A STUDY ON OPERATION CONCEPT FOR NEXT GENERATION AIR VEHICLES IN KOREA

February 20, 2013

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1. INTRODUCTION
1. INTRODUCTION

- Entry of an aging society
- Improving income levels & Borderless globalization
- International network system
- Digital economy
- Convergence & complexity of technologies

Increase of Personal Mobility

Increased Anxiety about the Disaster

Expectation of Increased Level of Safety

Increase of Social Mobility

Activated Leisure

Source: Master Plan of Construction and Transportation Technology R & D projects (KICTEP)
1. INTRODUCTION

Air traffic growth
average annual rate : + 7.3%

Air traffic delays
Operational efficiency and aviation safety

Overland traffic congestion
Emergence of PAV

Problems due to traffic congestion

Transport efficiency
Increased traffic congestion costs

- Limited road conditions, traffic congestion → Moving speed lower/ fuel consumption increased
  - Cost of road traffic congestion : ~ $24 billion (2008 in Korea)
  - Total population : 48.5 m (2008)
  - Annual Traffic congestion cost : 50 $/person
  - No. of Vehicle Registration : 16.4 m (2008)
  - Annual Traffic congestion cost : 150 $/vehicle

Cost of road traffic congestion : ~ $24 billion (2008 in Korea)
1. INTRODUCTION

**Number of vehicles registration**

![Number of vehicles registration chart](chart.png)

Source: The ROK Ministry of Land Transport and Maritime Affairs

**Annual Traffic Congestion Cost**

![Annual Traffic Congestion Cost chart](chart.png)

Source: The ROK Ministry of Land Transport and Maritime Affairs
1. INTRODUCTION
2. TRENDS OF PAV DEVELOPMENT
2. TRENDS OF PAV DEVELOPMENT

International Trend

- **NASA Concept of PAV**
  - In the 2005 Centennial Challenge initiative in conjunction with the CAFE Foundation, NASA has proposed the definition of a PAV as follows:
    - Seats 2 to 6 passengers, 240–320 km/h cruising speed
    - Quiet, comfortable and reliable
    - Able to be flown by anyone with a driver’s license
    - As affordable as travel by car or airliner.
    - Near all-weather capability enabled by synthetic vision systems
    - Highly fuel efficient (able to use alternative fuels).
    - 1,300 km range.
    - Provide "door-to-door" travel capabilities

- **AGATE/PAVE/SATS programs**
  - AGATE and PAVE programs performed by NASA for developing the core technologies of small aircrafts to provide safer, more convenient and comfortable air transport
  - SATS Program performed by FAA applying free flight concept for point to point air transport
2. TRENDS OF PAV DEVELOPMENT

- **NextGen**
  - JPDO (Joint Planning and Development Office) set up in 2005
  - To cope the air traffic demand of 2-3 times increase up to 2025
  - Air traffic infrastructure implementation plan
  - To improve safety and capacity of Airspace and Airport

Source: FAA NextGen
2. TRENDS OF PAV DEVELOPMENT

International Trend

- SESAR (Europe)
- Key Performance Targets in 2020
  - To enable 3 times increase in capacity
  - To improve safety 10 times
  - To reduce by 10% environmental impact per flight
  - To cut ATM cost by 50%

Source: SESAR In Brief, General Overview, 2009

- CARATS (Japan)

SESAR, an ambitious phased programme

→ The SESAR Definition Phase (2005-2008) delivered the SESAR ATM Master Plan. It was developed by a representative group of ATM stakeholders. The plan, based on future aviation requirements, identified the actions, from research to implementation, needed to achieve SESAR goals.

→ The SESAR Development Phase (2008-2013) will produce the required new generation of technological systems, components and operational procedures as defined in the SESAR ATM Master Plan and Work Programme.

→ The SESAR Deployment Phase (2014-2020) will see the large-scale production and implementation of the new air traffic management infrastructure, composed of fully harmonised and interoperable components guaranteeing high-performance air transport activities in Europe.
2. TRENDS OF PAV DEVELOPMENT

- **KOREA AEROSPACE RESEARCH INSTITUTE (2010)**
  - Preliminary study on PAV has been performed under the program of the ROK Ministry of Knowledge Economy (MKE).
  - Roadmap for the development of PAV has been set up to 2030 focused on the development of air vehicles.

- **THE KOREA TRANSPORT INSTITUTE (2011)**
  - Master plan study on the infrastructure for the PAV operation has been performed under the program of the ROK Ministry of Land Transport and Maritimes Affairs.
  - Operating type of PAVs has been classified into 2 modes.
  - Operation concept for the near-term, the mid-term and the long-term has been developed in the frame of the development stage of PAVs.
3. OPERATION CONCEPT FOR NEXT GENERATION AIR VEHICLES

3.1 Scenario for PAV Operation
3.2 Phase 1 operation concept
3.3 Phase 2 operation concept
3.1 Scenario for PAV Operation

**Conventional take-off and landing PAV**
- Mainly flying, possible to drive
- Operated environment friendly/economically
- Relatively long-haul flight

**Short/Vertical take-off and landing PAV**
- High space-utilization
- Operated simply
- More expensive than CTOL

Image sources: Terrafugia Transition, Paul Moller’s skycar etc.
## 3.1 Scenario for PAV Operation

<table>
<thead>
<tr>
<th></th>
<th>Phase 1</th>
<th>Early Phase 2</th>
<th>Late Phase 2</th>
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</thead>
<tbody>
<tr>
<td><strong>Type of PAV</strong></td>
<td>CTOL</td>
<td>STOL+VTOL</td>
<td>STOL+VTOL</td>
</tr>
<tr>
<td><strong>Operation Mode</strong></td>
<td>Single Mode</td>
<td>Single Mode</td>
<td>Dual Mode</td>
</tr>
<tr>
<td><strong>Accessibility</strong></td>
<td>City to City</td>
<td>Zone to Zone</td>
<td>Door to Door</td>
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<tr>
<td><strong>Airfield Size</strong></td>
<td>PAV airfield with runway</td>
<td>Vertical take-off and landing airfields (reduced in size), building rooftops, etc.</td>
<td>Private residential yards, building rooftops, etc.</td>
</tr>
<tr>
<td><strong>ATS</strong></td>
<td>Manned</td>
<td>Unmanned</td>
<td>Unmanned</td>
</tr>
<tr>
<td><strong>Pilot</strong></td>
<td>Manned</td>
<td>Manned</td>
<td>Manned (Road)/Automated (Sky)</td>
</tr>
</tbody>
</table>
3.2 Phase 1 operation concept

- **“See and Avoid” Operational Concept**
  - Similar to the operation for the light aircraft and ultra-light aircraft.
  - Visual flight rules and air traffic services with current air traffic control procedures.
  - Conventional infrastructure: aerodromes, taking-off and landing facilities, designated airspace for light and ultra-light aircrafts in Korea.
3.3 Phase 2 operation concept

- Door to Door
- Unmanned Control Tower
- Unmanned pilot
- Manned pilot
- Automatic en-route flight
- Airfield entry and Unfolding wings, Takeoff
- Satellite based Surveillance
- Landing, Folding wings and drive on the road
- Vertical Takeoff on Own yard
- Vertical Landing on Own yard

- "Detect, Sense and Avoid "Operational Concept
  - Ultimately, based on the concept and technologies for free flight.
  - Concept of highway in the sky with automatic air traffic service
  - Operated in vertical taking-off and landing mode and both on the ground and in the air.
4. CONCLUSION
4. CONCLUSION

- Emergence of New means of transportation
  - Traffic congestion, New technologies, Convergence of vehicle + aircraft
  - Types of PAV operation
    - Single mode (flying only)
    - Dual mode (flying and driving)

- Operation Concept
  - Operation concept for PAVs
    - Phase I (short term) : “see and avoid” under controller’s ATS
    - Phase 2 (long term) : “detect, sense and avoid” under automatic ATS
  - Accessibility to Destination improved (door to door).
Thank You!

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