Time to sweat the assets?: The analysis of two airport cases of restricted capacity in different continents

Miguel Mujica Mota, Geert Boosten, Catya Zuniga
Defining and measuring airport capacity

Capacity has been analysed and defined by different authors...

- Reichmuth, Berster, & Gelhause (2011)
  "Capacity is related to capability of a facility to handle people, freight and vehicles..."

- Barhart et al. (2012)
  "Capacity is defined by the number of movements per hour ..."

- Upham, Thomas, Gillingwater, & Raper (2003)
  "Capacity is a function of operational and environmental constraints..."
Airport operations approaches tends to focus on:

- The relationship between flight schedules, airport capacity and delays
- The relationship between airports and airlines and their respective business models
- As the interaction between four main factors:
  1. Operational, sizing and design of airside and landside infrastructure
  2. Economics
  3. Environmental restrictions and regulations and
  4. Social perception towards airport infrastructures

However...

no single/unique definition of airport capacity can be found; interaction between drivers can vary per airport
Our definition

It is proposed to define airport capacity as a multifactor function leaves

\[ \text{Airport capacity} = f(\text{Factor 1, Factor 2, Factor 3, \ldots, Factor n}) \]
<table>
<thead>
<tr>
<th>Limiting Factor</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Constraints</td>
<td>- Runways</td>
</tr>
<tr>
<td></td>
<td>- Terminal buildings</td>
</tr>
<tr>
<td></td>
<td>- Taxiways</td>
</tr>
<tr>
<td></td>
<td>- Technology on board/airport</td>
</tr>
<tr>
<td>Environmental Constraints</td>
<td>- Noise emissions</td>
</tr>
<tr>
<td></td>
<td>- Pollution</td>
</tr>
<tr>
<td></td>
<td>- Weather</td>
</tr>
<tr>
<td>Physical Boundaries</td>
<td>- Available land on and off-airport</td>
</tr>
<tr>
<td>Airline Business Models</td>
<td>- Hub and spoke/ point-to-point</td>
</tr>
<tr>
<td></td>
<td>- Connectivity</td>
</tr>
<tr>
<td></td>
<td>- Frequency</td>
</tr>
<tr>
<td>Airport Business Models</td>
<td>- Aeronautical business</td>
</tr>
<tr>
<td></td>
<td>- Non-aeronautical businesses</td>
</tr>
<tr>
<td>Relationship Airport-Airline</td>
<td>- Low-cost carriers / Full Service Carriers</td>
</tr>
<tr>
<td></td>
<td>- Minimum connection times</td>
</tr>
<tr>
<td></td>
<td>- Position of dominant airline</td>
</tr>
<tr>
<td>Relationship Region-Airport</td>
<td>- National economy, demand for connectivity, triple helix</td>
</tr>
<tr>
<td></td>
<td>- Business/development models of government</td>
</tr>
<tr>
<td>Governmental Regulations</td>
<td>- Security regulation</td>
</tr>
<tr>
<td></td>
<td>- Night curfew</td>
</tr>
<tr>
<td></td>
<td>- Land-use planning</td>
</tr>
<tr>
<td>Societal Behaviour</td>
<td>- Human behaviour inside and outside the airport</td>
</tr>
<tr>
<td></td>
<td>- New technology influencing passenger choice</td>
</tr>
</tbody>
</table>
Case studies

Amsterdam Airport Schiphol

Mexico City Airport (AICM)
<table>
<thead>
<tr>
<th>Limiting Factor</th>
<th>Schiphol</th>
<th>AICM</th>
</tr>
</thead>
</table>
| **Technical Constraints** | • Five runways, not most constraining factor  
   • Taxiway system  
   • Peak hour capacity | • Peak hour movements runway most constraining  
   • Two runways operate in a segregated mode  
   • The soil conditions of the airport |
| **Environmental Constraints** | • 500,000 ATM per annum  
   • Noise contour  
   • Emissions | • Fog in winter  
   • Cumulus clouds on summer (on Santa Lucia approximations)  
   • Wind (related to runway) |
| **Physical Boundaries** | • Airport land  
   • Noise contours  
   • Land-use planning  
   • Local communities | • Airport surrounded by urban (3-4floor buildings, antennas)  
   • For landing and departs ops, mountains and building (mainly on the south)  
   • Airport landside layout:  
     TWB (blocking taxi ops) and T2 ("U" shaped) |
| **Airline Business Models** | • Main user KLM/Skyteam 70% of business  
   • Hub operations with competition on frequency  
   • Important LCC and charter market | • Main user AeroMexico/Skyteam  
   • Mainly O/D traffic  
   • High LCC participation |
| **Airport Business Models** | • Airport City concept | • Aero- and non-aerobusiness in terminals  
   • Mix Tourist/Business model |
| **Relationship Airport-Airline** | • Strong demand for connectivity, triple helix  
   • Airport important economic factor | • Dominant carrier and alliances  
   • Long term commitments (AMX-T2)  
   • Slots to operate at AICM |
| **Relationship Region-Airport** | • Strong demand for connectivity, triple helix  
   • Airport important economic factor  
   • Airport involved in regional development | • Mexico hub  
   • Political parties (only for 6 years duration at the most) |
| **Governmental Regulations** | • Slot regulations  
   • Night limitations  
   • Airport system development  
   • Security | • Slot regulations  
   • Night limitations  
   • No formal relationship with domestic airports  
   • Security |
| **Societal Behaviour** | • Experienced travellers  
   • Human size facilities  
   • Limited acceptance for hinder  
   • New technology implemented in to support passenger choice | • Tourist/Business travellers  
   • Proposal of New AICM land used of communal lands |
Main drivers to increase operational capacity

For Amsterdam Airport Schiphol:

• Negotiations with stakeholders on ATM-capacity
• Creating leverage by supporting quality of life and nature in the airport area
• Slot allocation
• Moving flights to other airports in system
• Increase peak hour capacity
• Economic instruments/regulation
• Mainport policy: contribution airport to national economy
• Smart use of existing infrastructure/facilities

For Mexico City Airport (AICM):

• Revisiting the slot allocation policies
• Traffic deviation (TLC)
• Analyse in deep current operations
• Simulation to understand airport operations
• Flexible use of existing facilities
• Coordination within airport network (with domestic airports)
• Airport layout/ New airport project
• Transparent procedures from all stakeholders
Current challenges

**Schiphol**
- Schiphol reaching 500,000 ATM earlier than expected
- How to assign slots within ceiling
- How to divide traffic over Schiphol and reliever airports
- Invest in off-airport activities or in improving quality of life within communities
- Very complex Air Space in between the airport system: how to improve ATC with traffic growth at all airports
- Need to solve problems within a network context
- Investment decisions in expanding airport facilities and airspace

**AICM**
- Maximum arrivals per hour limit development airport and block new airline entries
- Network solutions (ground delay) cause delay at domestic airports
- Unbalance in use terminal facilities compared to domestic and international peak
- Exploit the benefits for all stakeholders of other slots policies
- Deviate some of the traffic to relievers airports
- Optimize the information processes (knowing what is happening, CDM)
- Need for simulation to gain insights in optimization options for operations
Conclusions

Both airport look for solutions to meet the growing demand.

Schiphol Airport growth potential is limited by 

*environmental limitations in terms of noise and emissions*

while

the International Airport of Mexico City is limited by 

*the technical capacity of the runway and air traffic control.*
Understanding operational airport capacity drivers is key to optimize airport capacity; simulation can be a useful tool to gain insights.

In case of environmental constraints the solution can be outside the airport in dealing with the local communities.
Thank you!!!!

Questions??

Miguel Mujica Mota
m.mujica.mota@hva.nl

Geert Boosten
g.boosten@hva.nl

Catya Zuniga Alcaraz
catya.zuniga@unaq.edu.mx