International Civil Aviation Organization

Eighth Meeting of the Aerodromes Operations and Planning Sub-Group (AOP/SG/8)

Bangkok, Thailand, 15 to 19 July 2024

Agenda Item 7: Airport Innovation and Technology

INITIAL STUDY ON AIRPORT OPERATION INNOVATION

(Presented by Republic of Korea)

SUMMARY

Airports, with their large onsite workforces, are particularly vulnerable to human error, and the shortage of skilled staff following pandemic outbreaks has increased safety incidents and security concerns. To address these challenges, the Korea Transport Institute (KOTI), in collaboration with the Ministry of Land, Infrastructure, and Transport, airport operators, ground handling service providers, and innovative startups, is conducting integrated research to enhance airport safety and efficiency by transforming operations through digitalization and automation. This initial study outlines goals, key focus areas, and implementation phases.

1. INTRODUCTION

1.1 Despite being complex systems where various advanced technologies are integrated seamlessly, airports still rely heavily on large onsite workforces, making them vulnerable to human error. Increasing air travel demand during the aviation recovery period, coupled with layoffs of skilled staff during pandemics and high turnover rates, has heightened safety incidents and security concerns.

1.2 The unforeseen COVID-19 pandemic has emphasized the critical importance of sustainability and resilience in the airport industry. The rapid advancement of technology is already transforming airport operations. Innovations in artificial intelligence and automation demand new concepts beyond traditional airport operation models. As the pace of technological development accelerates, these demands will continue to grow.

1.3 In response, KOTI, in collaboration with the Ministry of Land, Infrastructure, and Transport, airport operators, ground handling service providers, and innovative startups, is conducting integrated research to enhance airport safety and efficiency by transforming operations through digitalization and automation. By referencing IATA, ACI, and other Member States' cases, KOTI aims to utilize advanced technologies such as autonomous driving, robotics, biometrics, AI, IoT, and big data analytics. The goal is to maximize efficiency, reduce safety incidents, and improve the quality of passenger services through digitalization and automation of airport operations. This initial study outlines key focus areas and implementation phases.

2. DISCUSSION

Key Focus Areas

2.1 Three key focus areas have been identified to drive innovation in airport operations: ground handling and cargo terminal, airport operations, and passenger services.

- Ground Handling and Cargo Terminal: To minimize manual intervention and enhance efficiency in baggage handling processes, several innovative technologies and processes will be implemented. Robotic process assistance and baggage lifting assistive devices will be utilized. Passenger boarding bridge operations will be automated to reduce human error. Autonomous driving technology will be introduced to cargo tug cars and aircraft towing systems to achieve unmanned handling of baggage, cargo, and ground operations. Additionally, an advanced cargo terminal testbed will be operational, capable of automatically handling cargo weight and volume measurement, security screening, packing, loading and unloading, and enabling real-time cargo tracking and information sharing. Further innovations include AI-powered systems for optimizing cargo storage and retrieval, automated guided vehicles (AGVs) for transporting cargo within the terminal, and advanced sensor networks for monitoring the condition and security of cargo in real-time. These systems will be integrated to provide a seamless and efficient cargo handling process, reducing delays and improving overall operational efficiency.

- Airport Operations: To revolutionize airport operations, several advanced technologies and innovations will be adopted. A digital apron tower will be implemented to manage aircraft movements and ground operations more efficiently and safely. AI and real-time data analytics will be utilized to optimize aircraft turnaround processes, reducing delays and improving operational efficiency. Remote centralized image processing will be adopted for security checks and monitoring, enhancing the speed and accuracy of threat detection. An AI-based preventive safety management system will be operated to predict and mitigate potential safety hazards before they occur. Autonomous driving technology will be applied to airport security patrol vehicles, improving surveillance and response times, and autonomous snow removal vehicles will be implemented to ensure efficient and timely clearing of runways and taxiways. Additionally, digital twins of airport infrastructure and operations will be created to simulate, analyze, and optimize airport performance and planning.

- Passenger Services: To enhance passenger services, several innovative technologies and processes will be implemented. Self-service and contactless systems will be used for security screening, immigration, and boarding by utilizing biometrics. Advanced security screening technologies, such as CT scanners and AI-powered threat detection systems, will be deployed to increase the speed and accuracy of security checks while minimizing the need for manual inspections. Customized guidance based on individual passengers' itineraries will provide queue-free services, enabling hands-free travel throughout the end-to-end journey. Off-airport baggage check-in will be expanded with electronic baggage tags. Autonomous on-demand systems will be deployed for airport access transportation, mobility aids for people with disabilities, and baggage carts. Additional innovations include AI-powered digital assistants to assist passengers with real-time information and personalized support, augmented reality (AR) navigation to guide passengers through the airport, smart luggage tracking systems for real-time monitoring of luggage via mobile apps, and virtual queuing systems allowing passengers to reserve their place in line for security and other services via mobile apps.

Implementation Phases

2.2 Short-term: Actively utilizing various available technologies to transition from labor-intensive traditional airport operations to systematized and digitalized methods. This phase focuses on improving efficiency and safety in the initial stages of airport operations by implementing digital tools, automation of routine tasks, and enhancing data analytics capabilities.

2.3 Medium-term: Implementing innovative airport operational concepts where humans, robots, and AI systems collaborate in relatively less complex domestic airports or small international airports. This phase aims to realize partial automation, allowing for the testing and optimization of the automated airport operational model. Emphasis will be placed on refining the integration of advanced technologies and ensuring seamless cooperation between human workers and automated systems.

2.4 Long-term: Developing fully automated airport operations where all processes related to aircraft, passengers, and cargo are system-based, with necessary energy being self-produced. This phase aims to achieve the highest efficiency and sustainability in airport operations by integrating renewable energy sources, advanced AI, and comprehensive automation systems. The ultimate goal is to create a resilient and highly efficient airport ecosystem that can adapt to future challenges and demands.

Challenges: Ensuring Sustainability

2.5 Digital innovation in airport operations requires substantial energy consumption for fast and constant information exchange networks and large data storage. Therefore, securing energy sources necessary for the future airport transition is also a critical consideration.

2.6 To achieve carbon-neutral airport operations, the ROK will expand the development and production of renewable energy, such as solar and geothermal energy, in and around airport areas, and increase the installation of energy storage systems (ESS). High-capacity battery ESS solutions will ensure a stable power supply to meet airport demands, integrated with solar panels and geothermal power systems to maximize efficient use of eco-friendly energy. This will enhance the energy efficiency of airport operations and minimize carbon emissions, achieving sustainable airport operations.

3. ACTION BY THE MEETING

3.1 The meeting is invited to note the information contained in this paper, provide feedback and suggestions for further enhancing this initial study to ensure successful implementation and foster international cooperation in advancing airport operations through shared insights and collaborative efforts.

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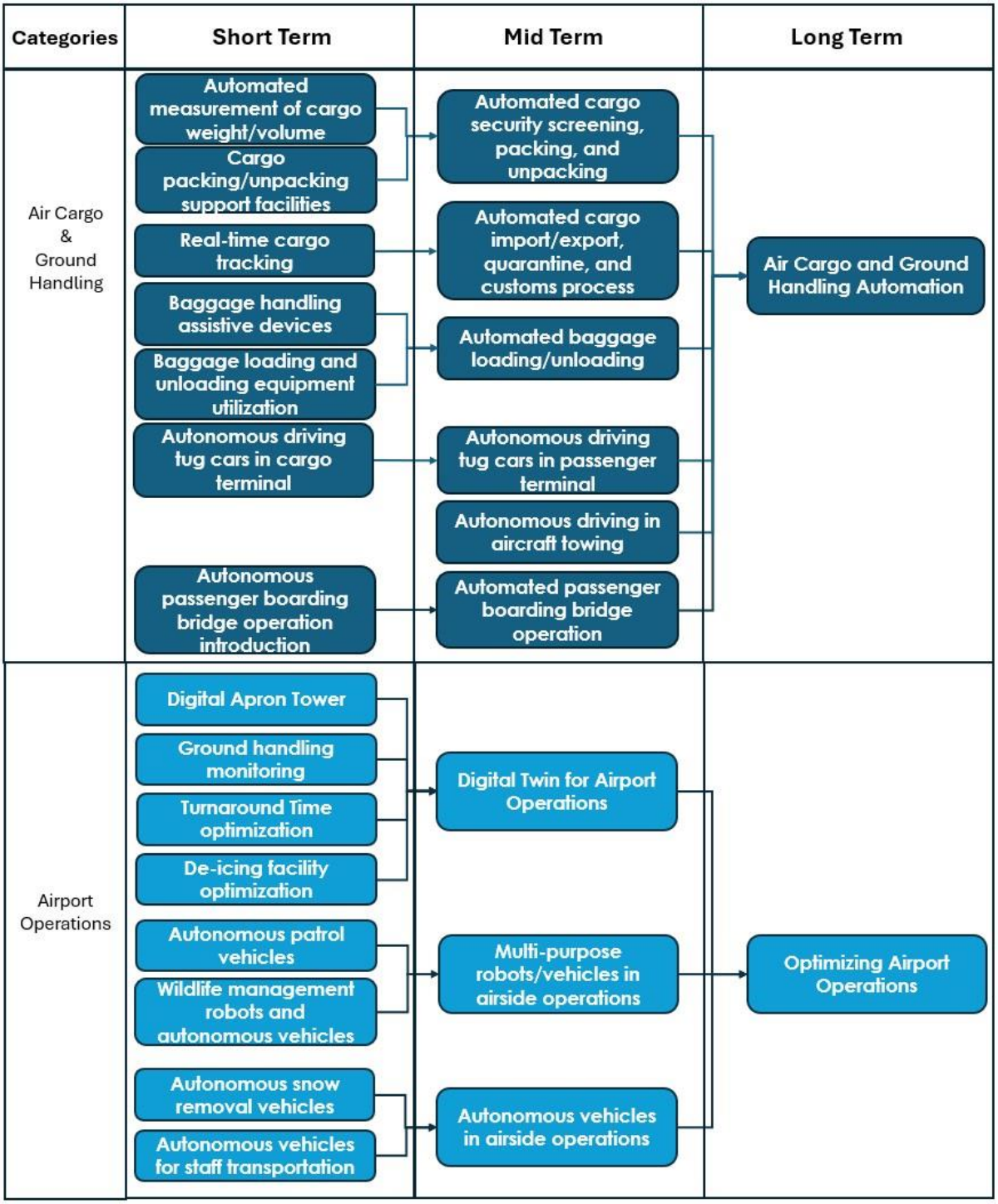
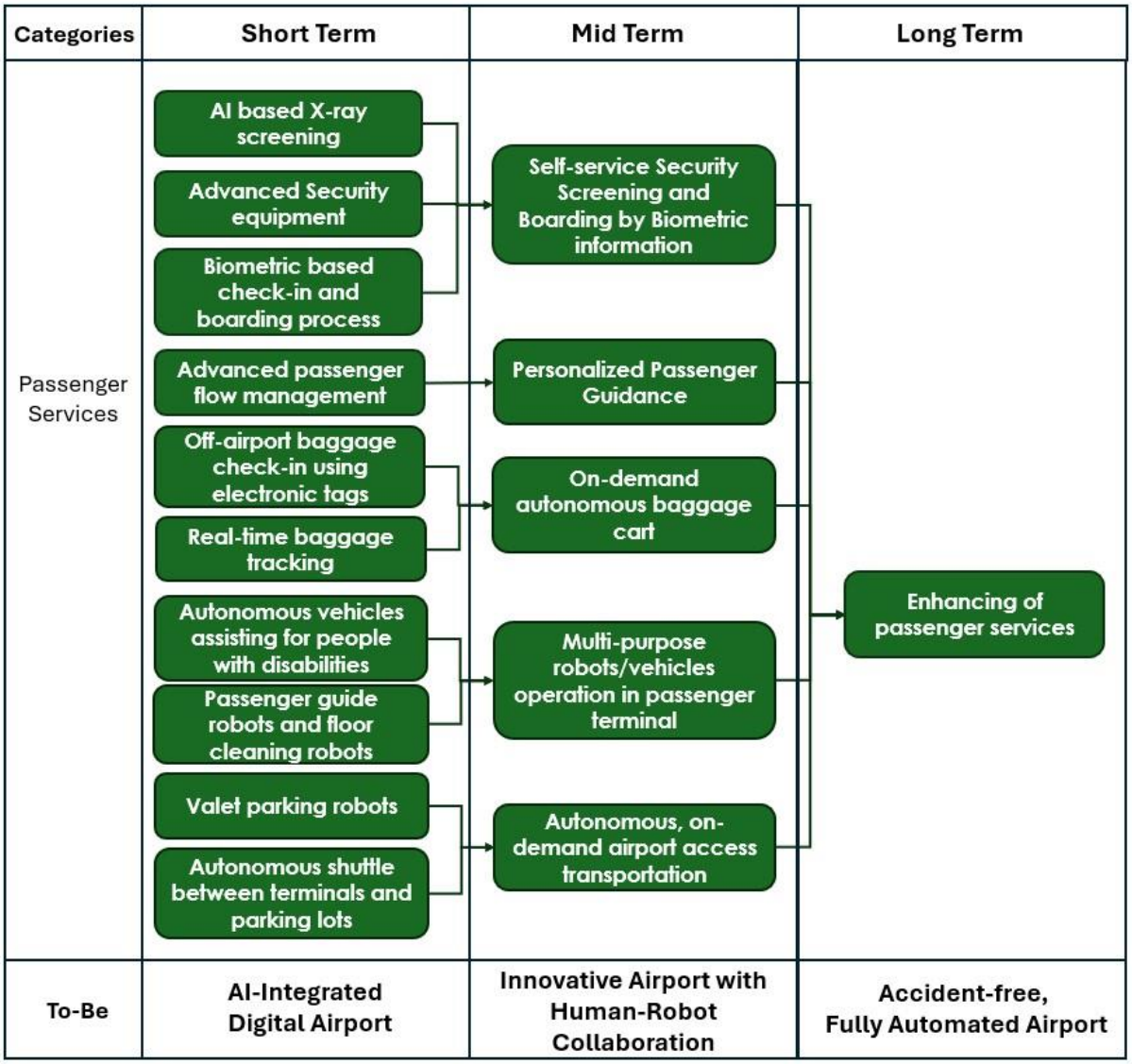
Appendix: Implementation Phases for Airport Operation Innovation




Categories
Short Term
Mid Term
Long Term
Passenger Services
AI based X-ray screening
Advanced Security equipment
Biometric based check-in and boarding process
Advanced passenger flow management
Off-airport baggage check-in using electronic tags
Real-time baggage tracking
Autonomous vehicles assisting for people with disabilities
Passenger guide robots and floor cleaning robots
Valet parking robots
Autonomous shuttle between terminals and parking lots
Self-service Security Screening and Boarding by Biometric information
Personalized Passenger Guidance
On-demand autonomous baggage cart
Multi-purpose robots/vehicles operation in passenger terminal
Autonomous, on-demand airport access transportation
Enhancing of passenger services
To-Be
AI-Integrated Digital Airport
Innovative Airport with Human-Robot Collaboration
Accident-free, Fully Automated Airport

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