Research Paper

BALANCING FACILITATION AND AVIATION SECURITY

- Research on accommodating both streamlined air travel processes and strengthened aviation security

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Summary

The acceleration of transnational human & material exchanges has boosted demand for air travel and frequency of airport use by travelers, creating revenue-generating opportunities for the aviation business. However, these new opportunities come at a price as examined in this paper.

Travelers today demand greater speed and convenience, yet the rising numbers of airport users has become an obstacle to providing faster, more convenient air travel. Tougher security checks at airports around the world stemming from the September 11th WTC terrorist attack are another major impediment to speed and convenience in air traveling, as passengers today must endure more complicated security procedures.

The current situation presents a daunting challenge for airport operators around the world, who must find alternatives that accommodate travelers’ demands for simplified arrival/departure procedures, while at the same time guaranteeing travelers’ safety through strengthened aviation security.

This paper presents research prompted by need to solutions to the aforementioned dilemma, and proposes new processes and alternatives that simultaneously satisfy the often-conflicting objectives of simplified airport arrival/departure and increased security. This paper draws its conclusion by analyzing current arrival/departure procedures at Incheon International Airport, and identifies the following ways to improve these procedures through application of the latest advances in IT and BT:

① Elimination of separate verification procedures for passports and boarding passes by creating a system for integrating travel documents check prior to security screening and passport control for departure.
② Prevention of fraud attempt such as boarding pass or passport swapping through creation of passport-based, automated boarding systems.
③ Installation of passport-based, automated equipment (e-gate) for arrival/departure for use by all holders of e-passports without requiring prior registration.
④ Bolstering security through sharing of passenger information (acquired during check-in and processing for departure, boarding, and transfer) between various agencies and airlines.
⑤ Programming of quarantine and customs clearance forms into automated check-in kiosks for:
  - Entry of paper-based information into electronic database.
  - Linkage of immigration and boarding information for more effective quarantine and customs controls.
  - Elimination of redundant verification of passenger records during arrival process.

Implementation of the above measures is expected to streamline arrival/departure procedures and strengthen airport security through safer yet more expeditious processing, and will provide such benefits as follows:

① Airports can respond to increased travel demand without recruiting additional service personnel or expanding the airport itself.
② Manpower made redundant as a result of automation can be utilized to provide services to special-needs passengers, such as the old, infirm, or handicapped, thereby increasing the 'human touch' at the airport, while improving the overall satisfaction level.
③ Efficiency of information management is improved through automation of duties of service providers and creation of new information for additional value creation, thereby upgrading the original duties.

The new arrival/departure processes outlined in this paper are feasible given the increased issuance and use of e-passports, Information and Biometric Technologies (IT/BT) readily available worldwide, and field-tested at ICN. However, as civic groups or individual passengers may voice strong objections to the active use of biometric information, securing individual permission and implementing measures to protect such sensitive information will be necessary before application of these systems.
I. Foreword

The accelerated pace of globalization has increased transnational business exchanges and resulted in economic growth and rising incomes, in turn leading to increased leisure time. This trend is expected to boost global demand for air travel and logistics by an average of 4.2% per annum over the next 20 years, providing the airline and air logistics industries greater opportunities for additional revenue generation and creating new profit sources. At the same time, increased travel demand also gives rise to several problems that must be dealt with.

Deregulation in the aviation industry has spurred demand for safer and faster air travel, creating a paradox whereby the increased number of airport users actively hinders the faster and more convenient arrival/departure process travelers want. Another obstacle to expediting air travel is the general tightening of aviation security around the world after the 9/11 WTC terrorist attack, requiring passengers to endure more complicated and inconvenient procedures.

The twin goals of “simplification of arrival/departure processes at airports” and “strengthening aviation security” appear diametrically opposed, yet they are basic requisite standards recommended by the ICAO. Accommodating these two objectives simultaneously has proven difficult, and previous theses and articles have dealt with achieving one at the expense of the other.

This paper seeks grounds for the coexistence and balance between these two concepts, and solutions enabling airport operators to adjust and respond effectively to the dual trends of the airport industry: increased demand for air travel and strengthened aviation security.

II. Simplifying Arrival/Departure Processes and Strengthening Aviation Security

1. Simplifying arrival/departure processes and Current Trends

“Arrival and departure processes” in this chapter refers to a dual series of procedures that passengers traveling by aircraft must undergo, namely, "check-in process from arrival at airport to boarding" and "entry process from disembarkation to leaving the airport."

The International Civil Aviation Organization (ICAO) has designated "standards and recommended practices" for simplification of arrival and departure processes (adopted on the basis of Article 37 of the Convention on International Civil Aviation) an annex to the Convention and has made compliance mandatory among all countries that ratified the Convention. The ICAO has also focused on preventing unnecessary delays to aircrafts, passengers, crew and cargo through the three major strategies; (1) Standardization of mechanically-deciphered travel documents; (2) Expedited immigration and customs procedures through judicious border control systems and procedures; and, (3) Use of new technologies to strengthen aviation security

Also, the Airports Council International Council (ACI) has forwarded a guideline intended to ensure for all

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1 ICAO Annex 9: Facilitation, Annex 17: Security
2 Annex 9: Facilitation
passengers efficient yet air travel, dubbed the Ideal Process Flow, as part of its efforts to promote its Simplifying Passenger Travel (SPT) program.

2. Strengthening Aviation Security and Worldwide Trends

The ICAO defines “security” as “Safeguarding civil aviation against acts of unlawful interference by combination of measures and human and material.”

Because of the potential for aviation mishaps to become catastrophes with high casualty numbers, aircrafts can be transformed into instruments of terror for attacks on various targets. This makes improvements in security an ever-present burden that must be borne by the aviation industry. Demand for tighter security at airports and on aircraft is increasing worldwide, especially after the 9/11 WTC terrorist incident. The list below outlines current trends in aviation security:

<table>
<thead>
<tr>
<th>Agency/Country</th>
<th>Actions Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICAO</td>
<td>○ Supplement relevant agency and aviation security statutes; Strengthen ICAO’s supervisory and regulatory powers ○ Pass resolution in 2008 security inspections concerning compliance with ICAO SARP for security in Annex 17 ○ Confer SARP status on rules concerning security checks on all staff with access to restricted areas ○ Include list of items banned on aircraft in security statues</td>
</tr>
<tr>
<td>IATA</td>
<td>○ Proposals for establishment of restrictive measures for travel document forgery through development of high-tech bio-recognition and new electronic systems; proposal for recognition/verification of dangerous individuals wanted by security organizations ○ Present main recommendations for improvement of aircraft security including strengthening of aircraft doors</td>
</tr>
<tr>
<td>USA</td>
<td>○ Creation of transportation safety and homeland security agencies ○ Posting of federal officials at airports and placement of locks on cockpit doors ○ Mandatory presentation of government-issued photo ID during check-in ○ Repeat verification of photo ID and additional inspection of carry-on luggage during boarding</td>
</tr>
<tr>
<td>Rep. of Korea</td>
<td>○ Creation of Civil Aviation Safety Authority (Aug. 12th, 2008) ○ Placement of security devices on cockpit doors and additional restrictions concerning access to cockpit ○ Authorization of weapons use (gas guns, tasers) by cabin security staff ○ Designation of specialized aviation security centers for training of professional security personnel and intensified training/education in aviation security</td>
</tr>
</tbody>
</table>

[Table 1] Actions taken in aviation security after 9/11

III. Analysis on Arrival/Departure Processes of Incheon International Airport (ICN)

In this section, existing procedures for arrival and departure of passengers at Incheon International Airport are analyzed from the perspective of “Facilitation” and “Aviation Security” in order to identify potential drawbacks and ways to improve or compensate for them.
1. Arrival and Departure Procedures

Boarding an airliner for departure from ICN is currently a five-step process comprising: (1) Check-in; (2) Travel documents checks prior to security screening; (3) Security screening; (4) Passport control; and (5) Boarding. Passengers arriving at IIA also go through a five-step process comprising: (1) Disembarkation; (2) Quarantine control; (3) Passport control; (4) Baggage claim; and (5) Customs declaration. The processes can be broken down into stages and procedures as below:

<table>
<thead>
<tr>
<th>Process</th>
<th>Key Procedure (Documents)</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Check-in (Passport, e-ticket)</td>
<td>Confirmation of travel reservation → Passenger ID and travel documents verification → Seat allocation → Baggage Check-in → Issuance of boarding pass</td>
</tr>
<tr>
<td></td>
<td>Travel Documents Checks (Passport, boarding pass)</td>
<td>Cross-checking information on passport and boarding pass → Passenger ID verification → Entering the Secured zone(for security screening)</td>
</tr>
<tr>
<td></td>
<td>Security Screening</td>
<td>Screening passenger and carry-on baggage to check the banned items such as weapons, explosive or other dangerous devices, or substances</td>
</tr>
<tr>
<td></td>
<td>Passport Control (Passport, boarding pass)</td>
<td>Checking passport information → Clearing passenger for departure → Checking boarding pass</td>
</tr>
<tr>
<td></td>
<td>Boarding (Boarding pass)</td>
<td>Checking boarding pass with Boarding Gate Reader(BGR) ※ Some airlines may also demand passport and passenger ID verification</td>
</tr>
<tr>
<td></td>
<td>Transfer (Passport, boarding pass)</td>
<td>Security screening→(Check-in, if necessary)→Boarding</td>
</tr>
<tr>
<td></td>
<td>Quarantine (Quarantine questionnaire)</td>
<td>Filling out quarantine questionnaire form → Submitting it to quarantine officer → Inspection for fever ※ Limited to passengers from flights emanating from epidemic zones</td>
</tr>
<tr>
<td></td>
<td>Passport Control (Passport, boarding pass)</td>
<td>Checking passport information → Clearing passenger for entry</td>
</tr>
<tr>
<td></td>
<td>Baggage Claim</td>
<td>Going to the designated carousel → Picking up baggage</td>
</tr>
<tr>
<td></td>
<td>Customs Declaration (Customs declaration form)</td>
<td>Filling out customs declaration form → Submitting it to customs officer</td>
</tr>
</tbody>
</table>

[Table 2] Arrival and Departure procedures
2. Major Issues and Problems with Existing Processes

2.1 Check-in

First of all, it is difficult to respond flexibly to a sudden rise in the number of passengers during peak hours due to manned check-in counters handling an overly large percentage of check-in requests.

Secondly, it is not able to prevent those who will not be cleared for departure passport control because they are travel-restricted persons from checking in, which necessitates additional work by airline staff to escort passenger from the passport control area back to check-in area.

Thirdly, it is possible for one person to procure boarding passes for two or more flights leaving from IIA, thus creating the risk of illicit acts, such as switching boarding passes in the boarding lounge.

2.2 Travel documents checks prior to security screening

Although travel documents controls before security inspection and passport control for departure are officially separate acts performed by different agencies (Incheon Int’l Airport Corporation for the former, Korea’s Ministry of Justice for the latter), they can be perceived by passengers as identical procedures as they involve the same process (passport and boarding pass control). Therefore, it is possible for these separate procedures to be merged.

2.3 Passport control for Departure

First, most passport controls are handled at manned stations, which can easily be overwhelmed by a surge in the number of passengers during peak hours, creating extensive delays and long lines.

Second, cases have occurred where passengers who have checked in at the counter and have passed through security are not cleared for departure due to travel restrictions or passport errors, forcing them to go back to the check-in area. Aside from inconveniencing the passenger concerned, it creates unnecessary waiting time and delays at immigration desks.

2.4 Boarding

The established practice of flight crew not checking passports expedites the boarding process, but also creates possibilities for illicit acts, such as switching passports and boarding passes between different individuals.

2.5 Quarantine

First, preventing the entry and spread of foreign epidemics necessitates effective tracking and monitoring of passengers suspected of being infected, as well as passengers that were seated in their vicinity—a task virtually impossible with the present system based on submission of handwritten quarantine questionnaires.

Second, existing quarantine questionnaires consist only of questions inquiring basic information, such as passengers’ passport information, port of origin, and notable symptoms. Passengers are providing information that the Ministry of Justice already possesses, and managing and assessing information on handwritten forms is often difficult.

2.6 Passport control for Arrival

Most inspections are handled at manned stations, which can easily be overwhelmed by a surge in the number of passengers during peak hours, creating extensive delays and long lines.
2.7 Customs Declaration

Similar to the problem with quarantine, passengers give information that Korean authorities already possess, while managing handwritten information and entering it into the data base is difficult and time-consuming.

3. Possible Improvements in Arrival and Departure Processes

The assessment of arrival/departure processes at ICN has yielded problems and possible alternatives as listed below.

<table>
<thead>
<tr>
<th>Areas</th>
<th>Procedures</th>
<th>Problems</th>
<th>Possible Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check-in</td>
<td>Overreliance on manned counters</td>
<td>• Overlap with departure passport control (Dual inspections of passports and boarding passes)</td>
<td></td>
</tr>
<tr>
<td>Travel Documents Checks</td>
<td>Overreliance on manned counters</td>
<td>• Overlap with departure passport control (Dual inspections of passports and boarding passes)</td>
<td></td>
</tr>
<tr>
<td>Departure Passport Control</td>
<td>Overreliance on manned counters</td>
<td>• Overlap with departure passport control (Dual inspections of passports and boarding passes)</td>
<td></td>
</tr>
<tr>
<td>Arrival Passport Control</td>
<td>Overreliance on manned counters</td>
<td>• Overlap with departure passport control (Dual inspections of passports and boarding passes)</td>
<td></td>
</tr>
<tr>
<td>Facilitation</td>
<td></td>
<td></td>
<td>• Spreading the use of self service check-in</td>
</tr>
<tr>
<td>Quarantine</td>
<td></td>
<td></td>
<td>• Integrating and automating travel document checks and passport control for departure</td>
</tr>
<tr>
<td>Customs Declaration</td>
<td>Submission of handwritten forms renders management of information difficult.</td>
<td>• Submission of handwritten forms renders management of information difficult.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Inconvenience of repeat recording of known passport information (Passed information already available to Immigration agency as a result of passport control)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Difficulty in tracking and monitoring infected passengers and passengers seated nearby.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Elimination of inconvenience by sharing information between agencies and electronic submission of records</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Enhancing quarantine controls by matching questionnaire information, passport information and advanced passenger information(API)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Expansion of prior passenger checks for prior discovery of travel-restricted persons by government</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Streamlining for more effective customs controls</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Development of automated boarding system with passenger recognition functions</td>
</tr>
</tbody>
</table>

[Table 3] Possible improvement in arrival/departure processes
IV. Balancing Facilitation and Aviation Security

1. Measures for Improving Arrival and Departure Processes

The time required to provide services during the arrival/departure process can be greatly reduced pending automation and mechanization of many of the procedures, with processes being simplified further through merging redundant activities into a single procedure. Details of the improvements to be made are as follows:

<table>
<thead>
<tr>
<th>Area</th>
<th>Procedure</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Facilitation</strong></td>
<td>Check-in</td>
<td>•Develop automated equipment for determining passenger’s travel document checks to access security restricted area and departure passport control simultaneously with passport information only. (e-gates for departure)</td>
</tr>
<tr>
<td></td>
<td>Travel Document Checks</td>
<td>(→it helps expand the use of mobile and web check-in due to obviating boarding pass checks)</td>
</tr>
<tr>
<td></td>
<td>Departure Passport Control</td>
<td>•Develop the above system for use by e-passport holders without any identity enrollment</td>
</tr>
<tr>
<td></td>
<td>Arrival Processing</td>
<td>•Develop automated immigration processing system for use by holders of e-passports without the need for prior registration</td>
</tr>
</tbody>
</table>
|                   | Quarantine                 | •Integrate quarantine functions into automated arrival processing system  
※Quarantine questionnaire issued only for passengers disembarking from flights originating from known epidemic zones.  
•Detect passengers with unusually high temperatures with heat-sensitive cameras attached to the above system |
|                   | Customs Declaration        | •Integrated customs functions into the above automated arrival processing system                                                                                                                                 |
| **Security**      | Check-in                   | •Expand pre-departure checks by government  
(→During check-in, biographic data of passenger and travel itinerary are transmitted to Immigration agency and the agency respond Authority to Carry (ATC) after background checks on the passenger) |
|                   | Transfer                   | •Develop automated transfer system to register passengers information                                                                                                                                     |
|                   | Departure                  | •Develop automated boarding system for inspection and verification of passenger's passport/biometric data  
(→Passenger information captured by the above equipment is transmitted to Immigration agency for the last check on traveler’s departure.)          |

[Table 4] Activities for facilitation and security
2. Arrival and Departure Processing after Change

This chapter presents a prospective “To-Be” model for arrival and departure process and security, reflecting the abovementioned improvements. The new model is shown on the right side of [Figure 1] below, after the automation and simplification of the entire process. Illustrations and functions of the automated system enabling the new process are shown in [Figure-2] below.

![Figure 1] Comparison of arrival and departure procedures

<table>
<thead>
<tr>
<th>e-Gate for Departure</th>
<th>e-Gate for Transfer</th>
<th>e-Gate for Boarding</th>
<th>e-Gate for Arrival</th>
</tr>
</thead>
</table>

As shown in [Figure 3], the new process allows the integration and simultaneous assessment of all passenger information necessary for check-in, departure, boarding, and transfer. The process enables automatic verification of whether the same individual went through all three stages of departure (check-in, inspection for departure, boarding) and both stages (transfer & boarding) for transfer flights, resulting in enhanced aviation security. It also offers the added benefits of automatic entry of formerly handwritten information into the data base, and the sharing of
information between airlines and relevant agencies to improve administrative efficiency in border control, quarantine control and discovery of illegal customs activities. Passengers will find the new process more convenient and faster, as multiple recordings of personal information would become eliminated.

<table>
<thead>
<tr>
<th>As-Is</th>
<th>To-Be</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="As-Is Diagram" /></td>
<td><img src="image2" alt="To-Be Diagram" /></td>
</tr>
</tbody>
</table>

**[Figure 3] Information flow in immigration processing**

2.1 Check-in

Passengers check in using automated kiosks, mobile phones, or the internet, and will be issued boarding passes when necessary. Only passengers who pass the pre-departure checks by Immigration agency will be allowed to complete check-in. The procedures are as follows:

1. Passport biographic data (Nationality, Date of birth, Passport number, Name, etc) and travel itinerary are transmitted in real-time from the airline host to the Immigration system of government authority
2. The Immigration system compares the information from the airline with its list of persons restricted from travel, clearing or blocking the passenger from departing, and transmits the information back to the airline.
3. They transmit their responses such as OK to board, not OK to board to airline host
4. The airline completes or discontinues check-in depending on the government’s response.

2.2 One-Stop Departure Process using “e-Gates for Departure”

“e-Gate for Departure” which integrates 3 stages for departure (travel document check prior to security screening, passport control for departure and security screening) provides passengers with genuine “one-stop service.” The process is as follows:

1. The passenger places his/her belongings in the X-ray machine, which scans the items while the passenger uses e-Gate for Departure located adjacent to it.
The passenger inputs his/her passport information into the e-Gate for Departure, and the e-Gate compares that information with the information provided by the airline. A match will open the door of the e-Gate and allow the passenger to proceed.

After proceeding inside the e-Gate, the passenger provides biometric information (facial image) and allows the e-Gate to verify information by scanning an image stored inside the RFID chip inside the passport.

The information provided in Step 2 is transmitted simultaneously to the Immigration system, and the database of the system transmits the response to the machine.

The backdoor of the e-Gate opens after receiving a positive response to the pre-departure check, in addition to positive verification of the passenger's ID through facial comparison.

The passenger is inspected by security gateways installed behind the backdoor. Those passing through without setting off the alarm receive personal belongings inspected by X-ray, and this concludes the process. If the gateway alarm is set off, the passenger concerned is subject to additional inspection by security personnel.

### 2.3 Automated Boarding using “e-Gates for Boarding”

All passengers use automated boarding systems prior to boarding, and the boarding process will be as follows:

1. Passport biographic data (Nationality, Date of birth, Passport number, Name, etc) is transmitted from the e-Gate to Immigration system.
2. The e-Gate for Boarding compares the information from the airline with the passport information to verify the identity of the passenger. Positive confirmation opens the front door to the e-Gate and allows passenger to proceed inside.
3. The Immigration system compares the information from the airport with its immigration record and transfer passenger registration data to clear the passenger for departure.
4. The e-Gate compares biometric information (facial image) on an e-passport or in the Immigration system (in case of transfer or foreign passengers) to verify identity of the passenger.
5. The backdoor of the e-Gate opens upon completion of Steps 3 and 4, allowing the passenger to proceed. This completes the boarding procedure.
6. Negative results at Steps 3 or 4 indicate the possibility that the passenger is engaged in illegal transfer activity, and will be subject to inspection by Immigration agency staff at the airport.

### 2.4 Transfer using “e-Gates for Transfer”

All transfer passengers are required to enter personal information into the automated system during security inspections as follows:

1. The passenger allows “e-Gate for Transfer” to scan his/her passport and enters through the front door.
2. Passport information provided in Step 1 is transmitted to the Immigration system and compared with Advanced Passenger Information (API) in the database.
3. The passenger’s facial image is taken, and the image is transmitted to and stored in the Immigration system (biographic data and biometric data utilized during boarding processes to verify passenger’s identity).
4. The passenger proceeds through the open backdoor of the e-Gate. This completes the transfer process.
2.5 One-Stop Arrival Process using “e-Gates for Arrival”

Passengers entering Korea proceed with combined processing for immigration, quarantine, and customs. The procedures are as follows:

① The passenger allows “e-Gate for Arrival” to scan his/her passport and enters through the front door.
② Passport information provided in Step 1 is transmitted to the Immigration system, which inspects information for entry and transmits the result of its inspection to the e-Gate.
③ The passenger allows “e-Gate for Arrival” to scan his/her face for photography and subsequent comparison with photographic information stored in the RFID chip in his/her e-passport.
④ Passengers disembarking from flights originating from known epidemic zones are automatically issued questionnaires to be answered via touch-screen, and infrared cameras on e-Gate check for fever.
→ The resulting information is stored in the quarantine database, enabling quarantine officers to access information for authorities to inspect the passenger concerned and others seated nearby.
⑤ The passengers automatically issued a customs declaration form for carry-on items, to be filled out via touch-screen. The customs information is added to the passenger’s personal information during immigration processing and stored in the Customs system.
→ The data enables customs authorities to execute more effective statistical management and data gathering on carry-on items brought in.
⑥ The backdoor opens following a positive response in Steps 2 and 3, and the passenger is allowed to proceed. This completes the quarantine and customs procedures.

V. Technical Feasibility of Implementing New Processes

An assessment of the potential of IT, Bio-recognition technologies, and e-passports currently available in the aviation industry for actual use, as well as various projects currently in progress at Incheon International Airport, have shown that utilization of such technologies is indeed feasible. However, as widespread use of such technologies is based on biometric and personal information collected from individual passengers, it must be tempered with measures for physical and legal protection of such sensitive personal information.

1. Application of BT/IT in Air Transportation and Expansion of e-Passport Use

The high reliability and improved security offered by bio-info recognition technology has drawn attention to what seems destined to become the next generation in security technology, not to mention the bio-info industry’s robust 40% annual growth. Passport and immigration control systems using this pioneering technology are being designed and developed in such countries as Germany, Canada, USA, Australia, and the UK. Examples of its installation and use at airports are on the rise, as noted by an IT Trend survey3 in 2008 that observed 18% of 200 major airports around the world using such systems for immigration processing, with the percentage expected to increase to 31% by 2010.

Standardized information databases such as APIS (Advanced Passenger Information System) or iAPP (interactive Advanced Passenger Processing) are already available for sharing by airlines and state agencies, and the expected appearance of e-passports in accord with ICAO standards (issued by over 42 countries) and their utilization

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suggests that the groundwork has already been laid for implementing the new system proposed by this paper.

2. ICN’s Projects for “New Processes”

In an effort to assess and ascertain the technical feasibility of the new process outlined in this paper, ICN has initiated several projects as shown in [Table 5] to simplify arrival and departure processing and enhance security.

<table>
<thead>
<tr>
<th>Project</th>
<th>Main Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated Immigration Processing System</td>
<td>○ Creation of automated immigration clearance system utilizing biological information (facial image, fingerprints)</td>
</tr>
<tr>
<td>(Date)</td>
<td>○ Current operation: 12 lines in departure area, 8 lines in arrival area, processing time: 5 seconds per passenger</td>
</tr>
<tr>
<td>Automated Boarding System</td>
<td>○ Comparison of passport information provided by passenger and airline’s customer list (boarding pass unnecessary)</td>
</tr>
<tr>
<td>(Dec. 2007–July 2008)</td>
<td>○ ICN first in the world to develop such system</td>
</tr>
<tr>
<td></td>
<td>○ Current operations: 6 lines in one location, processing time: 3 seconds per passenger</td>
</tr>
<tr>
<td>“Future Generation Intelligent Airport System”</td>
<td>○ Verification of simplified immigration process through development of following systems:</td>
</tr>
<tr>
<td>R&amp;D Project</td>
<td>- e-Gate for Departure</td>
</tr>
<tr>
<td>(Oct. 2008–June 2010)</td>
<td>- e-Gate for Boarding</td>
</tr>
<tr>
<td></td>
<td>- e-Gate for Transfer</td>
</tr>
</tbody>
</table>

[Table 3] ICN’s Projects for “New Processes”

[Figure 4] Automated immigration system in actual use  [Figure 5] Automated boarding system in actual use

VI. Benefits

1. National Level

First, provision of higher level of service in a more expeditious and convenient fashion can boost national competitiveness.

Second, application of bio-recognition technology and analysis of passenger information prior to boarding allows for more thorough detection and control of risks related to departing, arriving, and transfer passengers. This
will have the effect of enhancing national security, while improving the Nation’s international image for safe air travel.

Third, the social costs of time unnecessarily expended during check-in and waiting in queues will be reduced by 45,451,875,000 Korean won⁴ (US$35 million) per year.

2. Airport Level

First, the new technology may raise the level of traveler satisfaction concerning airport services and the airport’s overall image through provision of more expeditious service and security.

Second, the new technology may enhance ICN’s ability to adjust to increased demand for air travel without recruitment of additional personnel or expansion of the airport itself. If demand stays at present levels, currently idle space can be transformed into additional convenience or commercial facilities for creation of more value for the airport. The increases in the number of passengers handled and the utilization of space are presented below.

<table>
<thead>
<tr>
<th>Process</th>
<th>Processing Time Per Passenger (projected)</th>
<th>Increase in Required Space Per Passenger</th>
</tr>
</thead>
<tbody>
<tr>
<td>As-Is</td>
<td>Less than 45 minutes</td>
<td>Area needed for 1 immigration desk: 6.82㎡</td>
</tr>
<tr>
<td>To-Be</td>
<td>Less than 30 minutes</td>
<td>Area needed for 1 automated system: 4.20㎡</td>
</tr>
</tbody>
</table>

→ Improvement in use of space in departure area: 38.4%
151% increase in passenger accommodation ability

Third, the new system may enable airline and CIQ personnel formerly needed to process passengers to focus instead on special-needs passengers (old, infirm, and the handicapped), thus reinforcing the image of ICN as a more “caring” airport and raising the level of overall satisfaction. Other employees can be mobilized for complex analyses in back offices instead of floor work, raising the level of sophistication of airport operations at ICN.

Fourth, quarantine and customs offices are provided with electronic data to replace handwritten information for more efficient data management, as well as the ability to link acquired information with other data to formulate new information necessary to perform their duties in an expeditious and convenient manner.

3. Passengers Level

The average passenger will find the time necessary for departure and entering greatly reduced, making possible more leisurely use of the airport; or may use the time saved for more productive business than waiting in lines. As the boarding pass becomes unnecessary for departure, use of the airport becomes more convenient.

Ⅶ. Projections on the Future of the New Processes

Simplifying the difficulties of international travel for a given passenger means streamlining the process not

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⁴ Opportunity costs = Departures (Korean nationals) × User rate × Time reduced × Wages per minute
- Domestic departure (Korean nationals) for 2008: 17,135; User rate: 70%; time reduced: 15 minutes
- Wages per minute: 250 Korean won (Average wage in Korea: 2,405,000 won/US$1,920)
only at the point of departure, but also during entry at an airport in another country. The new process can be tailored according to different models for each country.

Airports in countries like USA and Japan collect bio-info from all foreign travelers upon arrival, creating delays for passengers during entry. Provision of information acquired at the airport of origin to the other airport before a given passenger arrives at the destination will eliminate the need for complicated procedures involving foreigners, as the passenger concerned can be processed in the same manner as a national of the country.

However, this must be predicated on an agreement signed between the two countries concerned beforehand, not to mention an agreement on standards and type of information to be transmitted across the border.

VIII. Conclusion

The increase in demand for air travel and frequency of traveler use of airports as a result of accelerated transnational human & material exchanges has presented air logistics businesses with new opportunities for generating revenue.

Travelers today are demanding that they be allowed to travel faster and in a more convenient manner, yet the rise in the number of people using airports is becoming an obstacle to fast and convenient travel. Tougher security checks at airports around the world stemming from the Sept. 11th WTC terrorist attack present another major impediment to speed and convenience in traveling, as passengers are now having to endure more inconvenience and complicated procedures at airports.

The situation has operators at airports around the world facing a dilemma of finding an alternative that will accommodate travelers’ demands for simplified arrival/departure procedures at airports, while also guaranteeing travelers’ safety by strengthening airport security.

This paper represents research born of the necessity to find a solution to this dilemma, and proposes new processes and alternatives that would make possible the simultaneous attainment of the competing goals of simplifying airport arrival/departure and increasing security. This paper draws its conclusion by analyzing current arrival/departure procedures at Incheon International Airport, thus finding ways to improve them through the application of the latest advances in IT and BT.

The new arrival/departure process outlined in this paper is feasible given the increased issuance and use of e-passports, Information Technology and Biometric Technology currently being promoted worldwide, and technologies that have been proven at ICN. However, as there is a possibility that strong objections against the active use of biological information may be voiced by civic groups or individual passengers, securing individual permission and measures to protect such sensitive information will be necessary before application of automated systems.

The application of the new process will allow the provision of airport services in a more expeditious and secure manner, enabling the airport to simplify immigration processing while enhancing security. Extensive use of sophisticated equipment will lead to automation of most duties performed at the airport, creating new information for efficient statistical management relevant to airport operations and for generating new value. Aside from allowing personnel to concentrate on their original duties, the new system will enable ICN to adjust to rising demand for air travel without recruitment of additional personnel or expansion of airport facilities.