

A Study on the Enhancement for Minimum Connecting Time of Incheon International Airport

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I. Introduction

In the world air transportation market, the Asia-Pacific region's proportion is expected to increase to 42% in 2010 from 35% in 2005. Particularly, the China market, will be expected to experience an explosive demand around Beijing Olympics of August 8, 2008 and Shanghai Expo of May 2010. This prospective market is expected to grow as a rate of 22%(passenger) and 10.3%(cargo) per annual. The countries adjacent Korea competitively is expanding airport infra structures under the governments' initiatives to enlarge the gateway function into the region and to take a priority in transportation market. These trends are well suggested that the new Guangzhou airport opened, on August 2004, Beijing airport is constructing the 3rd runway and the 3rd terminal by the end of 2007, and lastly Shanghai Pudong airport is hurry to add the 3rd runway by 2010.

Japan also opened Nagoya new Chubu International Airport(Centair) on February 2005, the 4th runway of Haneda airport and the 2nd runway of Kansai airport are being construction under the completion by 2009 and by 2007 each. Hong Kong's Chek Lap Kok Airport expand its 10 spots in the Apron area and passenger terminal. Singapore's Changi Airport constructed the 3rd terminal and focus on ensuring the competitive priority in aviation sectors among other countries. The newly signed U.S-China air services agreement includes increasing operations to 249 flights from current 54 flights per week over the future six years, deregulation on limit to launching cities, operating times, and newly launching of each five airlines of two countries

To cope with these changes in the northeast Asia airport sector, the Incheon International Airport implements plans to expand infrastructures and regional supportive function as executing 2nd construction plan('02-'08, USD 5,072 billion, Government financial support 50%) including constructing the 3rd runway, making up free trade zone(100ha), revitalizing and expanding International business District(I, II), operating 2 hotels, 4 business buildings, 1 commercial facilities, signing a MOU with British AMEC Corp to develop IBC-II region of 265 hectares(April 2004). On August 31, 2006, FedEx added

another five direct flights to U.S Anchorage and increasing the flights operation from existent 20 flights per week to 25, giving a hope to ignite the logistics demand in an advanced sectors as electronics, semi-conductors, display of Korea and to strengthen a hub airport position as connecting to Japan and to U.S.

But Incheon has weakness to be a northeast Asia compared with other adjacent airports. It is necessary to develop the region surrounding airports, to get more airlines launching, and access transportation mode, and also it is urgent to expand shopping, tour, business functions around airport develop together with developing logistics clusters aviation-related manufacturing facilities.

It is said Incheon has launching airlines who has relatively smaller transfer passenger demand than other northeast competing airports, and it does not meet the demand sufficiently in terms of variety and speediness of access modes yet. When comparing the number of launching airlines with other adjacent competitor airports, Incheon has 59 airlines, relatively smaller than Hong Kong's 72, Narita's 64 and Singapore's 62 airlines. It is judged Incheon International Airport are not in superior position in terms of accessibility to downtown, as the time taken to downtown from IIA is 50 minutes compared to 8 minutes from Pudong Airport to Shanghai city, Hong Kong or Singapore's 20 minutes. On the other hand, the rapid and swift logistics process capability is not in advantageous position compared to Hong Kong or Singapore Airport. This study will focus Incheon International Airport tries to be a northeast-Asia airport via reviewing the circumstances over the world major airport pursuing to be a hub-airport, none the less the airport should ensure competitiveness of all aspects of airport business to survive from the fierce competitions among northeast Asia airports. The scope of this study will be limited to a topic on improving Minimum Connecting Time (MCT) to increase T/S rate of hub-airport. It is judged it has great significance to review the elements to improve MCT (Minimum Connecting Time) for transfer passenger use Incheon International Airport. The elements can be represented as aircraft operation

punctuality, airlines assignment, gate assignment, baggage handling and passenger moving paths, which are not detail analyzed within short time. Therefore, in this study, it would be desirable that give some clues to find to methods to improve T/s rate of Incheon International Airport after reviewing MCT level, maintaining methods and other foreign advances implementing examples.

II. Review Minimum Connecting Time(MCT) to improve t/s rate

1. Definition of Minimum Connecting Time

1) As to the definition of The Travel Industry Dictionary, Minimum Connecting Time(MCT) is legally defined as minimum time necessary to change planes at a given or Amount of time, agreed in advance between airlines and airport authorities, that is considered sufficient to make a connection without difficulties. This Minimum Connecting Time is provided through OAG which incorporates them into OAG after collecting data directly from airlines with a view to inform the MCT for passengers or cargo transfer when planning air transportation schedule.

<Table 2-1> MCT in Europe

Minimum Connecting Time of Europe airports)	
Airports in Europe	Time(minutes)
Swiss Vienna Airport (VIE)	25-30
German Munich Airport (MUC)	35-45
Swiss Zurich Airport (ZRH)	40
Denmark Copenhagen Airport (CPH)	45
German Frankfurt Airport (FRA)	45
Netherlands Amsterdam Airport (AMS)	45-50
Belgium Brussel Airport (BRU)	50
France Charles de Gaulle Airport (CDG)	45-90
London Heathrow Airport (LHR)	45-90

1) The MCT is extracted from Worldwide Flight Guide OAG

2) As for Vienna airport, the 35% of total passengers are transfer passengers. Vienna airport the mo least MCT records, therefore it has priority in reserving airport through CRS, and the ticket sales for connecting flights has been greatly increased. In 2004, it recorded 18% of growth rate with carrying 5,089,624 passengers in short international routes, it has most ideal logistics system for transfer among all Europe airports. introducing one-roof conceptresulted in great reduction of MCT through using short distance gates between alliance airlines.
source : OAG Worldwide Flight Guide

III. Minimum Connecting Time(MCT) study of foreign exmaples

1. Japan

1) examples of Narita Airport

(1) airlines layout by each terminal

Narita airport in Tokyo opened the 3rd terminal on July 2006 and successively improved MCT from 100 minutes to 45 minutes by reassigning the terminal by each airlines alliances. The airlines consists Star Alliance are Air Canada (Canada), Air New Zealand (New Zealand), All Nippon Airways

(Japan), Asiana Airlines (Korea), Austrian Aviation Group (Austria), British Midland (England), LOT Polish Air(Poland), Lufthansa Group(German), Scandinavia Air System(Denmark, Sweden, Norway), Singapore Airlines (Singapore), Spanair(Spain), TAP Portugal Airlines(Portugal), Thai International Airways(Thai), United Airlines Group(U.S.A), U.S Airways(U.S.A), Varig (Brasil), airlines within Sky Team, Aeromexico (Mexico), Air France(France), KLM(Netherlands), Alitalia(Italia), Continental Airlines(U.S.A), CSA Czech Air(Czech), Delta Airlines Group(U.S.A), Korean Air(Korea), Northwest Airlines Group(U.S.A), One World is consist of Air Lingus(islands), American Airlines Group (U.S.A), British Airways(England), Cathay Pacific Airways (Hong Kong), Finnair(Finland), Iberia(Spain), LAN Group(Chile, Argentina, Peru, Ecuador, Dominica Republic), Qantas Airways(Australia)

<Table 3-1> airline layout of Japan Narita Airport Terminals

the 1 st Terminal	
North Wing	
North Wing Check-in Counters	
Air France(Skyteam)	Cathay Pacific Airways(Oneworld)
Air Tahiti Nui	Finnair(Oneworld)
Aircalin	KLM - Royal Dutch Airlines(Skyteam)
Alitalia(Skyteam)	Korean Air(Skyteam)
American Airlines(Oneworld)	Northwest Airlines(Skyteam)
British Airways(Oneworld)	Virgin Atlantic Airways
South Wing	
South Wing Check-in Counters	
Air Canada(Star Alliance)	MIAT Mongolian Airlines
Air Japan	Scandinavian Airlines System(Star) sanghai Airlines
Air Nippon(Star Alliance)	Singapore Airlines(Star Alliance)
All Nippon Airways(Star Alliance)	Swiss International Air Lines
Asiana Airlines(Star Alliance)	Thai Airways International(Star)
Austrian Airlines(Star Alliance)	Turkish Airlines
DRAGONAIR	United Airlines(Star Alliance)
Eva Air	US Airways(Star Alliance)
IBEX Airlines	Uzbekistan Airways
Lufthansa German Airlines(Star)	VARIG-Brazilian Airlines(Star)

The 2 nd Terminal	
Terminal 2 Check-in Counters	
Aeroflot Russian Airlines	Garuda Indonesia
Air China	Iberia
Air - India	Iran Air
Air New Zealand	JALways
Air Niugini	Japan Airlines
Air Pacific	Japan Asia Airways
Biman Bangladesh Airlines	Malaysia Airlines
China Airlines	Mexicana
China Eastern Airlines	Pakistan International Airlines
China Southern Airlines	Philippine Airlines
Continental Airlines(Skyteam)	Qantas Airways(Oneworld)
Continental Micronesia	SriLankan Airlines
Delta Air Lines	Vietnam Airlines
Egypt Air	XIAMEN AIRLINES

(2) Between International Connecting Flight

Passenger ought to pass through transfer security check, move to departure area and then go to airlines transfer information(even in the T/S information counter is located before security check).

In case transfer flights including movements between two terminal, the connecting bus will be available operated by airlines. In case from the 1st Terminal to the 2nd Terminal, Terminal 1, 28 > 59 >>> Terminal 2, 60 In case from the 2nd Terminal to the 1st Terminal, Terminal 2, 60 -> 80 >>> Terminal 59-28 Gate 80 is boarding only gate. In case of transfer flight from international to international, the passenger should wait in some waiting area(after immigration). If it need to go out this region to meet someone at airport or go outside, the emigration process is necessary at temporarily

2) Nagoya Centair Airport

All member airlines of Star Alliance flying to Japan Nagoya city provides transfer service at Chubu International Airport(Centair). des transfer service. This was done through moving the gates for Star Alliance member airlines

under the one-roof concept", which enable transfer passengers using these airlines to transfer within same terminal in Centair. Using this new single terminal for transfer reduced MCT to within average 60 minutes. To provide easy and convenient connection flight service to their passengers via using this super-hub transfer facilities, the member airlines of Star Alliance adjust and amend their own flight schedule. Particularly such examples are as in case of ANA, designated additional flights from Nagoya to Japanese major five cities; Fukushima Matzuyama, Tokushima, Tottori, and Yonago, add launching cities from 17 cities to 22 cities and increased 12 more operations from 51 flights to 63 flights. In addition, regional aviation and long-range international services were greatly improved. Air Canada relaunched from Nagoya to Vancouver routes from April 26, 2005, and currently Air New Zealand, All Nippon Airways, Asiana Airlines, Lufthansa Air System, Singapore Airlines, and Thai International Airways are being in launch at Nagoya Centair Airport. The new central international airport provides Star Alliance member airlines with so as it called "Move under one roof" concept, and sharing the check-in and ticketing counters at the same terminal. This airport poicty eventually reduced MCT at Centair airport.

2. Examples of Heathrow airport(England)

Heathrow Airport of England has a facilities named Flight Connections Centre(FCC) for transfer passengers. The passengers who want to transfer flight at Heathrow Airport can transfer at this FCC after moving following the signs of flight connection. As in this Flight Connections Centre(FCC), the two terminals, between the 3rd and the 4th are connected by buses on every 10 minutes, and the MCT is 100 minutes. The 1st and 2nd terminal can be connected by foot, and in this case, the MCT is 90 minutes.

3. Examples of Charles de Gaulle Airport(France)

1) MCT of CDG

Charles de Gaulle Airport is managed by ADP (Aéroports de Paris), and ADP have 7,800 employees, with total 82,000 residences (55,000 at CDG plus 27,000 at ORY). The rapid increase of air demand in Paris and its suburb drove Orly Airport to be saturated, the Charles de Gaulle airport was built as 2nd airport, the air shuttle services were implemented to link these two airports, and light rail was also constructed like "Orly". Charles de Gaulle airport are charging of supporting roles heading airport guides for passengers to transfer the right free shuttle buses within custom area between terminals. The free shuttle buses lining Terminals 1, 2 and 3 enabled passengers to get to transfer terminal 15 minutes before departure and also get only by feet. If the transfer time due is only left less than 45 minutes, the transfer-engaged airlines employees company and guide passengers most rapidly to aircraft, on the other hand, they also provide baggage handling services to be loaded into transfer aircraft without any problems. Besides the SNCF stations make it possible to transfer between TGV and aircraft, and the agreement between SNCF and the Air France increase the t/s rate between rail and air, and easily transfer from one to another transport modes.

In case of the 1st Terminal : the MCT is 90 minutes for all connect flights,
 ② In case of the 2nd Terminal : the MCT is 90 minutes for all connect flights
 ③ In case of the 3rd Terminal: the MCT is 60 minutes for all connect flights
 ④ from one terminal to another terminal : the MCT is 120 minutes for all connect flights
 ⑤ from Charles de Gaulles to Orly airport: the MCT is 180 minutes for all connect flights.

2) MCT related examples of CDG experienced by a passenger

I travelled to German to participate International Dental Show in Koln as representative on April 9, 2005. The price and conditions for Europe air tickets were so various, and considering business trip, I decided to purchase Air France's Early Bird product. I reserved the Air France's Seoul-Paris-Munich connection flight, the scheduled read the connecting time for transfer from Paris was only 50 minutes. I was so moved Air France and the Paris Charles de

Gaulle airport's system with connecting to other flight within simply 50 minutes, looking back into my previous experiences, while most international airports need minimum 60-90 minutes to transfer international-domestic connection flights

AF 267 punctually departed Seoul with I and my colleague board, but arrived the CDG 14 minutes later than schedule. We had only 36 minutes to transfer. It took a little time for immigration and we moved to Terminal to take a flight for Munich. We arrived the gate on exact 15:20, prior to 10 minutes for departing time, and we even need no other check-in process because we had already finished for boarding passes at Seoul. But the aircraft was not in the gate. The only we could do was seeing the aircraft towing back to runway. It was odd and strange, how could the airline depart the flight 10 minutes earlier than schedule, even if they knew seven passengers who got the connection boarding passes from Seoul were rushing to the terminal from other terminal they arrived? We were so embarrassed and check the time. It was as same as the gate display time, 15:20. We protested and complained to airline staff at there, and he guided us to ticket counters. We were dumb with treating us, the only we got from the airlines were boarding passes to Munchen(not Munich) flights departing after 3 hours later at that time and meal coupons for each of us. The aircraft operates long range flights boarding hundreds of passenger, and it is not easy depart on time and it is more difficult to arrive on time, considering all the other conditions like meteorology. We had no intent to complain for arrival delay, it could be so under the irresistible circumstances. However, I still cannot understand why the airline depart the flight 10 minutes earlier than schedule, even if they knew the passengers who got the connection boarding pass already arrived CDG, though 14 minutes later, but rushing into the Europe connection flight terminal from international. I even imagined that it would be another reason laid like overbooking in embarking earlier than schedule. My curiosity was getting more great the Air France's flight to Paris departed 5 minutes later than schedule and did not close the gate 10 minutes earlier than departure, when I boarded flight from Frankfurt for Paris after the business meeting.

Of course the Air France would have pride in 45 minutes of MCT at Paris

Charles de Gaulle Airport, and I know it would be impossible at U.S airports. This can be done through more perfect passenger. cargo system of airlines as well as the airport terminal structure and function. But I felt that the only attention Air France put to is 45 minutes of MCT and on-time operation of all flights and paid no care passengers inconveniences resulting from their deciding for short MCT. If so, Which airline, what on earth, cannot reduce the MCT to even 30 minutes if only give meal coupons to passenger who miss the connection flights and telling to aboard to next flight?

It does not make any sense Air France turned away from passengers who arrived prior to departure time, rushed into the gate with prohibiting physiological requirement for toilet, even the passengers were neither imminent to departing time nor being late. I think, Air France would never be proud of being 45 minutes for minimum connecting time. In the end, we missed the transportation mode and had to pay expensive taxi fee(100 dollars) to downtown.

4. Examples of UAE Dubai Airport

Due to the daily increasing demand for using Dubai Airport, the authority changed MCT from existent 45 minutes to 75minutes of every destination airports from Dubai departures on 1 June, 2006.

IV. Reviewing the condition to improve MCT of IIA pursuing hub airport

1. aircraft movements of IIA

During reviews for the prerequisites to improve MCT of IIA pursuing hub airport, the IIA's aircraft movements in traffic statistics from 2001 to 2004 are shown in <Table 4-1>, which represents obviously the movements of 2004 has

doubled compared to those of 2001.

<Table 4-1> traffic statistics of IIA(aircraft movements)

Year	movement				
	Passenger	Cargo	Sub-total	Others	Total
2001	71,982	14,441	86,423	632	87,055
2002	104,741	21,353	126,094	3,405	129,499
2003	105,938	24,247	130,185	3,604	133,789
2004	122,961	26,815	149,776	3,113	152,889

Source : IIAC(2006) Statistics, <http://www.aiport.or.kr>

<Table 4-2> shows air services agreement with Korea as one of recent open skies policy. Korea has signed with total 82 countries including 60 multiple and 22 single agreements

<Table 4-2> Air Services Agreements with Korea and other countries(as of September 2006)

Region	Multiple Agreement	Single Agreement
Asia (24 countries)	China, Thai, Japan, Brunei, India, Mongo, Viet Nam, Malaysia, Hong Kong, Philippines, Singapore, Uzbekistan, Macau, Indonesia, Pakistan, Kazakhstan, Kyrgyzstan, Nepal, Cambodia, Azerbaijan	Myanmar, Bangladesh, Maldives, Sri Lanka
Europe (26 countries)	England, Poland, Russia, Czech, Yugo, Romania, Malta, Bulgaria, Finland, Netherlands, German, Sweden, Denmark, Norway, Belgium, Swiss, , Ukraine, Austria, Portugal, Luxemburg, Islands	France, Greece, Spain, Hungary, Italy
America (8 countries)	U.S.A, Chile, Brazil, Argentina, Canada, Mexico, Peru	Panama
Africa (10 countries)	Tunis, Sudan, South Africa, Morocco, Egypt	Liberia,, Djibouti, Kenya, Gabon, Nigeria
Middle East (11 countries)	Arab Emirates, Oman, Iran	Saudi Arabia, Jordan, Turkey, Kuwait, Iraq, Israel, Qatar
Oceania (3 countries)	Australia, New Zealand, Fiji	
Total 82countries	60countries	22 countries

source : the Ministry of construction and transportation, Republic of Korea, <http://www.moct.or.kr>, Annual aviation statistics(2005), Korea Civil Aviation Development Association

The below <Table 4-3> shows the list of airlines launching in IIA, location of those airlines check in counters, and the airlines alliances. It will be used to emphasize the aspects of sharing terminal in common according to its alliances.

<Table 4-3> 70 airlines list launching Incheon International Airport

airlines	Check-in counter	Alliance	airlines	Check-in counter	Alliance
Garuda Indonesia	J		Uzbekistan Airways		
KLM Royal Dutch Airlines	C	Sky	Far Eastern Airlines		
Northwest Airlines	H	Sky	United Airlines		Star
Dalavia	J		UNI Airways		
Korean Air	D,E,F	Sky	UPS		
Lion Air	H		Iran Air	H	
Royal Khmer Airlines	G		El Al		
Lufthansa		Star	Eastline Air		
Malaysian Airlines System	G		Japan International Airlines		
Mongolian Airlines	G		Japan Air Cargo		
Southern Cargo Airlines			Great Wall Airlines		
Hang Khong Viet Nam	G		All Nippon Airways		One
Vladivostok Air	G		Air Gemini		
Sakhalinskie Aviatrassy			Jade Cargo		
Shandong Airlines	C		Air China	H	
Shanghai Airlines	J		China Southern Airlines	G,H	
Cebu Pacific Air			China Eastern Airlines	H	
Skyteam	H		Xiamen Airlines	H	
Siberia Airlines	H		China Postal Airlines		
Shenzhen air	G		Hainan Airlines	H	
Singapore Airlines		Star	China Airlines	G	
Avail NV			Cargolux		
Asiana Airlines	C,D	Star	Qatar Airways		
Atlas Air			Kalita Air		
Aeroflot	H		Cathay Pacific Airlines		One
Emirates	H		Krasnojarsky Airlines		
Eva Airways	H		Krylo Air		
Air Macau			Thai Skyteam Airlines	J	
Air Astana	H		Thai International Airways	K	Star
Air India	H,K		Turkish Airlines	C	
Air Canada		Star	Tradewinds Aviation		
Air Paradise	G		Federal Express		
Air France	D	Sky	Polar Air Cargo		
Air Hongkong			Phuket Air	C	
Orient Thai	G,H		Philippine Airlines		

note) Abbreviation represent Star : Star Alliance, Sky : Sky Team, One: OneWorld : source : IIAC(2006) Statistics, <http://www.aiport.or.kr>

OAG Worldwide Flight Guide(reincorporated by author)

<Table 4-4> shows the numbers of cities launching when compared with other northeast airports which have ranked as competing Incheon international airport. Incheon International Airport has airlines launching 111 cities(59 cities in northeast-Asia, 18 in southeast-Asia, 8 in Europe, 11 in America, and 15 in other areas) while Hong Kong International Airport in check-lap-kok has airlines launching 75 cities, Changi(Singapore) 75, and Narita(Japan) 57. IIA is said to have competitiveness compared with other nominal competitors in northeast-Asia.

<Table 4-4> comparison cities of launching of northeast-Asia airports

Region / Airport Name	Incheon	Hong Kong	Changi	Narita
Northeast Asia	59	31	19	21
Southeast Asia	18	20	25	13
Europe	8	5	9	5
America	11	4	2	11
Others	15	10	20	7
Total	111	75	75	57

<Table 4-5> represent passenger and cargo transfer rate of recent 2 years, in 2004 it shows the 12.3% of t/s rate with processing 2,915,039 persons while in 2005, t/s rate have decreased to 11.9 with processing 3,054,485 persons in 2005. As for cargo, it decreased from 46.2% to 44.2%.

<Table 4-5> Transfer rate of IIA in recent 2 years

year+	Passenger transfer(Transfer rate%)	Cargo transfer (Transfer rate %)
2005	3,054,485 (11.9%)	950,441 (44.2%)
2004	2,915,039 (12.3%)	984,700 (46.2%)

Source : IIAC(2006) Statistics, <http://www.aipor.or.kr>

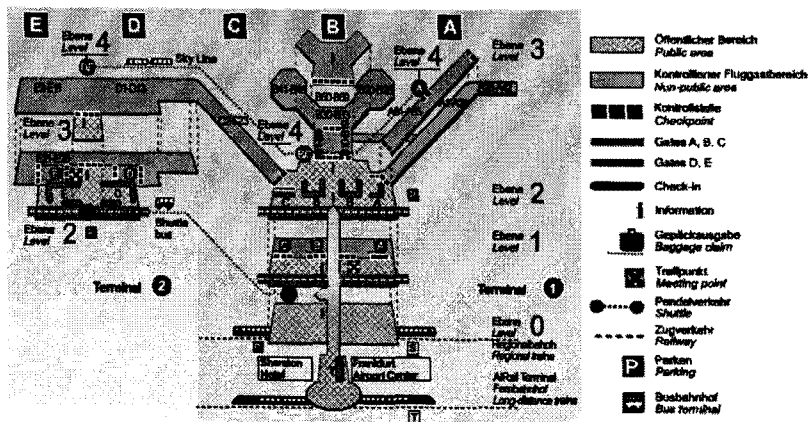
2. Review IIA aircraft movement schedule

1) Wave on aircraft movements

The daily schedule for aircraft departure and arrival of Incheon International

Airport is reviewed, It can be said the peaks happened both in morning and afternoon as for departure, the traffic is busy around 9:00 am, 1:00 pm and 7:00pm while for arrival flights are busy around 11:00 am and 5:00pm. In this peak cases, the connectivity of flights is significant, but Incheon Airport shows unplanned and irregular schedule connection. It is judged to increase air passengers' conveniences through more planned and regular aircraft flight connection.

As for foreign examples, in particular, in Frankfurt airport, the aircraft schedule shapes static circulation waves as 4 peak waves for departure and arrival regularly appear every 2-3 hours peak waves. It puts the most priority on air passengers' conveniences using connecting flights to other destination, which enable Frankfurt airport to function as hub and spoke for air transfer passengers who visit Europe. Furthermore, it gains reputation as one of most convenient transfer airports with providing the more opportunity to connect other destination among famous Europe airports.



<Picture4-1> Terminal Outlying in Frankfurt airport(German)

2) Examples of maximizing aircraft schedule

<Examples 1> Total time taken from German Frankfurt Airport via Incheon International Airport to US Auckland by legs (operation time aT1 + MCT + operation time bT2)

<Table 4-6> Total time taken by legs(FRA → ICN → AKL)

Airport	leg a			MCT	leg b			Total time taken(min,)
	Departure	time (min.)	flights		Departure	time (min.)	flights	
Direct	FRA	-		-	AKL	-		
Incheon	FRA→ICN	10H15	55	70	ICN→AKL	11H20	21	22H45
Narita	FRA→NRT	11H05	64	100	NRT→AKL	10H40	12	23H25
Chek Lap Kok	FRA→HKG	11H10	50	50	HKG→AKL	11H00	46	23H00
Changi	FRA→SIN	11H50	85	60	SIN→AKL	09H40	58	22H30
Pudong	FRA→PVG	10H20	52	90	PVG→AKL			-

3. The relation between Connectivity Index and Transfer Rate of allied airlines.

Generally, Connectivity Index(CI) of aircrafts in airport is defined as departing numbers of flights between Minimum Connecting Time and Maximum Connecting Time against arriving numbers of flights. The higher Connectivity Index(CI) is, the more available transfer flight and the more convenient. If CI increases, the numbers of transfer passengers naturally increases because the former and latter are in positive proportional relationship

As seen in <Table 4-7>, the Asia region have five representative airports like IIA, BKK, NRT, HKG, SIN, the Europe have AMS, LHR, FRT. IIA of Korea has two national carriers, Korean Air and Asiana Airlines, and NRT of Japan have also two, JAL and ANA. The Alliance of airlines can not only increase the t/s rate through convenient connectivity flights but also lead more great transfer through cooperation of two national carriers within one country.

<Table 4-7> Relationship between connectivity index and t/s rate of alliance airlines

Index Airport	Asia region					Europe Region			
	Incheon	Bangkok	Narita	Chek Lap Kok	Chagni	Schipol	Heathrow	Frankfurt	
Hub airlines	Korean Air Asiana	Thai	JAL ANA	Cathay Pacific	Sigarpore	KLM	British Airways	Lufthansa	
CI	SKY Team	429				14,315			
	Star Alliance	613	1,360	442		1,160			
	One World	-		187	932		10,810	27,455	
	Total	1,042	1,360	629	932	1,160	14,315	10,810	27,455
	Actual	429	1,360	442	932	1,160	14,315	10,810	27,455

4. Operational circumstances changes of Chinese and Japanese airports in Northeast Asia Region

China recently established new airlines, order hundreds of new aircraft and rapidly increase flights with active open skies policy with Korea. Ultimately, it happened the severe imbalances between china-incheon international airport-America transfer routes. Also in case of Japan, Narita airport in Tokyo opened the 3rd terminal on July 2006 and successively improved MCT from 100 minutes to 45 minutes and makes every other efforts to increase passengers' conveniences and increase the shares of t/s passenger rates. Narita airport is expected to increase its transfer rate to 23% from current 18.6% through these efforts. Therefore, Incheon has probability that its transfer rates to be shrunk to one-digit percentage from current 11.9% unless active alternative are searched as seen in Japan or China.

5. searching means for active mutual cooperating between national flag carriers

In Korea, Korean Air and Asiana Airlines play a great role as carriers of transfer passengers to make IIA northeast Asia hub. Therefore, it is

recommended to assign gates via cooperating partnership between two Korean national carriers, which enabling to reduce MCT to 50 minutes and pursue strategy to facilitate interline connecting flight with other airlines,

6. transfer passenger transportation system focusing airlines alliances and gates assignment

1) transfer check-in counters status of Incheon International Airport

<Table 4-8> represent the transfer check-in counters and the alliances types of airlines launching in II, and gives pre-concept of configuration in case of gates are assigned by their alliances types.

<Table 4-8> transfer check-in counters of airlines launching IIA and their types of alliances

transfer check-in counter	airlines	alliance	transfer check-in counter	airlines	alliance
A	OZ Asiana Airlines	Star	C	MH Malaysian Airlines System ^{3/4}	
	QF Qantas Airways	Oneworld		MU China Eastern Airlines	
B	KE Korean Air	Skyteam		NH v	Oneworld
	AZ Alitalia	Skyteam		NW Northwest Airlines	Skyteam
C	DL Delta Airlines	Skyteam		OM Mongolian Airlines	
	AC Air Canada	Star		OX Orient Thai Airlines	
	AD Air paradise			PR Philippine Airlines	
	AF Air France	Skyteam		QR Qatar Airways	
	CA Air China			S7 Siberia Airlines	
	CX Cathay Pacific Airlines	Oneworld		SQ Singapore Airlines	Star
	CZ China Southern Airlines			SU Aeroflot	
	GA Garuda Indonesia			SZ China Southwest Airlines	
	H8 Dalavia			TG Thai Airways International	Star
	HU Hainan Airlines			TK Turkish Airlines	
	HY Uzbekistan Airways			UA United Airlines	Star
	HZ Sakhalinskic Aviatrassy			VN Hang Khong Viet Nam	
	IR Iran Air			WH China Northwest Airlines	
	JL Japan Airlines International			XF Vladivostok Air	
	KL KLM Royal Dutch Airlines	Skyteam		4L 에어스타나	
	LH Lufthansa	Star		5J Cebu Pacific Air	
MF Xiamen Airlines					

note) Abbreviation represent Star : Star Alliance, Sky : Sky Team, One: OneWorld
source : <http://www.airport.or.kr>, OAG Worldwide Flight Guide(reincorporated by author)

Below table shows the current status of MCT in IIA takes 60 minutes from international flight to another international flight, 100 min. from international to domestic and 70 min. from domestic to international.

<Table 4-9> Current Minimum Connecting Time in Incheon International Airport

MCT within Incheon International Airport		MCT to and from Gimpo Airport	
International→International	60 minutes	Domestic→Domestic	60 minutes
International→Domestic	100 minutes	International→Domestic	160 minutes
Domestic→International	70 minutes	Domestic→International	170 minutes

note) Minimum Connecting Time registered in IATA, which is indispensable for ticketing

2) transfer check-in counters reassignment plan considering MCT

(1) Discussion gates reassignment by airlines through airlines alliances analysis

<Table 4-10> will be available as an alternative for changing gates in case of reassigning counters according to the types of alliances launching in Incheon International Airport.

<Table 4-10 transfer check-in counter changes for airlines launching IIA by each types of alliances

transfer check-in counter	airlines		alliance	transfer check-in counter	airlines		alliance
	airline code	airline name			airline code	airline name	
A	OZ	Asiana Airlines	Star	C	MH	Malaysian Airlines	
	QF	Qantas Airways	Oneworld		MU	China Eastern Airlines	
B	KE	Korean Air	Skyteam		NH	All Nippon Airways	Oneworld
	AZ	Alitalia	Skyteam		-	-	-
	DL	Delta Airlines	Skyteam		OM	Mongolian Airlines	
	AF	Air France	Skyteam				
	NW	Northwest Airlines	Skyteam				
C	KL	KLM Royal Dutch Airlines	Skyteam		OX	Orient Thai Airlines	
	AC	Air Canada	Star		PR	Philippine Airlines	
	AD	Air paradise					

-	-	-	QR	Qatar Airways	
CA	Air China		S7	Siberia Airlines	
CX	Cathay Pacific Airlines	Oneworld	SQ	Singapore Airlines	Star
CZ	China Southern Airlines		SUt	Aeroflo	
GA	Garuda Indonesia		SZ	China Southwest Airlines	
H8	Dalavia		TG	Thai Airways International	Star
HU	Hainan Airlines		TK	Turkish Airlines	
HY	Uzbekistan Airways		UA	United Airlines	Star
HZ	Sakhalinskije Aviatrassy		VN	Hang Khong Viet Nam	
IR	Iran Air		WH	China Northwest Airlines	
JL	Japan Airlines International		XF	Vladivostok Air	
-	-	-	4L	Air Astana	
LH	Lufthansa	Star	5J	Cebu Pacific Air	
MF	Xiamen Airlines				

note) Abbreviation represent Star : Star Alliance, Sky : Sky Team, One : One World
source : <http://www.airport.or.kr>, OAG Worldwide Flight Guide(reincorporated by author)

(2) Deciding MCT of Incheon International Airport

Below table shows the future Minimum Connecting Timewithin Incheon International Airport and transfer to and from Gimpo Airport when it is supposed to reduce MCT by 10 minutes from current .

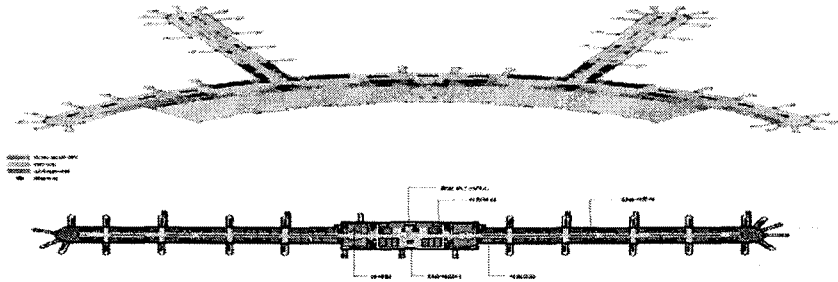
<Table 4-11> Future expected Minimum Connecting Timechange of IIA

MCT within Incheon International Airport		MCT to and from Gimpo Airport	
International→International	50min.(60)	Domestic→Domestic	60min.(60)
International→Domestic	90min.(100)	International→Domestic	150min.(160)
Domestic→International	60min.(70)	Domestic→International	160min.(170)

note) 1) Minimum Connecting Time registered in IATA, which is indispensable for ticketing

2) In general, MCT is reduced by 10 minutes

3) ()specify current Minimum Connecting Time.



<Picture 4-2> Passenger Terminal Layout of Incheon International Airport

V. Conclusion and suggestion

The new paradigm of international aviation policy via open skies drives three major axis of air transport industry(airports, airlines, and passengers), especially airports and airlines to make an every effort to adjust these changes. In fact, it is true the worries about the point to point policies are higher than those of existent hub policy due to the other adjacent airports in area competitive position while IIA's hub & spoke policy focusing on northeast Asia region. Fortunately, among these various changes, it is desirable air transport industry meet some new aspects such as the appearance of mega transportation aircraft like A380 and the new entrance of low cost carriers into the market. Airport policy changes currently implemented by world major airports heading for a hub to increase transfer rates are reviewed in this study. Particularly, considering the circumstances that Incheon International Airport endeavors to be a northeast Asiahub airport, it is judged it has great significance to review the elements to improve MCT(Minimum Connecting Time) for transfer passenger use IIA. The elements can be represented as aircraft operation punctuality, airlines assignment, gate assignment, baggage handling and passenger moving paths, which are not detail analyzed within short time. Therefore, in this study, the status of MCT of IIA and methods to

improve after reviewing MCT level, maintaining methods and other foreign advances implementing examples. One of the most important issues among above progress plans is to review the reassignment plan on transfer check in counters or gates classified by airlines alliances like other foreign airports are engaging. In case of Incheon International Airport, it is important to reduce MCT time from 60 minutes to 50 minutes without compromising existent partnership.

Similar examples can be found in Kanai Airport(Japan) which reduced MCT time from 90 minutes to 80 minutes in terms to increase passenger conveniences transfer domestic to international flights since 2005 winter schedule. Also it turned to be desirable to increase the current transfer rate from 11.9% to more than 20% through cooperation with Korean national flag carriers. In conclusion, it is time to renew the concept on transfer demand without counting only on direct flights demands. It is necessary to establish a convenient transfer procedures, to create cooperationsystem between flag carriers using Incheon airport as hub, to support an information sharing system on transfer passengers in common between flag carriers and international airport operating authority and establish an efficient terminal arrangement plan for airlines.

Key words: Hub Airport, Transfer Rate, Minimum Connecting Time, Connectivity Index

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요 약

공항의 환승율 제고를 위한 MCT의 향상 방안에 대한 정책적 제안 (인천국제공항을 중심으로)

이 강 석*

동북아시아지역에서 인천국제공항이 최고의 허브공항으로서 역할을 위해서는 무엇보다도 환승율에 대한 연구가 필요하다고 판단된다. 인천국제공항은 2005년도에 3,054,485만명의 환승여객을 처리하여 환승율은 11.9% 를 기록하였는데 이는 동북아시아의 경쟁허브공항의 환승율인 30-40%와 비교해보면 공항경쟁력이 상당히 뒤처진다고 할 수 있다.

이러한 약점을 보완하기 위하여 여러 가지 관련 인자들을 검토하는 것이 중요하다고 판단되어지는데 그중에서 인천국제공항의 비행편최소연결시간(MCT)을 개선하는 것이 필요하다. 이러한 문제를 개선하기 위해서는 항공기 스케줄, 항공사 배치, 게이트 배정방법, 수하물처리, 여객 동선 등이 함께 검토되어야 할 것이다. 그러나 이러한 인자들에 대한 세부적인 분석이 단기간에 걸쳐 해결되는 문제가 아니기 때문에 본 연구에서는 외국 허브공항의 MCT 수준, 관리방법, 국외사례 등을 고찰해 보고 동북아시아에서 허브공항을 향한 인천국제공항의 환승율 제고차원에서 정책적 방안을 제시하고자 한다.

주제어: 허브공항, 환승율, 비행편최소연결시간, 연결성지표

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