the fact that Hong Kong was adjacent to Shenzhen and Macau, they were actually quite distant from Hong Kong in terms of travel time due to inadequate roads connecting Shenzhen and a distant water-crossing to Macau. Technical factors such as zoning restrictions and topographical constraints may also impel the development of a multi-airport system [de Neufville, 2003].

Graham (2003) also analyzed a range of factors affecting airport choices. Traditionally, airlines were the only 'true' customers of airports as they were subjected to legally bound contracts. The airport management considered passengers as airlines' customers instead. As more airports had been privatized, airports shifted from a public services provider to a commercial-oriented business. Airports realized commercial revenue (non-aeronautical revenue) as a growing source of income. Airports' car-parking, retail and property rental (both inside and outside the terminal) were targeting passengers or even non-passengers as customers. The cost-sensitive LCCs also demanded that airport management lower aeronautical charges. The nature of revenue changes led airports to re-focus their services on the needs of passengers.

Passengers	Airlines
Destinations of flights	Catchment area and potential demand
Flight fare (ticket price)	Slot availability
Flight availability and timing	Competition
Frequency of service	Network compatibility
Image and reliability of airlines (especially the FBOs)	Airport fees and availability of discounts
Airline alliance policy and frequent flyer program	Other airport costs (e.g. fuel, handling)
Surface access cost to reach the airport	Marketing and support
Accessibility of the airport	Range and quality of services and facilities
Car parking fee	Ease of transfer connections
Range and quality of shops, catering and other commercial facilities	Maintenance facilities
Image of airport and ease of use	Environmental restriction

Table 2. Factors for Airport Choices by Passengers and Airlines

The majority of studies on airport choices were based on the San Francisco Bay area, Central England and the Baltimore-Washington area due to the availability of information required for analysis. In *Loo's* (2007) preference study regarding HKIA in the PRD multi-airport system, she showed that air fare, access time, flight frequency and number of airlines were the most important level-of-service (LOS) factors considered by passengers making airport choices, whilst access modes, access cost, airport retail and check-in-times were not statistically significant.

Many of the above studies were based upon information received from passengers and user surveys at the airports concerned. Some authors also asked passengers directly for fare information. Appendix II summarizes the survey techniques adopted for each of the multi-airport systems concerned.

4. Market Dynamics of the HKIA-SZA-GZA Multi-Airport System under the Rail Link—Benefits Could be Marginal

Multi-airport systems perform well only for some hub-cities that originate large amounts of passenger traffic. (Note: as an example Amsterdam Schiphol Airport is a large hub airport but supports only a small domestic population and therefore is not a substantial gateway airport) Otherwise, the strategy adopted independently by each of the constituent airports would confuse and disrupt airlines' normal operations. Airports in each system will compete with each other for traffic and services. The problem with a multi-airport system is that the development of individual constituent airports could often be misjudged by other members within the system. In order to evaluate whether to build the HKIA- SZA rail link, we need to understand the adjustment mechanism of each of the constituent airports within the PRD system.

Currently, the direct connection between HKIA and SZA is through the SkyPier by sea (please see Appendix IV for the procedures for using the SkyPier at HKIA and Appendix V for the information on other transport modes between HKIA and SZA). According to the information released by the HKIA SkyPier, the total number of passengers using the ferry connection service between HKIA and SZA (Fuyong) was 501,000 in 2006, which is only 1.13% of HKIA total passenger throughput (see Table 6). However, a significant portion of these 501,000 passengers might not be destined for SZA flights. They may use these ferry services for accessing other parts of the PRD. As we do not have this piece of important information, we are unable to estimate how many of these ferry passengers were actually going to SZA (Fuyong) for flights (or coming to HKIA directly after deplaning from SZA flights). A special survey at the Shenzhen Fuyong Pier will be required to obtain the necessary information.

	Shares of HKIA-SZA ferry users out of HKIA's total passengers
2003	0.13%
2004	0.79%
2005	1.02%
2006	1.13%

Table 3. Share of SkyPier's Passengers to Total Air Passengers.

Based on these fragmented statistics, we assume that all of the ferry passengers from HKIA to SZA (Fuyong) deplane directly from HKIA to SZA for flight connections or vice versa. On average, this is equivalent to around 1,400 passengers per day. It is possible that some other passengers may travel by other transport means (by coach or rail) between the two airports. But we do not have any information about this now. If possible, another independent survey should be conducted at HKIA and SZA.

Another important issue is whether this rail-link will be located airside (within the restricted area inside the airport) or landside (within the area accessible by the public). If airside, the rail link can only serve users of HKIA (see Figure 2).

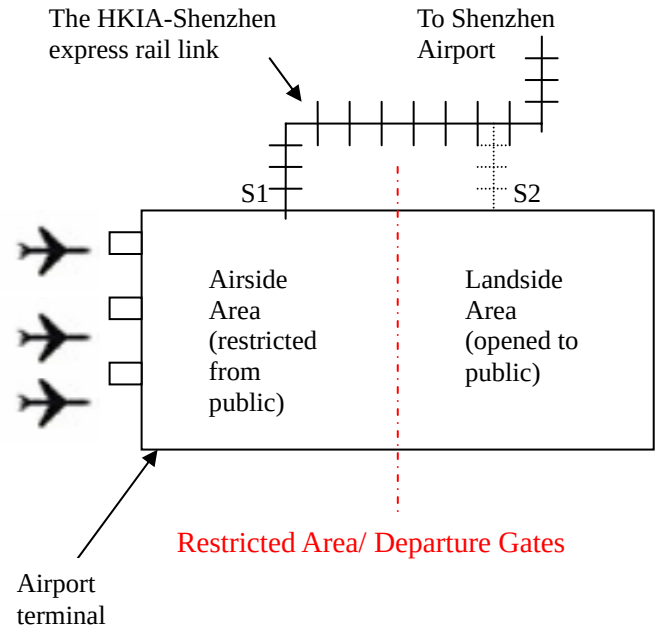


Figure 2 The Significance of Station Locations

The figure on the left shows two possible locations for express rail stations that connect HKIA to Shenzhen Airport. S1 (located airside) and S2 (located landside). As shown earlier, there are only 1,400 passengers that currently require connections between the two airports (S1). To fully optimize the express rail link service, it should also be available to users from the landside general public. The same should apply at Shenzhen Airport.

All multi-airport systems, for example, London, New York and Tokyo, provide some transport services among airports within the system. Appendix III summarizes the

inter-transport links between the airports within the system concerned. Some do not have any dedicated links to other airports in the same catchment area, e.g. Washington. Most of the airports seem to consider other airports in the same catchment area as competitors. The Hub airport and other major airports would rather focus on their primary role. This could partly be due to the increasing airport competition from minor airports, given the deregulation in the industry.

Table 4 compares the special features of HKIA and SZA from a passenger's perspective. In general, HKIA has many good offers for passengers, but SZA clearly provides more services and frequency to the Mainland.

	Shenzhen	Hong Kong
Access Costs	-	-
Airport Efficiency		+
Range and quality of shops, catering and other commercial facilities		+
Flight Frequency (International)		+
Flight Frequency (Mainland Domestic)	+	
Ticket Prices (Mainland Domestic)	+	
Ticket Prices (International)		+
Destinations Offered (International)		+
Destinations Offered (Mainland Domestic)	+	

Table 4. Comparison between SZA and HKIA

HKIA and SZA provide some similar services (see Figure 2). With the Rail Link, some passengers from both sides should be able to benefit somewhat. For example, more Hong Kong passengers could travel to SZA by the faster rail to take flights to the Mainland. Since SZA has few international long-haul flights, the potential passengers from the Shenzhen area have already chosen HKIA for its international services. It is therefore very uncertain how much the rail-link would enhance the business opportunity (in terms of passenger numbers) for HKIA. It is not easy for us to provide a definite and quantifiable answer to this question. At this stage, we consider that it would be impossible to give a reasonably reliable estimate on how much traffic (in terms of passengers) that HKIA would gain by building the rail link. The net outflow from HKIA could be one-sided.

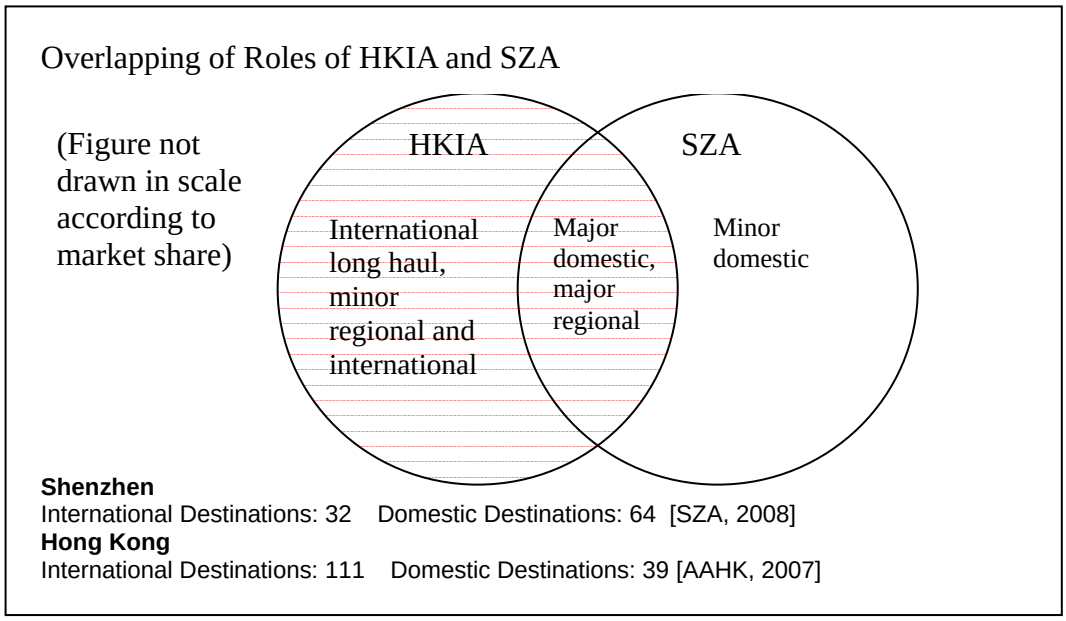


Figure 2. Roles of HKIA and SZA

Theoretically, a faster link between HKIA and SZA airports may attract more passengers from the other part of PRD, probably away from GZA. We could illustrate this by the following diagram, by assuming that passengers' demands are distributed uniformly along the line and these airports are accessible without barriers.

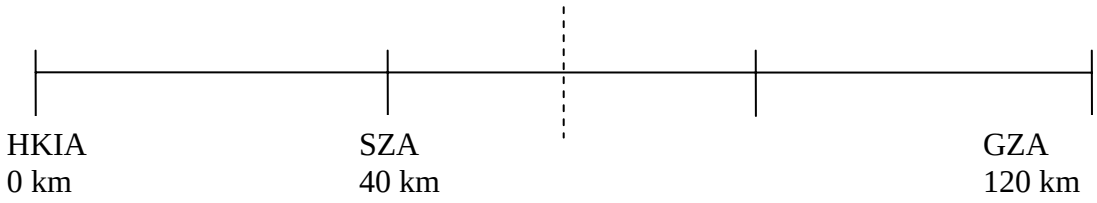


Figure 3. A Simplified Location Model of the Three Airports

To start with, assuming there was no SZA, then both GZA and HKIA would have 50% of the market share and their respective market would reach up to 60 km away from HKIA. With SZA located and operating in-between, it occupies a better position to capture a significant portion of the market from both airports. Clearly, HKIA is in a less advantageous position compared to GZA as it is closer to SZA.

In order to conceptualize the possible impact of the rail link, let us examine the demand for international long-haul flights in the PRD. As SZA does not offer any long-haul passenger flights, passengers in the Shenzhen area are already choosing either HKIA or GZA.

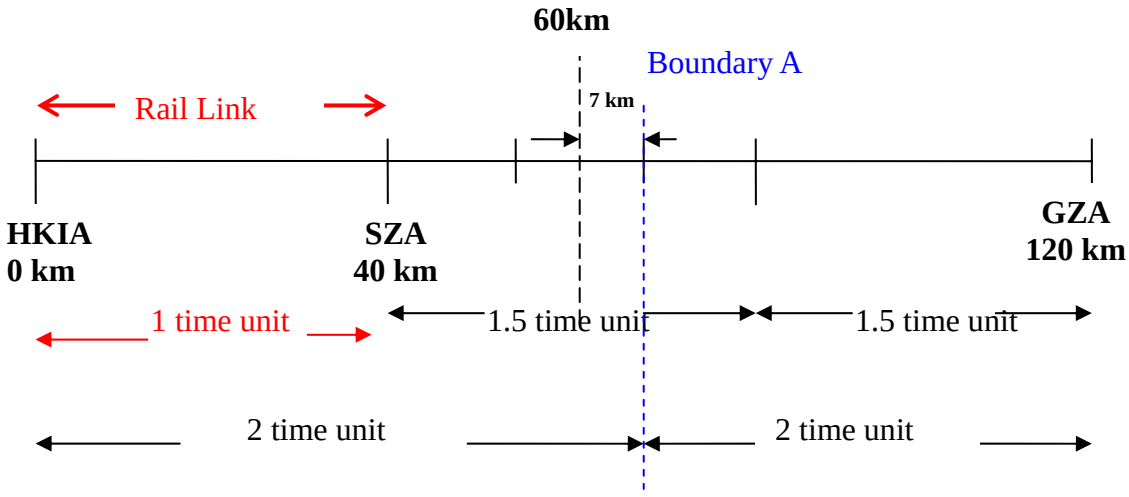


Figure 4. The Revised Location Model of the Three Airports Given the Rail Link

An airport express rail linkage is now added to the diagram. According to the Bauhinia Foundation Research Centre's paper, the speed of this express rail could reach up to 140 km/hour [Bauhinia Foundation, 2006]. We assume the current direct

linkage between SZA and GZA would be by buses and coaches, with an average speed of around 90km/hour. By applying the various speeds of different transport modes upon the respective parts of different journeys and normalizing them in term of the access time, we estimate that it would give Hong Kong a 5 - 7% advantage to capture more passengers for long-haul international flights by the new rail link in terms of the access time. The faster access time permits HKIA to extend its attainable maximum-distance (catchment area) for international flight passengers from 60 km to 67km (see Figure 4). Travelers located within boundary A from HKIA could access both GZA and HKIA within 2 time units, despite part of it being geographically closer to Guangzhou. However, cautions must be taken as the this is subject to the border control

Other than access time, we should examine the impact of travel cost in monetary terms as well at a later stage. Loo (2007) showed that the cost for accessing an airport had a significant bearing on airport choices in the PRD.

5. Financial Viability of the Rail Link Project—A Scenario Analysis

Other than some SkyPier statistics and information on speed limits of various modes of transport, we do not have any other necessary information to assist us in estimating the long-term overall economic benefit of the Rail Link project. However, we could broadly estimate the financial viability of the project based on some crude assumptions. The assumptions used for the scenario analysis are as follows:

(a) the total construction cost would be HK$30 billion, HK$40 billion and HK$50 billion;
(b) using a rate of return of 3%, 5% and 7%;
(c) using a 50-year straight-line depreciation method;
(d) assuming the fare structure did not affect the passenger demand (this is a very restrictive assumption at this stage) and
(e) using MTRC's operating profit ratio as a proxy for the Rail Link Project and this ratio was assumed to be constant with different fares .

Total number of passengers required (in million, per annum)			
Achieving a 3% rate of return			
Construction Costs			
	HKD$30 billion	HKD$40 billion	HKD$50 billion
Ticket Price per traveler			
HKD$200	13.69	18.25	22.81
HKD$300	9.12	12.17	15.21
HKD$400	6.84	9.12	11.41
Achieving a 5% rate of return			
HKD$200	19.16	25.55	31.93
HKD$300	12.77	17.03	21.29
HKD$400	9.58	12.77	15.97
Achieving a 7% rate of return			
HKD$200	24.64	32.85	41.06
HKD$300	16.40	21.90	27.37
HKD$400	12.32	16.42	20.53

Method of Approximation: The number of users required per annum to achieve the required rate of return could be estimated based on the revenue earned (revenue earned from ticket sales), the operating profit/revenue ratio of MTRC (see Table 6) and the depreciation cost. The operating profit estimation was only based on the train operations aspect of MTRC. Other possible sources of revenue (such as rental , property development) were not considered.

Table 5. A Scenario Analysis on the Financial Feasibility of the Rail Link

Operating Statistics of MTRC (Annual Report 2007)
Average weekday patronage for domestic services in December 2007: 3.5 million passengers per day
Average fare per passenger for all services: HKD$7.5
Average operating cost per passenger for all services: HKD$3.39
Average operating profit before depreciation per passenger for all services: HKD$4.11 (54.8%)

Table 6. Using MTRC's Operating Statistics as Assumptions

In the scenario analysis (see Table 5), under the assumptions of the lowest construction cost of HK$30 billion and the highest ticket price of HK$400, it would require 6.84 million passengers annually to achieve an annual rate of return of 3%. This number is more than ten times the number of passengers using the SkyPier ferry service to Shenzhen Pier (Fuyong) (only 501,000 in 2006[1]). The current fares for the SkyPier are between HK$250 and HK$350. As the fast rail would provide a more superior service than the ferry, we assume that the fare charged could be as high as HK$400 per trip in our scenario analysis. In fact, HK$200 per trip would be a more reasonable assumption adopted and the corresponding number of passengers required to achieve an annual rate of return of 3% would be 13.7 million. If a higher rate of return was targeted, more than 20 million passengers would be needed annually.

Beside the transit travelers who left for SZA from HKIA, there are other Hong Kong passengers using air services at SZA. According to a survey undertaken by the HK Government in 2006, a daily average of 4,900 cross-boundary trips passed through Guangdong Province and Macau bound subsequently for other Mainland cities. Nearly half of those journeys (i.e. 2,400) selected to enter/leave the Guangdong Province or Macau by air. Among those air trips, 78.7% used SZA [HKSAR, 2006]. This gives a daily average of 1,889 passengers. Assuming 50% of these 1,889 passengers would be users of the HKIA-SZA Rail Link, the total number would be

[1] A free coach service is available between Shenzhen SkyPier and Shenzhen Airport and it takes about 10 minutes. We do not have any independent information to estimate the exact proportion of these SkyPier users going to Shenzhen Airport directly or going to other parts of PRD. But in order to give the "benefit-of-doubt" to the advantage of the Project, we assume that all these 501,000 SkyPier passengers were potential passengers for the Rail Link.

344,500 annually[2]. Together with the 501,000 passengers using the SkyPier in 2006, we would assume the total number of potential passengers using the Rail Link for the first year to be 845,500. This is far less than the 6.84 million (fare charged at HK$400) and 13.69 million (fare charged at HK$200) required to achieve a 3% rate of return.

SkyPier passengers grew by an annual rate of 31% between 2004 and 2006 and by 21% in 2006 alone. SkyPier started its operation in 2003 and therefore recorded a very high growth rate in these early years of operation. Using these two different growth rates and 845,500 as the passenger number achieved at the end of the first year of operation for the Rail Link, Table 7 shows that it would require at least 9 years (for a 31% growth rate) or 12 years (for a 21% growth rate) before the Rail Link could attain the 3% rate-of-return for a construction cost of HK$30 billion and the fare charged at HK$400 If the fare is charged at HK$200 per trip, the corresponding years are 11 and 16. **Though we are using some crude and restrictive assumptions, and partial data for our analysis, we are rather comfortable to conclude that the Rail Link Project is not financially viable.**

[2] The Rail Link will be located at the HKIA and passing through the western side of the New Territories. There may be one or two intermediate stops. Therefore, it is very unlikely that people living in the eastern side of the New Territories, or even on Hong Kong Island, would use the Rail Link to go to SZA. .Thus, we assume that only 50% of them would be potential passengers for the Rail Link.

Number of Years Required to Achieve the Rate of Return with Ticket Price of HK$400						
	21% Annual Growth (based on the growth rate of passengers using HKIA-SZA ferry from 2005-2006)			31% Annual Growth (based on the average annual growth rate of passengers using HKIA-SZA ferry from 2004-2006)		
Construction costs	HKD$30 billion	HKD$40 billion	HKD$50 billion	HKD$30 billion	HKD$40 billion	HKD$50 billion
3% rate of return	12.0	13.5	14.6	8.7	9.8	10.6
5% rate of return	13.7	15.2	16.4	10.0	11.0	11.9
7% rate of return	15.1	16.5	17.7	11.0	12.0	12.8

Method of Approximation: We assume 845,500 passengers (see page 17) would be using the HKIA-SZA express Rail Link at the end of the first year of its operation. With a 21% or 31% growth rate for each year, this gives an expected number of passengers using the Rail Link in each of the subsequent years. Comparing these numbers with the total numbers of passengers required (see Table 5) to achieve a particular rate of return, we could estimate the number of years of operation required before achieving that particular rate of return.

Table 7. Estimated Number of Years for Achieving Certain Rates of Return

Furthermore, the SkyPier ferry service is very likely to co-exist with the Rail Link. For the less time-conscious passengers, the SkyPier will continue to be an effective choice. In fact, the actual "waiting time" for transfer passengers may be the same, unless the schedule of the connecting flights can be rearranged. With the Rail Link, transfer passengers may have a new choice to wait longer at HKIA or to take the fast train to wait at SZA for the connecting flight instead. These transfer passengers would literally spend no time even at HKIA.

In fact, the potential increase in aircraft movements from HKIA should be a better indication of how much Hong Kong could benefit from the Rail Link. But it is impossible to estimate the net effect on aircraft movements: potential loss of

Mainland flights from HKIA due to SZA's extensive Mainland network vs. the potential gain of international long-haul flights to HKIA due to a larger catchment area in the PRD. Data for a typical day at HKIA show that Mainland flights account for nearly a third of total aircraft movements (see Table 8). If the Rail Link is "successful", it will reduce Hong Kong's flights to the Mainland (or even some regional flights) in absolute terms or at least reduce HKIA's growth potential into the Mainland market in the longer term. This is a vital part of Hong Kong's hub operation. Conversely, SZA will not be adversely affected because it has no long-haul international flights. **The overall economic benefit of the Rail Link to Hong Kong, to say the least, is dubious and uncertain.**

Daily Aircraft Movement Statistics of HKIA (data summarized from traffic of 2/1/08)	
Total Arrivals	344
Arrivals from China Mainland	111
Total Departures	350
Departures from China Mainland	113

Table 8. Daily Movement Statistics of HKIA

6. Enhancing SkyPier' s Operation between HKIA and SZA—A Superior Policy Option

Given that the Rail Link is very unlikely to be financially viable and its overall economic benefit to Hong Kong is dubious and uncertain, we would like to focus on the possible enhancement of SkyPier's services as an alternative policy for strengthening the HKIA and SZA connection. Ships are very much like aircraft: size, speed and range have a direct impact on the efficiency, productivity and economics of the routes. Generally speaking, the larger a ship, the lower will be its direct operating costs per unit of output. The operator of the SkyPier between SZA and HKIA: TurboJET Limited, operates a range of fast marine craft on its network between Hong Kong and Macau and the Mainland. These craft have different technical specifications (see Table 9). On the route between HKIA and SZA, TurboJET operates a fleet of catamarans nicknamed 'Flying Cat'.

Ship	'Tricat'	'Flying Cat'	'Jetfoil'	'Foilcat'
Vessel Type / Builder	Catamaran/ FBM Marine, UK	Catamaran/ Kvaerner Pte. Ltd, Fjellstran, Norway	Jetfoil/ Boeing Co., USA	Catamaran fitted with foils/ Kvaerner Pte. Ltd, Fjellstran, Norway
Cruise speed	45 knots	35 knots	45 knots	45 knots
Gross tonnage (measure of the overall size of the ship)	602	479	467	561
Net tonnage (actual earning space)	182	155	100	193
Total seating capacity	303	303	240	423
Unit productivity per hour (net tonnage-kilometers per hour)	15,106	10,075	8,300	16,019

Table 9. Selected Technical Specifications of Turbojet Fleet [TurboJet, 2008]

SkyPier's statistics show that the passenger throughput was only 501,000 in 2006. The operator provides eight services from HKIA to SZA and ten services for the return trip. The data gave an average of about 76 passengers per ship. The load factor was only a quarter of the 300-seat capacity.

A vessel's cruise speed is an important factor to reduce the travel time. The current ferry connection time by 'Flying Cat' is about 40 minutes, with a cruise speed of about 32 knots. Using ships like 'Jetfoil', 'Foilcat' and 'Tricat' that have a cruise speed of 45 knots, the journey could be shortened to less than 30 minutes. This represents a 25% reduction in travel time and only 10 minutes more than the travel time offered by the proposed Rail Link (its travel time will be longer if there are other intermediate stops) . The 'Jetfoil' would be a better vessel to replace the 'Flying Cat' on the HKIA-SZA routes, if a faster journey is demanded. TurboJET may have selected 'Flying Cat' for its higher comfort standards. However, as many studies have shown, the level of comfort could be compensated by faster accessibility. Furthermore, under the rising demand situation, higher frequency of service should be provided to reduce the waiting time at the piers as well.

7. Impacts of Other PRD Infrastructure Projects on the Rail Link—Reducing Its Importance and Necessity

Land connections between Hong Kong and Shenzhen have greatly improved in recent years. From 2007, passengers leaving Hong Kong for SZA can obtain their boarding passes at the Airport Express Kowloon Station before taking the 75-minute coach ride to SZA via the Shenzhen Bay Port. The fare costs HK$90 one-way[3]. The coach service is available every 30 minutes and runs to SZA between 7:15 am to 7:15 pm daily and back to Hong Kong from 10 am to 9 pm. The authorities are planning to increase the frequency to 20 minutes starting next year and to 15 minutes in 2009 [China Daily, 2007].

[3] However, luggage check-in service is not available at this stage because of security reasons.

More importantly, the HKSAR government has recently finalized the funding arrangements for the long-discussed Hong Kong-Zhuhai-Macau Bridge and committed to build the Hong Kong section of the Guangzhou-Shenzhen-Hong Kong Express Rail Link. The Bridge and Express Rail Link are expected to be completed before 2015 and by 2015 respectively. These two mega projects have significant implications for the HKIA-SZA airport Rail Link. The overall effect is likely to be negative for the airport Rail Link (in terms of traffic demand). These two Projects will bring more Mainland passengers to HKIA, but not using the airport Rail Link.

Regarding the Guangzhou-Shenzhen-Hong Kong Express Rail Link, the project aims to improve Hong Kong's surface access to Shenzhen and Guangzhou. This fast link between Hong Kong and Shenzhen will definitely facilitate the travel between Hong Kong and Shenzhen (included the airports on both sides). However, with faster connection to Guangzhou, some Hong Kong passengers may prefer going to GZA instead of SZA and HKIA. GZA offers even more Mainland destinations than SZA and cheaper ticket prices[4]. This could reduce the potential demand for direct connection between HKIA and SZA[5].

[4] Guangzhou is the third largest airport in the Mainland and the largest domestic hub in the Pearl River Delta area

[5] It is worth noting that since the first day that the idea of a SZA- HKIA Rail Link was announced to the public (during the Government's Policy Address 2007-2008), the Government has not released any related figures or statistics to indicate the estimated demand for the project. On the other hand, the Government estimated that there would be 100,000 passengers daily using the Hong Kong-Shenzhen-Guangzhou Express Rail in 2020. Its completion is scheduled between 2014-2015

	HKIA- SZA Express Rail Link	Guangzhou-Shenzhen-Hong Kong Express Rail Link
Speed	140 km/hour	200 km/hour
Destinations	HKIA, SZA (probably with one or two intermediate stops)	West Kowloon (Hong Kong), Futian (Shenzhen), Longhua (Shenzhen), Humen (Dongguan), ends at Shibi (Guangzhou)
Travel time required	About 20 minutes (from point to point airport to airport)	About 14 minutes (from HK-Shenzhen)
Target customers	Mainly transit passengers and others[6]	Current cross-boundary travelers (both Hong Kong and Mainland)
Project cost	Approx. HK$30 to 50 billion (our rough guess)	HK$39.5 billion
Distance	About 30 km	West Kowloon to Futian (Shenzhen): 26 km
Current Status	Purely at conceptual stage. Detailed feasibility study ready by the end of 2008	Due for completion in 2014/2015. Initial cost and finance arrangements are agreed for the first stage. For the HK section, initial cost will be paid by the Government, while the MTRC. will be given the right to operate for 50 years under a BOT arrangement. Profit will be based on a ratio of 9:1 between Government and MTRC.
Estimated demand	An estimate of 2, 320 daily passengers based on 2006 information	100,000 daily passengers in 2020; 120,000 daily passengers in 2030

Table 10. A Comparison of HKIA-Shenzhen Airport Express Rail Link and Guangzhou-Shenzhen-Hong Kong Express Rail Link

[6] See Section 5 for the analysis and assumptions.

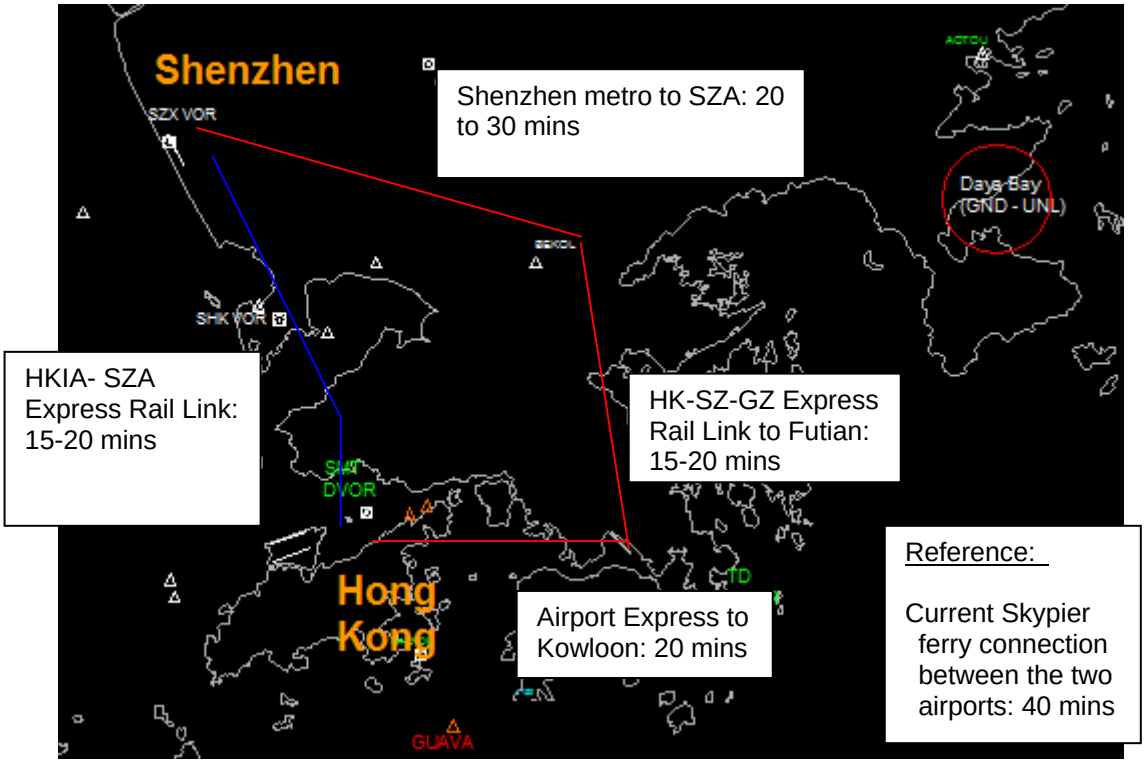


Figure 5. A Simple Illustration of the Possible Connections between HKIA and SZA

The red lines illustrate three different connections: the existing HKIA airport express rail, the new Guangzhou-Shenzhen-Hong Kong rail link (2015-ready, start at West Kowloon, stops at Shenzhen Futian) and the Shenzhen Metro connection to SZA (2009-ready). The blue line on the other hand represents the proposed HKIA-SZA rail link which will suffer from inadequate demand.

In the future, if a passenger gets off at HKIA and takes the MTR Airport Express to Hong Kong /Kowloon Station (approximately 15-20 minutes), jumps on the Hong Kong-Shenzhen- Guangzhou Express train to Shenzhen (approximately 15 minutes) and then goes to SZA via the Shenzhen Metro[7] (approximately 30 minutes[8]), the total travel time will be similar to the current traveling time offered by the SkyPier. The HKIA- SZA Rail Link on the other hand will only take about 20 minutes. However, the Hong Kong- Shenzhen- Guangzhou Express means a faster connection to the heart of Shenzhen from Hong Kong. This will be beneficial to the general public of HK. The HKIA- SZA Rail link should only be attractive to arrival passengers at HKIA who require flight connections at SZA (the current SkyPier users). Given the Hong

[7] Assuming both the Hong Kong- Shenzhen- Guangzhou fast rail link and the Shenzhen Airport Metro connection would have been constructed by then.
[8] Based on initial estimation.

Kong-Shenzhen-Guangzhou Express, it would be very difficult to attract other local users to use the Rail Link to reach SZA, even if it is available at the landside area of the airport[9]. The exception to this may well be those who live in the vicinity of HKIA or can access it easily by the AEL or MTR/bus (i.e the travel time is less to the airport than to the departure point of the Hong Kong-Shenzhen-Guangzhou Express or there is a substantial fare differential).

Regarding the Hong Kong-Zhuhai-Macau Bridge, the bridge will link up the three places with fast and direct ground connections. Currently, connections to the west of PRD from Hong Kong are mainly sea-based transport with high speed ferries and hydrofoils. A ferry journey from Hong Kong to Macau takes approximately one hour. This will be shortened to less than half an hour by car after the completion of the Bridge. The Bridge will therefore provide an alternative form of fast surface accessibility between HKIA and Macau Airport and Zhuhai Airport. Both Macau and Zhuhai airports will become accessible to Hong Kong passengers, also for Mainland and regional flights. Some estimates have already indicated that the demand for ferry services between Hong Kong and Macau would drop to about 10% of the current level. As SZA offers a wider range of domestic destinations than Macau and Zhuhai[10] it should remain as the 'long-term partner' for HKIA. But SZA's relative importance to Hong Kong passengers would diminish.

8. Preliminary Findings and Suggestions for Further Research

Based on very limited information, this paper attempts to evaluate the financial viability (and economic benefits to some extent) of the proposed HKIA-SZA Express Rail Link in the context of the PRD multi-airport system. The proposed Rail Link may improve both airports' competitiveness in the system, which will allow better transit and direct connection between HKIA and SZA. Therefore, more traffic should be created for and diverted to this HKIA-SZA system, probably at the expense of GZA. The critical issue would be how HKIA and SZA divide their roles among short- , medium- and long-haul flights given the new Rail Link? Should the project lead to a

[9] For example, imagine a citizen lives in the Northeastern part of Hong Kong like Tai Po, he/she may not want to travel all the way to HKIA for the fast connection service to Shenzhen Airport.
[10] SZA handles more freight, passengers and aircraft than Macau and Zhuhai combined.

clearer division of labor between these two airports and would this new arrangement be beneficial to Hong Kong's status as an aviation hub? Our analysis cannot give a definitive answer to these questions, mainly due to the limitation of data.

In very board terms, our preliminary findings are as follows:

(a) Whether the Rail Link Project is financially viable independently? **Our answer: NO.**
(b) Whether overall economic benefits out-weigh economic costs for Hong Kong? **Our answer : Probably NO.**
(c) Whether the Project would result in more or less traffic (number of flights, passengers and cargo) for HKIA? **Our answer: UNCERTAIN.**
(d) Whether other modes of existing transports can improve the linkage between two airports more economically? **Our answer: YES.**

Given our initial findings, we suggest an exploration of the following issues in greater detail in the second phase of this policy study:

1) China has been progressively liberalizing her air transport market, both locally and internationally. SZA international destinations increased from 10 cities in 2003 to 26 in 2007, and international flights from 45 per week in 2004 to 190 per week in 2006. GZA has expanded even faster. The HKIA-SZA rail link would provide opportunities as well as threats to HKIA. Would HKIA remain competitive (in terms of quality of services, flight frequency, ticket prices, destinations, airlines, etc.) under this new HKIA-SZA business model (with more long-haul international flights and less regional and Mainland flights)? So far, we have no basis to establish that Hong Kong would have more air passengers and flights due to the Rail Link. We should examine this issue in greater detail and with quantitative assessment.
2) The exact location of the rail link may have some bearing on the issue. If landside-located with additional intermediate stops, it should attract some more people to use it. However, this arrangement would largely divert passengers from other modes of prevailing transport to the Link, instead of creating new passengers. The Guangzhou-Shenzhen-Hong Kong Express Rail and the Hong

Kong-Shenzhen-Zhuhai Bridge may also divert demand away from the HKIA-SZA Rail Link. Eventually, the Express Rail Link network may transport passengers to both HKIA and GZA airports effectively as well. Furthermore, the improved land access of the entire PRD to Guangzhou by highways and subways in the next five years may neutralize any potential gains of the HKIA-SZA Rail Link for Hong Kong. Thus, given all these new land transport developments in the PRD region, the impact of the HKIA-SZA Rail Link upon Hong Kong's aviation development is very uncertain and could be marginal.

3) Can we reasonably estimate the overall economic benefits of the rail link (other than the saving of travel time by some passengers) to Hong Kong and Shenzhen respectively? We should not be over-optimistic about the actual benefit of the Rail Link, despite both governments having given positive signals for the Project. Our initial guess is that the overall economic benefits for Hong Kong would be rather limited. We should gather more information and examine this issue in greater detail.

4) HKIA is a base for a large number of airlines connected through global alliances and code-sharing. How would the existing airline operations and planning be affected by the Rail Link? For example, there might be a possibility that airlines might decide to reschedule their flight operations to feed some passengers from one airport to the other through the Rail Link. Many major Chinese carriers nowadays have joined alliances and more co-operations, such as code-sharing, might occur between Western and Chinese carriers. This may gradually reduce the significant role of local airlines as Western carriers' major Mainland China connecting partners. It is vital that the Hong Kong government consults with domestic airlines and other major international airlines to understand their reactions and concerns and the impacts that may result on the Hong Kong's hub and gateway position.

5) From our initial financial estimation, the Rail Link will not be a financially viable project. Alternatively, we should explore other options for providing better linkages between the two airports. For example, smaller but faster ferries and more frequent SkyPier ferry services can be arranged. Also, improved transit services between the two airports (for example, advanced check-in is only available for limited airlines at SZA (Fuyong) pier at this stage) need to be

considered. AAHK has already announced further facilities expansion at the SkyPier, costing HKD$1 billion. By introducing more efficient ferry services, SkyPier should achieve a more economical solution, at a much lower cost. We should evaluate this policy option in greater detail.

6) As HKIA has been undertaking an initial feasibility study on the 3rd runway, it is important to evaluate the necessity and benefit of the rail link within the context of the 3rd runway. As both projects may require an investment in the order of about HK$40 billion each, it is very unlikely that Hong Kong can afford to construct these two projects at the same time. Also, there are other obvious conflicts (for example, land requirement and environmental concerns) between the master plans of HKIA and the Rail Link. As Shenzhen Airport will complete its second runway in 2011, what will be the traffic dynamics of airlines' and passengers' airport choices given the rail link? Over time, more and more Hong Kong passengers will go to SZA directly because of its cheaper ticket prices and a wider range of domestic destinations offered. **With the possibility of reducing demand for flights to the Mainland from Hong Kong, there is a distinct risk for Hong Kong to lose her status as the aviation hub of southern China and the proposed Rail Link between HKIA-SZA could partly contribute to it. On the other hand, projects like the 3rd runway would clearly provide HKIA a direct advantage in terms of hardware to develop itself into a stronger hub in the long term by providing more extra rooms for business.**

Appendix I Summary of Academic Research Findings on Airport Choices

Researchers	Findings	Methodologies	Catchment Area Concerned
Ashford, N. and Bencheman, M. (1987)	Business travelers: access time, flight frequency Leisure travelers: access time, flight fare, flight frequency Inclusive tour: access time, flight frequency Domestic: access time, flight fare, flight frequency.	MNL model	Five airports in Central England and London (Heathrow, Manchester, Birmingham, East Midlands and Luton),
Brooke, A., Caves, R., Pitfield, D. (1994)	Flight frequency	MNL model	Central England (East Midlands, Birmingham, Heathrow, Manchester and Leeds/Bradford airports)
Thompson and Caves (1993)	Flight frequency, the number of seats on the aircraft (reflecting size/comfort).	MNL model	North of England
Ndoh et al (1990)	Access time, found that the use of NL model for investigation was more superior.	Both NL and MNL models	Central England

Researchers	Findings	Methodologies	Catchment Area Concerned
Mason, K. J. (2000)	This research is not about multi-airport choices, but into the business travelers' propensity to use low cost carriers. To them, air ticket price, in-flight comfort and frequency were important for choosing an airline, which directly affected their choices of airport.	Stated preference (SP) analysis including regression model	England
Bradley, M. (1998)	Air ticket price and access time.	Stated preference (SP) analysis	unknown
Furuichi and Koppelman (1994)	Flight departure frequency, access time & cost.	NL model	Japan
Loo et al. (2005, 2008)	Air fare (inc. airport tax), access cost.	Stated preference survey, MNL model	Pearl River Delta Area
Kanafani, A. (1981)	Air fare, flight frequency, access time.	Aggregate zonal model	Los Angeles- San Francisco corridor

Researchers	Findings	Methodologies	Catchment Area Concerned
Harvey, G. (1987)	Business: access time, relative flight frequency, absolute flight frequency. Non business: access time, flight frequency	MNL model	San Francisco Bay Area
Skinner (1976)	Flight frequency and ground accessibility.	MNL model	Baltimore-Washington DC area
Windle & Dresner (1995)	Flight frequency and airport access time, also revealing that the more often a traveler using a certain airport, would tend to choose the same airport again.	MNL model	Baltimore-Washington DC area
Ozoka & Ashford (1989)- from Polak ref	This research was not strictly a multi-airport system research but did include some investigation into the effect of adding an extra airport to a multi-airport system, suggesting that the choice of location played an important role in the success of an airport, along with the provision of good access facilities.	MNL model	Nigeria

Researchers	Findings	Methodologies	Catchment Area Concerned
Hess & Polak (2005)	Access time, fare and frequency of service. Sensitivities varied from business and leisure travelers.	*mixed* MNL model (MMNL)	San Francisco Bay Area
Pels, E. et al (2001)	Travelers were more likely to switch between airlines than between airports.	Nested logit (NL) model	San Francisco Bay Area
Pels, E. et al (2003)	High sensitivity to access time, especially for business travelers.	NL model based on a joint choice above access mode choice	San Francisco Bay Area
Basar & Bhat (2004)	Identify the sociodemographic impacts on airport choices. Because of this, not all airports were considered by a particular traveler. Flight frequency was the most important aspect in choice-set composition, whilst in actual choice of airport, access time was most important.	NL model with the incorporation of choice-set formation	San Francisco Bay Area

San Francisco Bay Area	Based on 1995 Metropolitan Transportation Commission Airline Passenger Survey. Some 21,500 pax departing from the airports were interviewed, within 45 mins to 1 hr prior to take off. Questions mainly asked about their access modes. Information collected included purposes of travel, destination, number in the traveling party, mode of transport to the airport, airline and flight details, sociodemographic attributes of the travelers were also obtained.
London/ England	SP (stated preference) survey, a hypothetical scenario was created and then variables were included in the experiment. It was decided that respondents should evaluate airline products on a hypothetical route. The respondents were interviewed in the UK,
Hong Kong	A stated preference survey conducted in the restricted area of HKIA, for passengers travelling from HK to 15 destinations. 308 questionnaires were completed. Information included access mode, access cost and air fare.
Others	Unknown

Appendix III A Summary of Transport Modes between Major Airports within Different Multi-Airport Systems

1) London Airports (Heathrow, Gatwick and Stansted)

Datum Airport: Heathrow Airport

To Gatwick (40 km away)

Mode	Journey Time	Note
Coaches (National Express)	70 minutes	Adult single fare: £17.5 Run every 15 to 20 minutes in the morning. Every 30 minutes from 12:00 till 22:00
Train (Gatwick Express)	30 minutes (from Central London)	There's no direct rail link between Heathrow to Gatwick. Gatwick Express is fed at Central London (Victoria) Trains run every 15 minutes

To Stansted (66 km away)

Mode	Journey Time	Note
Coaches (National Express)	90 minutes	Adult fare starts at £26
Train (Stansted Express)	45 minutes (from Central London)	There's no direct rail link between Stansted and Heathrow. Stansted Express is fed at Central London (Liverpool Street or Tottenham Hale)

Connections between Stansted and Gatwick (86 km away)

Mode	Journey Time	Note
Coaches (National Express)	2 hours 45 minutes	Return fare starts at £30. Operates in an hourly basis.

2) New York Airports (John F. Kennedy, LaGuardia and Newark)

Datum Airport: JFK Airport

To LaGuardia (17 km away)

Mode	Journey Time	Note
Coach (New York Airport Service Express Bus)	45 minutes	$13 per trip, running every 30 minutes

To Newark (34 km away)

Mode	Journey Time	Note
Coach (New York Airport Service Express Bus)	45-60 minutes	$15. To Grand Central Terminal in Manhattan
Light Rail (Air Train JFK)	(unknown)	Service every 4-12 minutes

Connections between LaGuardia and Newark (27 km away)

Mode	Journey Time	Note
Coach (New York Airport Service Express Bus, Newark Airport Express Bus)	30-60 minutes (depending on routes and companies)	$10-12 (depending on routes and companies)

3) Paris Airports (Charles de Gaulle, Orly, 36 km away)

Mode	Journey Time	Note
Coach (Express shuttle bus run by Air France)	50 minutes	€16 for adults, €8 for children. Service every 30 minutes,

4) Washington Airports (Reagan National, Baltimore Washington International, 72 km apart)

Mode	Journey Time	Note
		(No dedicated public transports services are provided.)

5) Tokyo Airports (Narita, Haneda, 60 km away)

Mode	Journey Time	Note
Train (Kesei, Toei Asakusa and Keihin Kyuko lines)	1-2 hours (depending on the routes)	¥900-1560 (depending on the routes)

6) PRD A5 (Hong Kong, Macao, Shenzhen, Guangzhou and Zhuhai)

Datum Airport: Hong Kong International Airport

To Macao Airport

Mode	Journey Time	Note
Ship (SkyPier marine feeder services)	45 minutes	HK$180-300 (depending on class), service nearly every 2 hours. Macao Airport located around 10 minutes drive time from the pier

To Shenzhen Airport

Mode	Journey Time	Note
Coach	2 hours to 2 1/2 hours	HK$180, service every half to one hour. Operate from HKIA
Express Coach (from Kowloon Station)	75 minute (from Kowloon Station)	HK$90 one way, service every half an hour, operate from Kowloon station
Ship (SkyPier Marine feeder services)	40 minutes	HK$250-350 (depending on classes), service nearly every hour

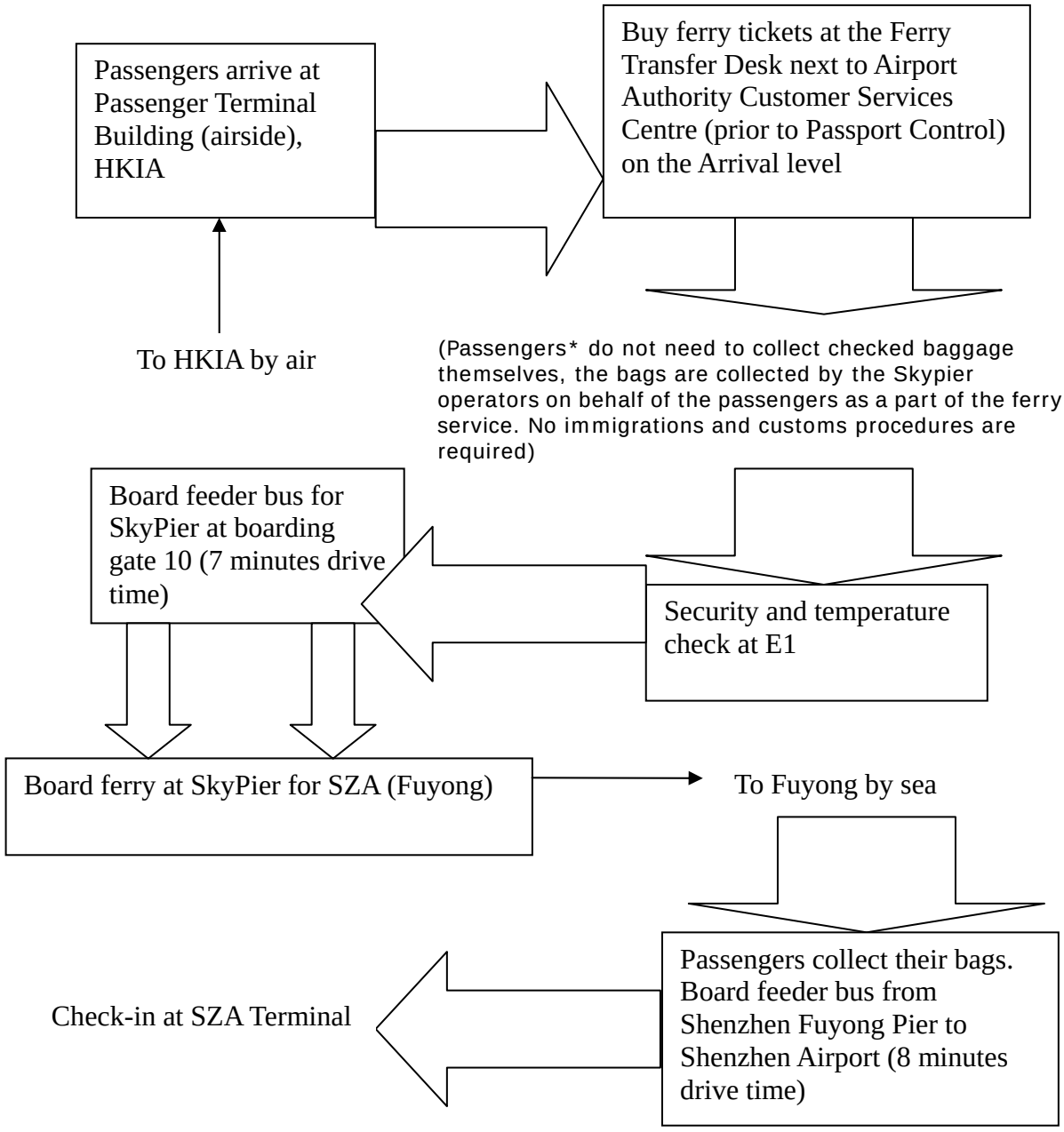
7) Shanghai Airports (Pudong and Honggiao, 55 km apart)

Mode	Journey Time	Note
Coach (Line 1 Airport Connection Coach)	About 1 hour	RMB¥30, non-stop service every 15-25 mins
Shanghai Maglev Train*	15 minutes	RMB¥50 or above (depending on classes), connected via Longyang Road Station on Shanghai Subway Line 2
Shanghai Metro*	1 hour 20 minutes	Work is underway on a western extension from Songhong Road to Shanghai Hongqiao International Airport, and an eastern extension from Zhangjiang Hi-Tech Park to Shanghai Pudong International Airport, most of which will be built underground. Extension to both airports will see the total length of the metro line increase to over 50km, considerably longer than the current 25.4km, both extensions would be finished before EXPO 2010.

* Proposed and undergoing project

Appendix IV

The Flow Sequence of a Passenger Landed at HKIA and Taking SkyPier to SZA.



Note:

* Passengers must present the following at the SkyPier transfer desk:

1) a valid passport and visa for intended destinations

2) a valid ferry ticket

Air-to-Sea passengers with checked baggage should arrive at the Ferry Transfer Desk 60 minutes before ferry departure for document check/ purchase of tickets.

Air-to-Sea passengers with hand baggage should arrive at the Ferry Transfer Desk 30 minutes before ferry departure for document check/ purchase of tickets.

Passengers using these services are treated as transit passengers and are not considered to have entered Hong Kong for immigration purposes. For this reason, access to the ferry terminal is before immigration in the airport for arriving passengers.

[Information sources: websites of SZA and HKIA]

Appendix V Major Modes of Transport from HK to SZA

Route: Wan Chai to Shenzhen Airport

Place	Transportation mode / Time / Cost	Place	Transportation mode / Time / Cost	Place	Transportation mode / Time / Cost	Place	Transportation mode / Time / Cost	Place	Total time / costs
Wanchai	MTR / 62 minutes / HK43.5	Lo Wu	Shenzhen Metro / Time unknown / Cost unknown	深圳華聯大廈	330 Bus / 40 minutes / RMB$20	Shenzhen airport			(102 + x) minutes / HK$(63.5+x)
Wanchai	MTR / 62 minutes / HK43.5	Lo Wu	Taxi / 40 minutes / Cost unknown	Shenzhen airport					102 minutes / HK$(43.5+x)
Wanchai	Coach / 3 hours / HK$100	Shenzhen airport							3 hours / HK$100
Wanchai	MTR / 18 minutes / HK$8.5	Kowloon Station	Coach / 75 minutes / HK$90	Shenzhen Airport					93 minutes / HK$98.5
Wanchai	MTR / 7 minutes / HK$5	Sheung Wan	TurboJet / 55 minutes / HK$208	Shenzhen Airport					62 minutes / HK$213

Route: Tsuen Wan to Shenzhen Airport

Place	Transportation mode / Time / Cost	Place	Transportation mode / Time / Cost	Place	Transportation mode / Time / Cost	Place	Transportation mode / Time / Cost	Place	Total time / costs
Tsuen Wan	MTR / 65 minutes / HK$40.5	Lo Wu	Shenzhen Metro / Time unknown / Cost unknown	深圳華聯大廈	330 Bus / 40 minutes / RMB$20	Shenzhen airport			(105+x) minutes / HK$(60.5+x)
Tsuen Wan	MTR / 65 minutes / HK$40.5	Lo Wu	Taxi / 40 minutes / Cost unknown	Shenzhen airport					105 minutes / HK$(40.5+x)
Tsuen Wan	MTR / 19 minutes / HK$8.5	Kowloon Station	Coach / 75 minutes / HK$90	Shenzhen airport					94 minutes / HK$98.5
Tsuen Wan	MTR / 19 minutes / HK$7.5	Prince Edward	Coach / 3 hours / HK$90	Shenzhen airport					3 hours 19 minutes / HK$97.5

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(Plus the websites of various organizations concerned in the report)