Configuration of Airport Passenger Buildings

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Outline

- Introduction
  - Motivation
  - Important Ideas
- Range of Configurations
- Process of Evaluation
  - Criteria of Selection
  - Method of Analysis
  - Differences in Traffic Loads on Buildings
- Performance of Configurations
- Recommendation
  - “Hybrid” design responsive to future traffic
Motivation

• No Agreement in Industry about good configuration
  → NACO -- X-shaped satellites in parallel rows: Bangkok/2nd Airport; Kuala Lumpur /International
  → “Atlanta” -- Midfield lines: Denver/International
  → Aeroports de Paris -- Triangles onto spine roads Paris/ de Gaulle

• Many Errors -- Many Choices have been inadequate for eventual traffic
  → Dallas/Ft Worth -- linear building bad for transfers
  → Boston/Logan -- International Building => domestic hub

Important Ideas

• “Airport Passenger Building”
  → NOT A TERMINAL, many passengers do not end their air trips there
  → Many passengers “transfer” between
    • Airlines; Buildings; Aircraft of an Airline

• “Correct Choice”
  → NOT THE OPTIMUM, for assumed conditions
  → RIGHT RESPONSE, over range of conditions
## Change to View of Airport as “Passenger Buildings”

<table>
<thead>
<tr>
<th>Criteria Considered</th>
<th>Single (or Few)</th>
<th>Multiple</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow</td>
<td>Prevalent in Current Practice</td>
<td>“Terminals”</td>
</tr>
<tr>
<td>Broad</td>
<td>Broad Range, Multiple Criteria Performance</td>
<td>“Airport Passenger Buildings”</td>
</tr>
</tbody>
</table>

## Range of Conditions

- **“Pure”** Concepts
  - Linear or Gate Arrival
  - Pier ; Satellite
  - Midfield
  - Transporter
- **“Hybrid”** Concepts
  - Combinations of Pure Elements
- **Centralized and Decentralized**
- **Rail Access**
  - Automated People Movers
  - Metropolitan
Linear: Dallas/Forth Worth

Source: FAA Office of System Capacity
www.asc.faa.gov

Finger Pier: Miami/International

Source: FAA Office of System Capacity
www.asc.faa.gov
Satellites (New York/Newark)

Satellites: Tampa
Midfield, Linear: Denver/Intl

Source: FAA Office of System Capacity
www.asc.faa.gov

Midfield, X-shaped: Pittsburgh

Source: FAA Office of System Capacity
www.asc.faa.gov
Transporter: Washington/Dulles

Source: FAA Office of System Capacity
www.asc.faa.gov

Hybrid: New York/LaGuardia

Source: FAA Office of System Capacity
www.asc.faa.gov
Hybrid: Chicago/O’Hare

Process of Evaluation

- Criteria of Selection
  - Multiple Criteria
  - Broad Forecasts

- Methods of Analysis
  - Rapid, Computerized

- Differences in Traffic Loads on Buildings
  - Percent Transfers
  - Variability of Traffic
  - Need for Services

- Performance of Buildings
Criteria of Selection

- **Multiple**
  - Walking Distances
    - Average, Extremes
    - Terminating, Transfers
  - Aircraft Delays
  - Costs

- **Under Range of Conditions**
  - High, Low Traffic
  - High, Low Transfer Rates

Methods of Analysis

- **Manuals (IATA, ICAO, etc.)**
  - Limited Perspective
  - Unsuitable for Major Projects

- **Analytic Formulas**
  - Unrealistic

- **Detailed Simulations**
  - Difficult to Set Up
  - Too Slow for Planning

- **Need:** General, Computer Analysis
Problem Statement (Graphically)

Current Decision Support Is Inadequate

<table>
<thead>
<tr>
<th>Step 1</th>
<th>Reference Manuals/Texts</th>
<th>Analytic Formulae</th>
<th>Computer-Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection Of Initial Configuration and Geometry</td>
<td>LATA, ICAO, FAA, TRB, Parsons, Transport Canada, Ashford, Blow, Hart, Blankenship, Horonjeff and McKelvey</td>
<td>Bandara, Robuste, Vandebona, Wirasinghe</td>
<td>Need</td>
</tr>
</tbody>
</table>

| Step 2 | Detailed Layout of Floor Plan | LATA, ICAO, FAA, TRB, Parsons, Transport Canada, Ashford, Blow, Hart, Blankenship, Horonjeff and McKelvey | Impractical | Dunlay, Pararas, BAA, FAA, Transport Canada, Private Industry |
Difference in Loads

- “Total Number of Passengers” does not properly define loads on Buildings
- Effective Loads depend on Passenger Needs
- Key Load Characteristics:
  - Transfer Rates (%)
    - passengers changing aircraft, buildings or airlines
  - Variability of Traffic
    - Daily, Seasonal Patterns
  - Need for Services
    - International controls; Meals and accommodations
  - Industry Structure
  - Aircraft Types

Transfer Rates

- Transfer passengers require:
  - Easy Internal Flow; No Airport Access
- Hub-and-Spoke Airports
  - have very high transfer rates, more than 50%
  - are increasing, worldwide
- Examples:
  - High Rates: Chicago/O’Hare, Minneapolis/St.Paul, Denver/Intl, Pittsburgh, Dallas/Fort Worth, Detroit/Metro, Salt Lake City, Hong Kong/CLK, Tokyo/Narita (Northwest), London/Heathrow, Amsterdam/Schiphol...
  - Low Rates: Boston/Logan, San Francisco/Intl, Montreal/Dorval, London/Gatwick...
Variability of Traffic

- **Steady Loads**
  - Low Cost/Passenger for Built Facilities
  - Typical Case: Business Market
  - Example: New York/LaGuardia

- **Variable Loads**
  - Low Utilization for Marginal (less Attractive) Facilities
  - High Cost/Passenger for Built Facilities
  - Typical Case: Tourist, Special Event Markets
  - Examples: London/Gatwick; Jeddah

Performance

- Linear
- Centralized
- Satellite
- Midfield
- Transporter
- Sensitivity to
  - Transfer Rates
  - Industry Structure

![Graph showing variation of passenger flows at South and North Terminals from Monday to Sunday, with data for May 4-10 and July 20-26.](image1)

Variation of Passenger Flows (London/Gatwick, 1992)

![Graph showing variation of thousands of passengers in the South Terminal from Monday to Sunday, with data for May 4-10 and July 20-26.](image2)
Variations in Traffic at New York and London Airports (c.1975)


Sources: Port Authority of NY/NJ, 1995

Source: ICAO Digest of Statistics, 1995
Example of Daily Traffic Fluctuations

Heathrow - Hourly Distribution of Passengers
(Averaged over August 1997)

Gatwick - Hourly Distribution of Passengers
(Averaged over August 1997)

Performance: Linear

- **Cost**
  - High
  - Only one side of “fingers” used by aircraft

- **Access**
  - Mixed
  - Passengers: OK for locals, Terrible for Transfers
  - Aircraft: Good

- **Services:**
  - Poor
  - Excessive Staff/Passenger
  - Low Traffic for Concessions
Performance: Centralized

- **Cost**
  - Relatively Low
  - High per Passenger if Variability is high and expensive building often under used

- **Access**
  - OK in General
  - Especially good for transfers
  - Not so good for aircraft

- **Services**
  - Good
  - Efficient use of Personnel
  - High traffic for concessions

Performance: Satellite

- Efficient Use of Waiting Areas
- Efficient for Transfers
- Best Designs Sensitive to Transfer Rates
- See Illustrations from Computer Analysis
Robustness to Level and Type of Transfer Traffic

- Decentralized Gate Arrival
- Decentralized Midfield “X”
- “Atlanta-Like”
- “Boston-Like”

Level of Transfer Traffic (P)

Fraction of “Hub” Transfers

Robustness to Industry Structure

- Decentralized Gate Arrival
- Decentralized Parallel Pier
- “O’Hare-Like”
- “Atlanta-Like”
- Centralized Midfield “X”

Level of Transfer Traffic (P)

Number of Competitors
Performance: Midfield

- **Big Differences between**
  - Linear buildings (Atlanta)
  - X-Shaped (Pittsburgh)

- **Linear**
  - Space Needed/Aircraft Stand: Excellent
  - Delays to Aircraft: Minimal
  - Practical When distances between runways large

- **X-Shaped**
  - Suitable for Narrow Airfields
  - Space Needed/Aircraft Stand: Poor
  - Delays to Aircraft: Large

Performance: Transporter

- **Cost**
  - Mixed
  - Variability high: Good -- costs are reduced when service not needed
  - Low Variability: High Costs

- **Access**
  - Good Overall
  - Passengers: generally good... delays on short flights
  - Aircraft: Great

- **Services**
  - Good
Recommendation: “Hybrid” Designs Best

• Hybrid designs best because:
  → Meet Variety of Existing Needs
  → Adapt Easily to Future Needs
  → Cost-Effective
  → Maximize quality of service to
    - Passengers
    - Airlines
    - Airport Owners

• Example:
  → Paris / Charles de Gaulle (Air France)

Conclusion

• Configurations
  → Cannot be best for all conditions
  → ... only for some limited conditions

• Since Conditions Vary
  → For Airport Users:
    - Business Shuttles, Holiday Traffic
  → Over Time
    - With Traffic Levels and Types
    - Changes in Industry Structure

• Do not apply single configuration!