



Incheon Airport Autonomous People Movers

Guidance

Purpose	<p>The purpose of this document is to provide guidance and best practice examples for stakeholders aiming to introduce similar initiatives related to accessibility and assistance to persons with disabilities in an airport environment.</p> <p>The case study is not intended to endorse any technology or provider, but rather provide details of the key considerations as well as various implementation models which could be adopted.</p> <p>The intended audiences may include but are not limited to: Airports, Airlines, Technology Providers, and Regulatory Bodies.</p>
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Scope of this Guidance	<p>This guidance is provided as a source of information to help and support industry players to implement initiatives related to accessibility and assistance to persons with disabilities in and airport environment.</p>
The Case Study Template	<p>In some situations or jurisdictions, a prescribed case study template may be necessary that meets the local requirements of a particular business, organization, or regulatory body. For this guidance document, the following sections provide the general steps involved in developing a business case and/or case studies, including a brief explanation of their purpose, benefits, and considerations.</p>

CASE STUDY

BACKGROUND/BUSINESS NEEDS

Since its grand opening in 2001, Incheon International Airport has focused on enhancing the passenger experience significantly. While Incheon Airport has various services to provide a convenient, seamless, and pleasant journey in the airport, trending with the digital transformation phenomenon was inevitable.

In order to increase operational efficiency and minimize operating expenses, many kinds of unmanned, automation-related technologies have been developed worldwide. In terms of transportation, there are new mobility concepts such as Urban Air Mobility, autonomous vehicles, etc. As for logistics, drones and delivery robots are aggressively developed to cope with the increased cargo. Furthermore, there is a change in the way of communicating as well, where contact-free communication rather than the traditional in-person is more and more privileged. Studies show that people feel psychological safer when they are experiencing contact-free service; this trend accelerated when going through the COVID crisis. In the airport environment, it is crucial to provide passengers with customized services that reduce waiting times and inconveniences, and that are safe.

Incheon Airport launched the 'Smart Airport' initiative in 2017, abiding by the importance of digital transformation. The two primary objectives of the 'Smart Airport' initiative are to enhance passenger experience and increase the airport's operational efficiency. Even if both aspects are nearly equally important in general, Incheon Airport is putting a great deal into meeting the high standards of customers' needs, with a focus on carefully meeting the needs of passengers with reduced mobility—being this one of the critical parts of passenger service.

As a result of this combination of new technologies in passenger service, we developed Air Ride (self-driving indoor shuttle) and Air Porter (cart robot), and their operation started in October 2020.

Air Ride: Autonomous Indoor Mobility

Air Ride is Incheon Airport's first attempt at indoor self-driving mobility. It has four-person maximum capacity with separate luggage storage. It has 3D and 2D LiDAR sensors, cameras and C-ADAS sensors for accurate and smooth control to prevent accidents or inconveniences. A total of two vehicles were introduced: one in the airside departure hall of Terminal 2 and the other in the airside arrival hall of Terminal 1. In Terminal 2, Air Ride provides services from the information desk to the boarding gates. It automatically moves to the arrival gates in connection with flight status data, and then from the arrival gate to quarantine in Terminal 1. With many functions, such as cautious path planning, obstacle detection and avoidance, and automatically returning to the charging station, Air Ride provides a new experience for passengers.

Air Porter: Cart Robot

Air Porter is the first cart robot introduced at Incheon Airport. We have six cart robots in the airside of Terminal 1, Terminal 2, and Concourse. It can transport a maximum of two pieces of luggage from 3kg to 50kg. With LiDAR sensors, cameras, and ultrasonic sensors, Air Porter can self-drive and lead the passenger or follow passengers with its image-tracking technology. Air Porter operates when passengers tag their flight tickets, and can choose numerous places, such as boarding gates, F&B stores, duty-free shops, toilets, etc., from the touchscreen map.

BENEFITS

Passengers: New Experience and Contact-free Service

There is more demand for contact-free services as passengers are worried about hygiene conditions and unknown germs or viruses. We cannot replace all in-person services, which is premature since some people still find it uncomfortable; however, the voices for contact-free services are certainly increasing. Incheon Airport is a vast place to walk around with baggage. All passengers, including those with reduced mobility, are happy to move around without hand-carrying luggage using Air Porter, the cart robot, and to hop in the self-driving shuttle to move a long distance to the boarding gates.

Passengers at Incheon Airport feel interested when they have a new experience to try out. Many people often cheerfully take pictures and videos of the robots and new vehicles. It is an excellent combination of simultaneously providing a joyful new experience and being helpful.

Airport: Enhancing Core Value and Optimizing Operation

Enhancing passenger experience and satisfying passengers is vital to most airport operators; it is even more crucial for Incheon Airport. As an infrastructure and service provider, the airport operator is responsible for making passengers safe and comfortable.

Since 2020, ensuring the passengers' safety and hygienic comfort is more important than ever. Airport operators should be prepared for a sustainable air transport ecosystem. To assure constant airport operations, these kinds of autonomous services will be more helpful in the future. Today, these types of amenities and services are still in the early stages and do not replace all human interactions. However, in the future, they can fill in as a supporting function where there is insufficient supply, such as during night time or when services lack human resources.

Airlines: Cooperation and Sustainable Co-existence

Cooperation from airlines and airport operators is crucial in the aviation industry. Airlines already provide various services for persons with reduced mobility; however, there may be staffing shortage due to operational efficiency and other environmental issues. It is essential to work closely with all stakeholders, including airlines, to avoid operational obstacles when introducing new systems or services at the airport.

When Incheon Airport developed Air Ride, the self-driving indoor shuttle, we took in consideration the needs of the airlines to have an on-demand shuttle per airline calls. National carriers operate their own vehicles (manually), but foreign carriers cannot operate such a service. Therefore, we developed Air Ride to receive airline calls if they are needed on demand so it can pick up the passengers with reduced mobility. Even for the national carriers, it can be helpful when they are in temporary shortage. It is an early stage of the trial for cooperation, but we expect this type of cooperation will be more fruitful in the future.

CONSTRAINTS

Technological Limits

Technology is rapidly developing, and it is hard to keep up with the speed to utilize it in airport operation. Sometimes, we may find that the development of technology is not sophisticated enough in the details. As an airport operator, it may not be very reassuring in the initial phase. As the airport operator, when we adapt and operate new systems and services, we should find improvements and customize the solution for situations as the technology keeps evolving.

For example, Air Porter has a 'follow-me' function, by which the image tracking technology allows Air Porter to follow the passenger as he/she registers his/her figure. Air Porter remembers the figure and follows the passenger with the image tracking algorithm; however, it might lose the figure and not be able to follow the passenger correctly. Although the technology combination of robot and image tracking is still not mature enough, it is expected to have enormous potential in the future. Amendments and upgrades need to be made as the technology evolves.

Policy Limits

Airports are regarded as one of the most highly secured places. It may be difficult to introduce state-of-the-art technology within the circumstance as it often confronts security and safety matters. Some people feel that artificial intelligence and deep learning are significantly vulnerable in the early stages. Most government agencies take on a conservative approach regarding technology, and it may be challenging to persuade and work together to introduce new systems or services. Internally, the importance of cooperative decision-making is essential as there may be challenging views between departments.

Cost Limits

If we had an unlimited budget, there should be no problem. In reality, we have to prioritize objectives and goals due to a limited budget and amend our plans according to the situation. We try to achieve the best outcome possible within the given situation, but there are always areas to improve when operating new systems or services.

For example, Air Porter depends only on LiDAR technology when it recognizes the surrounding environment and decides its route. Compared to Airstar (Guidance Robot of Incheon Airport), the self-driving technology and map accuracy of Air Porter is a bit lower as Airstar uses multiple sensor systems, LiDAR and camera sensors combined. For this case, we had to find the right balance, since more sensors means more expensive robots. These experiences gave us insights into the budget and the project size for further consideration.

Operational Limits

You learn and get to know some new elements by operating new services for a certain amount of time. From the operation of Air Ride and Air Porter, we realized that we need to look more closely to needs of passengers with reduced mobility. In the future, we expect to have a more delicate approach to the different segments: elderly passengers, pregnant women, families with infant(s), persons who are blind or not comfortable walking long distances. Finally, to embrace all kinds of passengers, we must keep upgrading to make these systems and services more accessible to those who feel digitally disadvantaged.

Furthermore, we found some interesting results from the operation of the autonomous rides. More foreigners and families with young children will use Air Ride and Air Porter. The survey conducted showed that many Koreans do not want to receive attention in public, while foreigners and young children are relatively fine with such attention. We are now considering how to make these services more accessible to more passengers in the future.

TECHNOLOGY, PROCESS, and INFRASTRUCTURE REQUIRED

In the future, we plan to consider the following elements listed below when proceeding with similar initiatives:

Infrastructure: Robot Docking Station

As every robot needs its exclusive docking station, greater space is necessary for robots. Therefore, if the airport operator plans to operate many robots in one area, they need to check whether there is enough space for the same number of robot docking stations. Once the multi-docking system is available, the problem will be resolved, but this technology is not mature enough for use in public areas.

Infrastructure: Robot Control System

Similar to the robot docking station, most robots have their own control system. However, the operator needs to consider an integrated robot control system to operate more than two types of robots. For the operators, it makes the robot operation much more manageable than with separated control systems.

Process: Safety Standards

Since the airport is a very crowded area, all robots should satisfy the safety conditions. ISO 13482 is a well-known safety standard for service robots. Before introducing a new robot, the operator must check in advance if these satisfy all safety conditions, including physical and electrical risks.

LESSONS LEARNED

From Trial to Main Business

When new technology is implemented in the airport, numerous barriers will be encountered. It may be a challenge to persuade various stakeholders to accept the concept, purpose, and necessity of introducing fascinating technologies in an airport environment. Although feasibility and sustainability would be good reasons for its introduction, the main reasons should be the safety and stability of the systems and services in place. Both enhancing operational efficiency and increasing passenger satisfaction (upgrading passenger service) were considered for the Air Ride and Air Porter projects; however, increasing passenger service was the main driver for their implementation.

Some people tend to be anxious or afraid when they are confronted with new experiences. There is a need for extra caution when the human factor is involved. As expected, when comparing Air Ride with Air Porter, passengers and stakeholders were found to show less resistance to the later, since they were transported together with all their belongings.

The Air Ride project faced more resistance from its early stages as it was the first trial of self-driving mobility in the airport terminal. Nevertheless, we know from our own experience that once people got used to it, they realized that it is not a big deal. Many were worried about unexpected accidents, but there have been none so far. We managed the settings very conservatively to prevent any inconvenient accidents. These robots and services are gradually becoming familiar to many users and stakeholders, which is very helpful to proceed with other similar projects relatively smoothly.

Importance of the Operational Concept and Maintenance

As an airport operator and public company, we have to consider national, legal, and institutional rules and policies when proceeding with projects.

Every system and service need to take into account operational concepts and maintenance procedures, and the importance of this consideration is growing even more nowadays. The trends are changing fast, technologies are rapidly developing, and their cost and size are considerably high. During the planning stage, we consider as many options and concepts as possible to facilitate the best performance, yet the output turns out in many different ways.

For example, while creating the Air Ride concept, the design got bigger than the original plans because we thought it was essential to secure enough space for luggage. However, the operational results showed a different pattern. Passengers did not put their luggage in the separate space in the back of the Air Ride if their hands or seats were not fully occupied. They took their luggage on their seat to conveniently walk in or out of the vehicle.

Furthermore, many users were travelling solo or in pairs. This data indicated that we could implement autonomous personal mobility to target one or two persons, thus reducing the luggage space and creating a smaller device with better manoeuvrability that could navigate through any narrow corridors of the airport. We can use this data as grounds for planning a new project for self-driving personal mobility aid.

Finally, maintenance is an important part that we need to consider. Many areas are very sophisticated and specific. It is a challenge to know and cover all details for general operators or software technicians. Especially with these new technologies, the dependence on manufacturers is increasing. It is crucial to consider this aspect more than ever to operate smoothly and sustainably.

PICTURES AND VIDEO



Air Porter (Cart Robot)



Air Ride (Autonomous indoor shuttle)



Airstar (Guidance Robot)

ICN video Meet Air Star, Air Porter and Air Ride, the Smart Robot Trio that will make your travel comfortable based on the cutting-edge 4th industry technology [https://www.youtube.com/watch?v= PWsGXzNu4](https://www.youtube.com/watch?v=PWsGXzNu4)