Developing Airport Business: the key role of pavements in airfield investments

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Dimitrios J. Dimitriou
Professor Asst, DUTH
BoD Chairman, Athens International Airport

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Presentation outline

✔ Corporate view: Pavements in Airfield
  • Role in Decision making
  • Assessment concept

✔ AIA Case study: Key technical & operational characteristics
  • Airfield Pavements Maintenance & Management
  • Airport Development Agreement / Master Plan considerations
  • Airside pavements - current status & foreseen expansions

✔ Discussions
  • Future trends / R&D
Pavements in Airfield: the Corporate view
Transport Airport Corporate Decision Making Equilibrium

**Strategy**
- Market Development
- Governance structure
- Funding - new investments
- Social impact and CSR

**Planning**
- Capacity – New Infrastructure
- CAPEX control
- Business Resilience & Sustainability
- Business Development

**Innovation**
- Technology - Products – Materials – Services
- Smart business
- Adaptation/mitigation
- Research – R&D

**Competitiveness**
- Business regulation – protection
- Competition Regulatory framework
- Monitoring/Review performance
- Analysis of the competition

Dimitriou, 2017, IJESRT, 6(1)
Key variables influence transport infrastructure business

- Regulatory framework
  - Privatization and ownership
  - Deregulation
  - Environmental and safety restrictions
  - Geopolitical and safety restrictions

- Infrastructure capability
  - Infrastructure capacity expansion
  - New infrastructure construction
  - Traffic management

- Carrier strategy
  - Carriers hubs /national carriers
  - Carriers alliances
  - Low-Cost Carriers Demand Stimulation

Dimitriou, 2017; IJESRT, 6(1)
Key question in strategic planning and decision making

Equilibrium??

Financial analysis

Added value to CAPEX

Dimitriou 2017; IJRSM, 4(3)
CAPEX Impact Assessment - General Framework

- Socioeconomic Analysis
- Multivariable Assessment

- Financial analysis
- Technical Analysis

- Payback
- NPV
- ROI
- IRR

- Social benefits
- User Benefits
- Welfare
- Environmental Auditing
- Qualitative Risk analysis
- Probabilistic cost analysis

Dimitriou 2017; IJESRT, 6(1)
### Influencing Demand

**Key Strategies**
- Connectivity
- Carriers
- Demand patterns

**Key Challenges**
- Type of Aircraft
- Aircraft impact
- Incentives

### Mega infrastructures as a ‘private’ Company

**Key Strategies**
- Efficiency (operation)
- Performance (profitability)
- Marketing

**Key Challenges**
- CAPEX
- OPEX
- Investor’s appraisal

### Management

**Key Strategies**
- Risk sharing
- Cost control
- System of System approach

**Key Challenges**
- Unit cost
- Capacity/Utilization/life cycle
- Auditing
Pavements and Airport Corporate actions
AIA Case study
AIA is a pioneer PPP greenfield project

- 1996-2026 concession contract (ADA)
- ADA ratified as Law 2338/95, provides for extension
- A 2.2 billion Euro Project - 60% funded by commercial debt
- User recovery principle - Dual till regulation
- AIA is run by a Board of Directors:
  (4) Private Shareholders
  (4) Greek State
  (1) Independent (by parties’ consensus, otherwise appointed by EIB)
- AIA is “managed and operated as a commercial, profit-making company in the private sector”

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hellenic Republic Asset Development Fund</td>
<td>30.00%</td>
</tr>
<tr>
<td>Greek State</td>
<td>25.00%</td>
</tr>
<tr>
<td>AviAlliance</td>
<td>26.67%</td>
</tr>
<tr>
<td>AviAlliance Airport Capital</td>
<td>13.33%</td>
</tr>
<tr>
<td>Copelouzos Family</td>
<td>4.99%</td>
</tr>
<tr>
<td>Greek state Investors/Private sector</td>
<td>55%</td>
</tr>
</tbody>
</table>
Greek GDP and AIA Passenger Traffic disconnected

- Greek GDP a valid index of passenger traffic development up to 2013
- Since 2014 passenger traffic “decoupled” from the GDP trend

Greek GDP Growth 2010-2015 Actual Figures: source Eurostat
Greek GDP Growth 2016 projection: Economist Intelligence Unit, Jan 2017 - “Country Forecast Report, Greece”
Fluctuation of Economic Impact of Air Transport in Greece

Air Transport economic impact in Greece

Dimitriou et al., ICTR 2017

Current prices

<table>
<thead>
<tr>
<th>Year</th>
<th>Catalytic impact in GDP</th>
<th>Induced impact in GDP</th>
<th>Indirect impact in GDP</th>
<th>Direct impact in GDP</th>
<th>Total GDP (market prices)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>120,000</td>
<td>60,000</td>
<td>30,000</td>
<td>20,000</td>
<td>230,000</td>
</tr>
<tr>
<td>2010</td>
<td>100,000</td>
<td>50,000</td>
<td>25,000</td>
<td>15,000</td>
<td>190,000</td>
</tr>
<tr>
<td>2012</td>
<td>90,000</td>
<td>45,000</td>
<td>22,500</td>
<td>12,000</td>
<td>170,500</td>
</tr>
<tr>
<td>2014</td>
<td>80,000</td>
<td>40,000</td>
<td>20,000</td>
<td>10,000</td>
<td>160,000</td>
</tr>
<tr>
<td>2016</td>
<td>70,000</td>
<td>35,000</td>
<td>17,500</td>
<td>8,500</td>
<td>153,000</td>
</tr>
</tbody>
</table>
Key operational and technical characteristics
2 RWYs (4km & 3.8km respectively)
13 TWYs with 2 Aircraft Bridges

- ASPHALT Pavements  1,800,000 m²
- CONCRETE Pavements  1,100,000 m²
Width: RWYs 60m, TWYs 44m
Distance between: RWY and main TWY 195m
11 GSE areas within APRON

primary and secondary TWY 100m
Flexible pavements differ from rigid pavements in terms of load distribution.

In flexible pavements load stresses are distributed to the substrates, hence design failure is vertical strain in the subgrade.

In rigid pavements load stresses are mostly carried by the concrete slab and design failure is slab cracking.
Flexible (Bituminous) Pavement
- Hot Mixed Asphalt Surface 25cm
- Cement Treated Base Course 30cm
- Selected Material Sub-base Course 40cm
Total: 95cm

Rigid (Concrete) pavement
- Portland Cement Concrete Course 43cm
- Cement Treated Base Course 12cm
- Selected Material Sub-base Course 15cm
Total: 70cm

The following FAA Design criteria were considered
- Design Aircraft B747-400, Gross Weight 400tns (450tns for Bridges)
- 37,500 Annual Departures for RWYs and 45,000 for TWYs
- Road Class: D
- Category: IV
- Sub-grade CBR: 9
a Pavement performs well for the majority of its life, after which it reaches a “critical condition” and begins to deteriorate rapidly;

maintaining and preserving a pavement in “good condition” versus rehabilitating a pavement in “poor condition” is 4 to 5 times less expensive and increases pavement life.
an effective Pavement Preservation program addresses pavements while they are still in good condition and before any serious damage occurs;

the cumulative cost of the series of Pavement Preservation treatments is substantially less than the cost of the more extensive, higher cost of reconstruction and generally more economical than the cost of major rehabilitation.
High construction – Low maintenance costs

- Overall construction cost of ~€330M - 15% of airport’s investment.
- Low maintenance expenses at ~ €80K annually.
- Construction & maintenance costs are being recovered by landing and parking fees.
Airfield Pavements Management & Maintenance
Pavement Maintenance - Why & How?

✓ ICAO Annex 14-Aerodrome maintenance-Pavements
   The surfaces of all movement areas including pavements (runways, taxiways and aprons) and adjacent areas shall be inspected and their conditions monitored regularly as part of an aerodrome preventive and corrective maintenance programme.

✓ ICAO Airport Services Manual Part 9 - Airport Maintenance Practices
   Maintenance includes measures to keep or restore the operational function as well as measures to check and to evaluate the present function of an element.

✓ Why manage Airfield Pavements:
   to prevent severe deterioration of the pavement;
   to minimize risk of damage to aircraft;
   to identify pavement distresses for rehabilitation and budget planning purposes

✓ The basic maintenance services:
   Inspection
   Repair & Overhaul
Applying the right treatment at the right time

✓ FAA AC 150/ 5380-7B
   ➤ A PM Program provides a consistent, objective, and systematic procedure for establishing facility policies, setting priorities and schedules, allocating resources and budgeting for pavement maintenance and rehabilitation.

✓ Transport Canada AC 302-016
   ➤ A PM System is a set of defined procedures for collecting, analysing, maintaining and reporting pavement data to assist airport operators in finding optimum strategies for maintaining pavements in a serviceable condition for the least cost.
Aircraft movements evolution

Significant growth in aircraft movements recorded in the recent years, increasing the utilization of the pavement system

<table>
<thead>
<tr>
<th>Year</th>
<th>Aircraft movements (in ‘000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>188.7</td>
</tr>
<tr>
<td>2015</td>
<td>176.2</td>
</tr>
<tr>
<td>2014</td>
<td>154.5</td>
</tr>
<tr>
<td>2013</td>
<td>140.4</td>
</tr>
<tr>
<td>2012</td>
<td>153.3</td>
</tr>
<tr>
<td>2011</td>
<td>173.3</td>
</tr>
</tbody>
</table>
**Routine maintenance**

- Preservation of the pavement to achieve the design life
- Consists of work planned and performed on a regular basis
  - Daily inspections
  - Yearly crack sealing
  - Partial depth spall repair
AirPave Management System

✓ A tool to manage pavements and optimize maintenance budgets.
✓ Gives detailed information on pavement condition.
✓ Provides documentation for management decision making.
“AirPave Management System 5.0” is:

- used in many international airports (Athens, Copenhagen, Newcastle, Sydney, Lisbon, Vienna, etc.);
- implemented in AIA since 2006;
- performed every year in all Airfield Pavements.
Airside Pavements have been divided into 426 sections:

- Runways : 31 sections
- Taxiways : 232 sections
- Aprons : 98 sections
- Service roads and GSE areas : 65 sections
AirPave inputs

- Pavement geometry & structure
- Traffic
- Measurements (friction, roughness, laboratory tests, FWD)
- Visual distress survey
AirPave Outputs

- Structural (bearing capacity)
- Functional (ride quality)
- Wearing course (condition of the surface)
Pavement Condition is assessed through KPIs

100% = perfect

70% = maintenance required
Life Cycle Reporting & Forecasting Tool

Course of pavement condition 2016 - 2026

Functional Condition in %

<table>
<thead>
<tr>
<th>Condition</th>
<th>Condition now</th>
<th>In 5 years</th>
<th>In 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>93.3</td>
<td>82.8</td>
<td>53.8</td>
<td></td>
</tr>
<tr>
<td>6.2</td>
<td>16.3</td>
<td>43.6</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>0.1</td>
<td>46.6</td>
<td></td>
</tr>
</tbody>
</table>

Wearing Condition in %

<table>
<thead>
<tr>
<th>Condition</th>
<th>Condition now</th>
<th>In 5 years</th>
<th>In 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>47.0</td>
<td>22.6</td>
<td>22.6</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>12.5</td>
<td>84</td>
<td></td>
</tr>
<tr>
<td>16.6</td>
<td>4.8</td>
<td>58.4</td>
<td></td>
</tr>
</tbody>
</table>

Structural Condition in %

<table>
<thead>
<tr>
<th>Condition</th>
<th>Condition now</th>
<th>In 5 years</th>
<th>In 10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.2</td>
<td>39.3</td>
<td>54.3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>21.1</td>
<td>68.1</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2.07</td>
<td>18.1</td>
<td></td>
</tr>
</tbody>
</table>

Condition (<=) | 100 | 90 | 80 | 70 | 55 | 40 | 20 | 0 |
Structural Condition 2016

- Very good -
Functional Condition 2016

Very good
Wearing Course Condition 2016 (above 80%)

- Very good
All KPI’s > 80%, v. good pavement condition

Not Our Case...

As shown above airfield pavements are performing well with the overall condition being maintained at high levels.

As a rule of thumb, flexible pavements typically require rehabilitation in 15 to 20 years (asphalt milling and overlaying), while the life expectancy of rigid pavements is 40 years.

So far no problems were faced with either type of pavement, with maintenance interventions being limited to minor repairs and friction course restoration.
Airport Development Agreement / Master Plan considerations
Process for Airport Expansion

- ADA Article 19 foresees an evaluation of the need to implement Airport Expansion, once demand exceeds certain capacity thresholds (usually referred to as “trigger points”)

- ADA identifies five capacity parameters:

<table>
<thead>
<tr>
<th>Capacity Parameter</th>
<th>Design Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Terminal Facilities</td>
<td>Annual &amp; Hourly</td>
</tr>
<tr>
<td>Runway Capacity</td>
<td>Daily &amp; Hourly</td>
</tr>
<tr>
<td>Aircraft Parking</td>
<td>Hourly</td>
</tr>
<tr>
<td>Freight</td>
<td>Annual</td>
</tr>
<tr>
<td>Mail</td>
<td>Annual</td>
</tr>
</tbody>
</table>
The Capacity triggers are set at 90% of respective Design Capacity levels

<table>
<thead>
<tr>
<th>Capacity Parameter</th>
<th>Trigger Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Terminal Facilities</td>
<td>Passengers exceed 90% of ADC in 12 calendar months</td>
</tr>
<tr>
<td></td>
<td>Passengers exceed 90% of HDC for more than 250 hrs during the 4 busiest months in a 12 month period</td>
</tr>
<tr>
<td>Runway Capacity</td>
<td>Movements exceed 90% of DDC for more than 50 days during the 4 busiest months in a 12 month period</td>
</tr>
<tr>
<td></td>
<td>Movements exceed 90% of HDC for more than 250 hrs during the 4 busiest months in a 12 month period</td>
</tr>
<tr>
<td>Aircraft Parking</td>
<td>Aircraft parking stand (with certain requirements) demand exceeds 90% of HDC for more than 250 hrs during the 4 busiest months in a 12 month period</td>
</tr>
<tr>
<td>Freight</td>
<td>Tonnes of freight exceed 90% of ADC in 12 calendar months</td>
</tr>
<tr>
<td>Mail</td>
<td>Tonnes of mail exceed 90% of ADC in 12 calendar months</td>
</tr>
</tbody>
</table>

ADC refers to Annual Design Capacity
DDC refers to Daily Design Capacity
HDC refers to Hourly Design Capacity
What happens once the capacity trigger is reached?

1. **AIA will request from IATA:**
   (i) to provide a forecast of demand in relation to the relevant parameter(s) at the Airport over the then next two years, and...
   (ii) to determine whether, after allowing for any increase in the Design Capacity of any buildings or equipment due to technological, organisational or other improvements [...], the relevant ninety per cent threshold would still have been reached. [...]

2. Such forecast and determination (i.e. IATA study results) will be provided by AIA to the Greek State.
✓ Airside pavements - current status & foreseen expansions
Airside pavements / expansions foreseen

Runway system
✓ it is expected that it will be able to accommodate the traffic up to the ultimate development phase of the airport (50 MAP)

Apron stands
✓ current areas can accommodate a traffic corresponding to at least 26 Million annual passengers
✓ potential for additional apron exists (mainly at the western airfield) when such a need arises

Taxiways
✓ current taxiways can accommodate a traffic corresponding to at least 26 MAP. Extension will be required to accommodate increased apron areas when such need arises. Additional taxiway bridge(s) may be required.
Discussion

✓ Future Trends, R&D
Research and procedures are implemented globally to lower the costs of paving.

Use of reclaimed asphalt pavement and industrial byproducts decreases the cost of asphalt pavements (less new bituminous binder and aggregates).

Not only a good cost-saving strategy, but it also reduces the carbon footprint of the industry.

Concrete pavement mixtures also incorporate industrial byproducts, such as fly ash from coal burning and slag cement from iron production. Concrete itself, is 100% recyclable.

These practices not only conserve natural resources, but also divert materials away from landfills.
Finally, the development and implementation of a life-cycle cost analysis, will allow engineers, designers and owners to understand the implications and determine the most cost-effective option among different competing alternatives.
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