TURKISH AVIATION ACADEMY

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Design of Passenger Terminals

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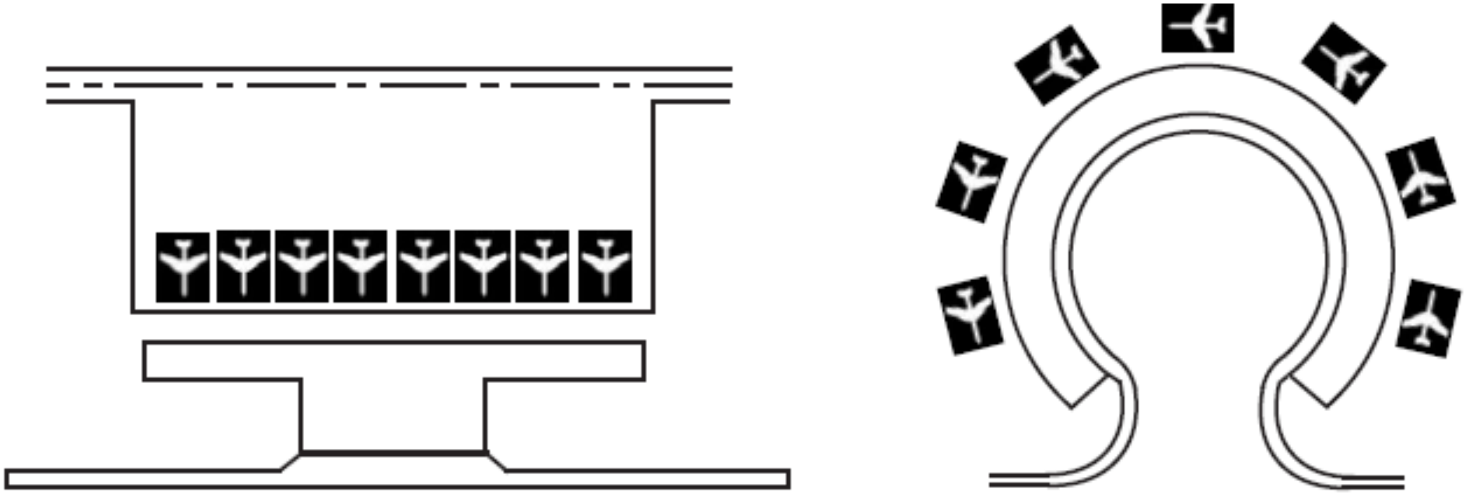
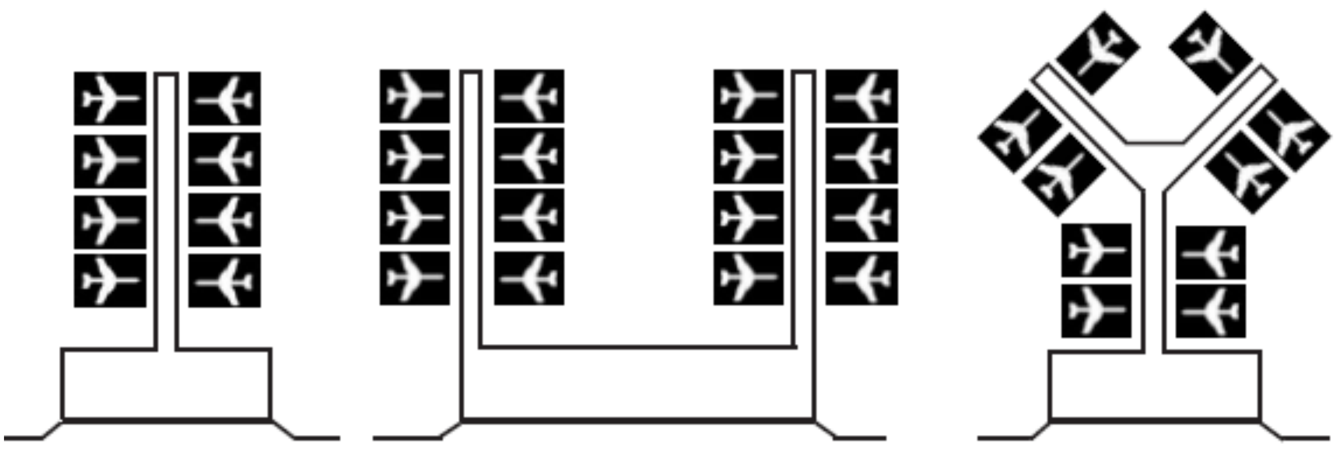
Typology of Passenger Terminals

- With respect to processing departing passengers:
  - Centralized vs. decentralized
- With respect to configuration ("concept") of the building:
  - Linear
  - Transporter
  - Finger (or pier)
  - Conventional satellite
  - Midfield satellite
- However, these distinctions become blurred as an airport becomes busier and older: "hybrid" configurations become more common
- All of the above have advantages and disadvantages

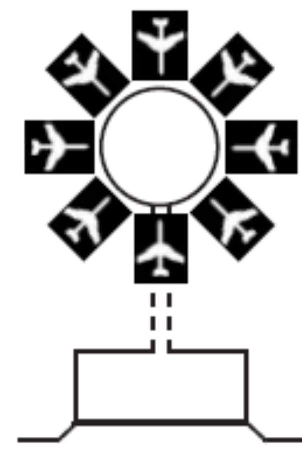
Linear, pier/finger and satellite concepts



Linear concept and its variations



Pier (finger) concept



Satellite concept

Example: Demise of Linear-Decentralized Concept

A DFW Terminal "Module"

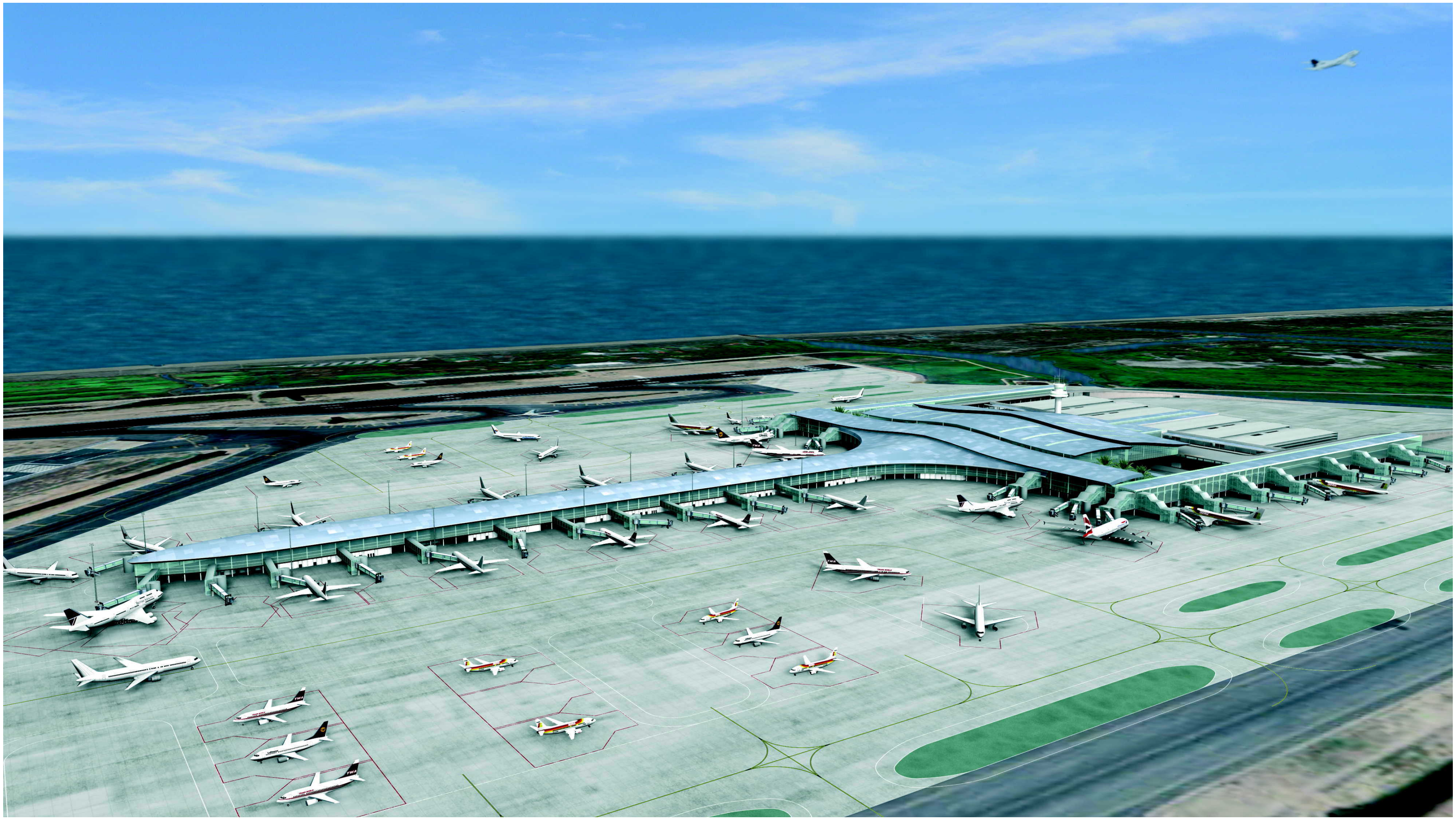
Example: Demise of Linear-Decentralized Concept [2]

CDG: Part of Terminal 2

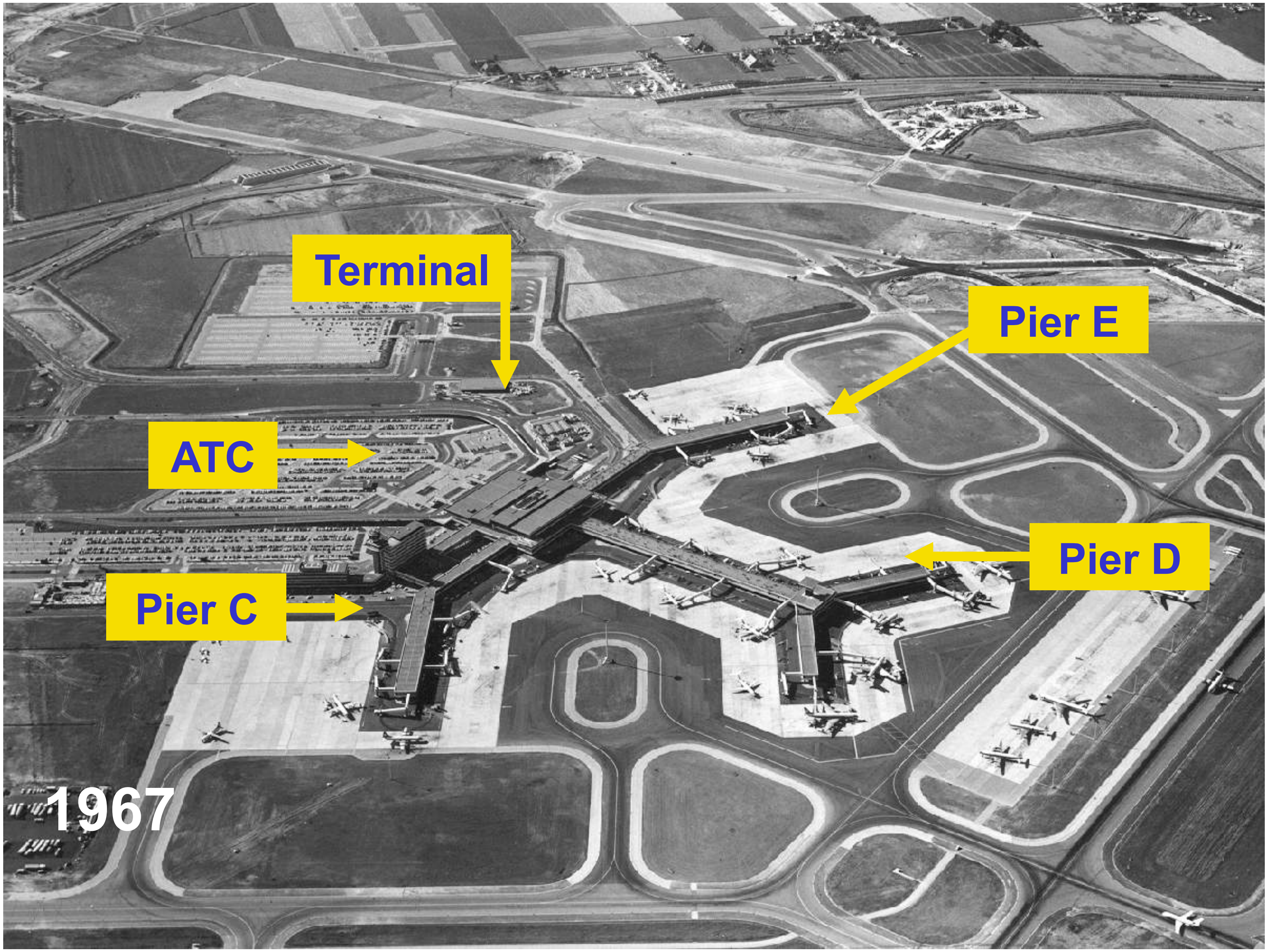
Source: Airliners.net

Rio de Janeiro/Galeão–Antonio Carlos Jobim (GIG)

Barcelona: South Terminal (2009)



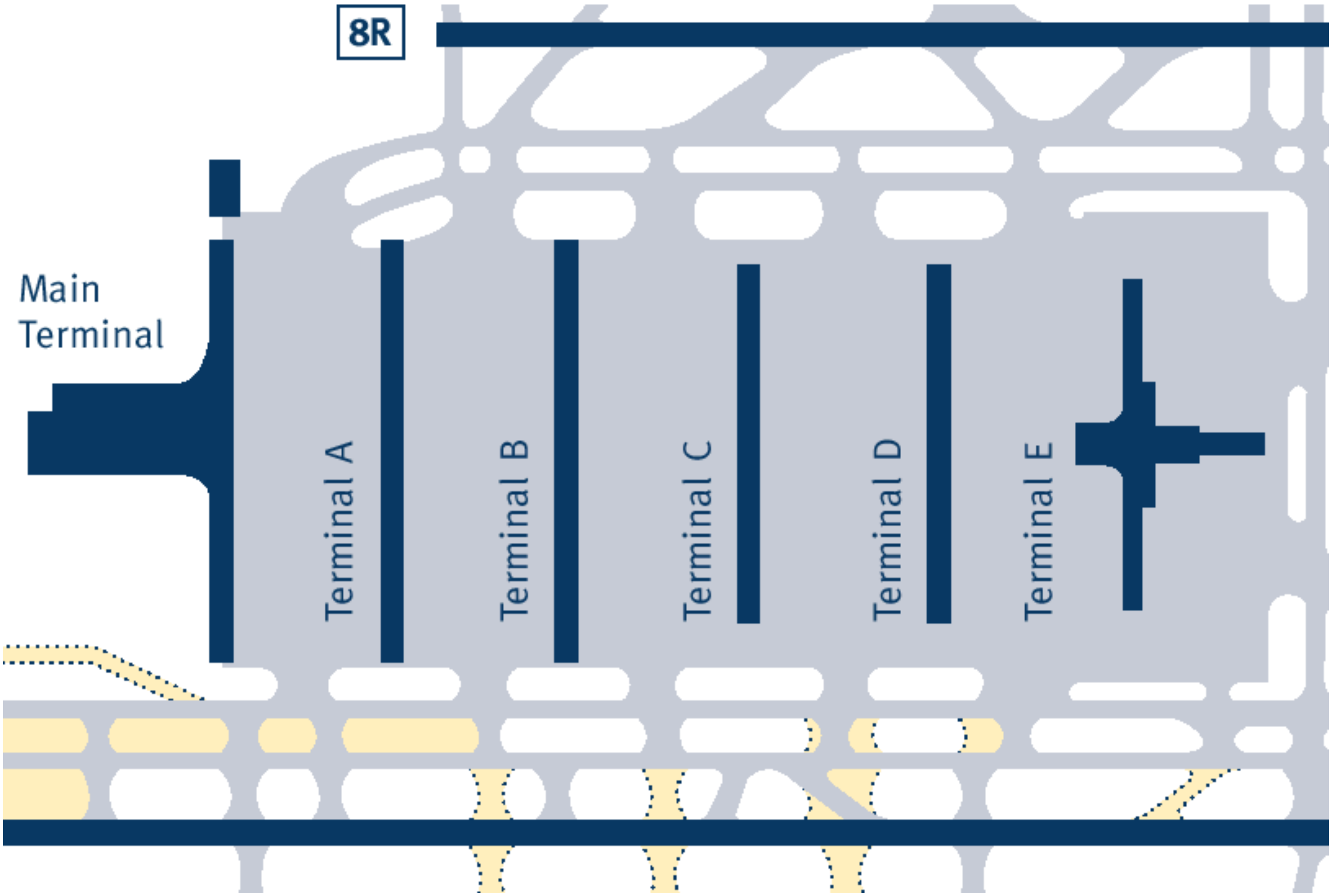
Evolution of Amsterdam Schiphol



Source: NACO, B.V.

Tampa: Main Terminal + 6 Satellites

Midfield linear satellites: Atlanta (ATL)



Stakeholders in Passenger Building Design/Planning

- ❑ Airport operator
- ❑ Airlines
- ❑ Passengers
- ❑ Government (security, immigration, customs, etc.)
- ❑ Commercial vendors and interests

- ❑ Efficient terminal vs. “shopping mall”

Evaluation Measures for Passenger Terminals

- Direct:
  - Capacity
  - Waiting time
  - Facility requirements
  - Time-in-system
  - Space requirements
  - Walking distances
- Indirect:
  - Non-aeronautical revenues
  - Operating costs
  - Flexibility
  - Ambience / image
  - Staffing requirements
  - Security
  - Signalization/orientation

Level of Service (LOS)

- A verbal description of Quality of Service in terms of Ease of Flow and Delays
- Six standard categories:

LOS / Comfprt	Flows	Delays
A – Excellent	Free	None
B - High	Stable	Very Few
C - Good	Stable	Acceptable
D – Adequate	Unstable	Passable
E – Inadequate	Unstable	Unacceptable
F – Unacceptable	--- System Breakdown ---	

- System Managers, Designers should Specify LOS
  - Level C is recommended minimum
  - Level D is tolerable for peak periods

Level of Service Standards: Space (sq. m. per occupant)

	A	B	C	D	E	F
Wait and circulate with bags	2.7	2.3	1.9	1.5	1.0	?
Wait and circulate w/o bags	2.0	1.8	1.6	1.4	1.2	?
Wait with bags	1.8	1.6	1.4	1.2	1.0	?
Wait without bags	1.4	1.2	1.0	0.8	0.6	?

Source: IATA Airport Development Reference Manual, 8th ed., 1995

Refinements to the LOS Standards

- IATA Airport Development Reference Manual, 9th ed., 2004 has refined the 1995 LOS standards
- Depending on the type of space being considered, the LOS standards are now also sensitive to
  - The presence of carts in the space
  - The number of bags (many or few) typically carried by passengers occupying the space
- For passageways (such as corridors and stairways), allowances are also made for ergonomics; for example, for 2-way passenger flows. 1.5 m extra is required to account for “edge effects” (0.5 m from each side of the corridor and another 0.5 m between the two flows)

Space Required

- Space Required, sq. meters =

  (Load, persons/hour) (Standard, sq.m./ person) (Dwell time, hours)

- Example:

  What space is required for passport inspection of 2000 passengers per hour when maximum dwell is 20 minutes?

Space Required = 2000(1)(1/3) = 667 sq. m.

Level of Service Standards: Passageways

Type of Passageway	Speed of Walking	Level of Service					
		A	B	C	D	E	F
Corridor	Regular	10	12.5	20	28	37	More
Stairway	Slower	8	10	12.5	20	28	More

- Shown as "number of passengers per meter of effective width per minute" (PPM) [Source: Modified from Fruin (1971)]

Connecting traffic, dwell time, discretionary time

- Hubbing airports must serve large numbers of connecting passengers instead of just originating and terminating ones
- Connecting passengers often have long dwell times at airports (space needed) and take advantage of commercial services there
- Dwell times of departing passengers are also becoming longer, primarily due to security requirements
- Large investments in infrastructure required
- Influencing the magnitude and allocation of dwell time and of "discretionary" time has become critical for airports

Design Peak Days and Design Peak Hours

- Airfields and passenger terminals are designed for "design peak days" (DPD) and "design peak hours" (DPH) associated with selected annual traffic levels
- The DPD and DPH loads are estimated in terms of aircraft movements (for airfields) and of arriving and departing passengers (for terminals and landside facilities)
- Numerous definitions of DPD (and DPH)
  - 20th or 30th or 40th busiest day of year
  - Average day of peak month
  - 90th or 95th percentile busiest day of year
- Common characteristic of all definitions: not busiest day (or hour) of the year, but "reasonably close" to it
- Practical rule: It makes little difference which definition one chooses, as long as it is consistent with the above concept

Demand Peaking and "Conversion Coefficients"

- Airport demand forecasts are typically given in terms of annual numbers
- For design purposes, annual numbers must be converted to DPD and DPH demand estimates: "conversion coefficients"
- Important observation: In the absence of major "shocks", seasonal, monthly, and daily demand profiles change slowly over time, especially at major airports
- Therefore, historical data are very useful in developing these conversion coefficients
- Two other important considerations:
  1. Demand peaking becomes less intense as total demand increases
  2. Passengers "peak" more than aircraft movements

Estimating Conversion Coefficients

- The value of conversion coefficients depends on many things, such as:
  - Overall size of demand
  - Seasonality of traffic
  - "Peakiness" of daily traffic
  - Presence or absence of curfew hours
  - Geographical location and time zone of airport

- Beyond historical data, one must also exercise judgment about potential changes in peaking as demand increases and circumstances change

A Classical Example

- Classical example: FAA's DPH conversion coefficients for passengers (1969):

More than 20 million annual pax	0.0003
10 – 20 million	0.00035
1 – 10 million	0.0004
0.5 – 1 million	0.0005

- Why does this work?

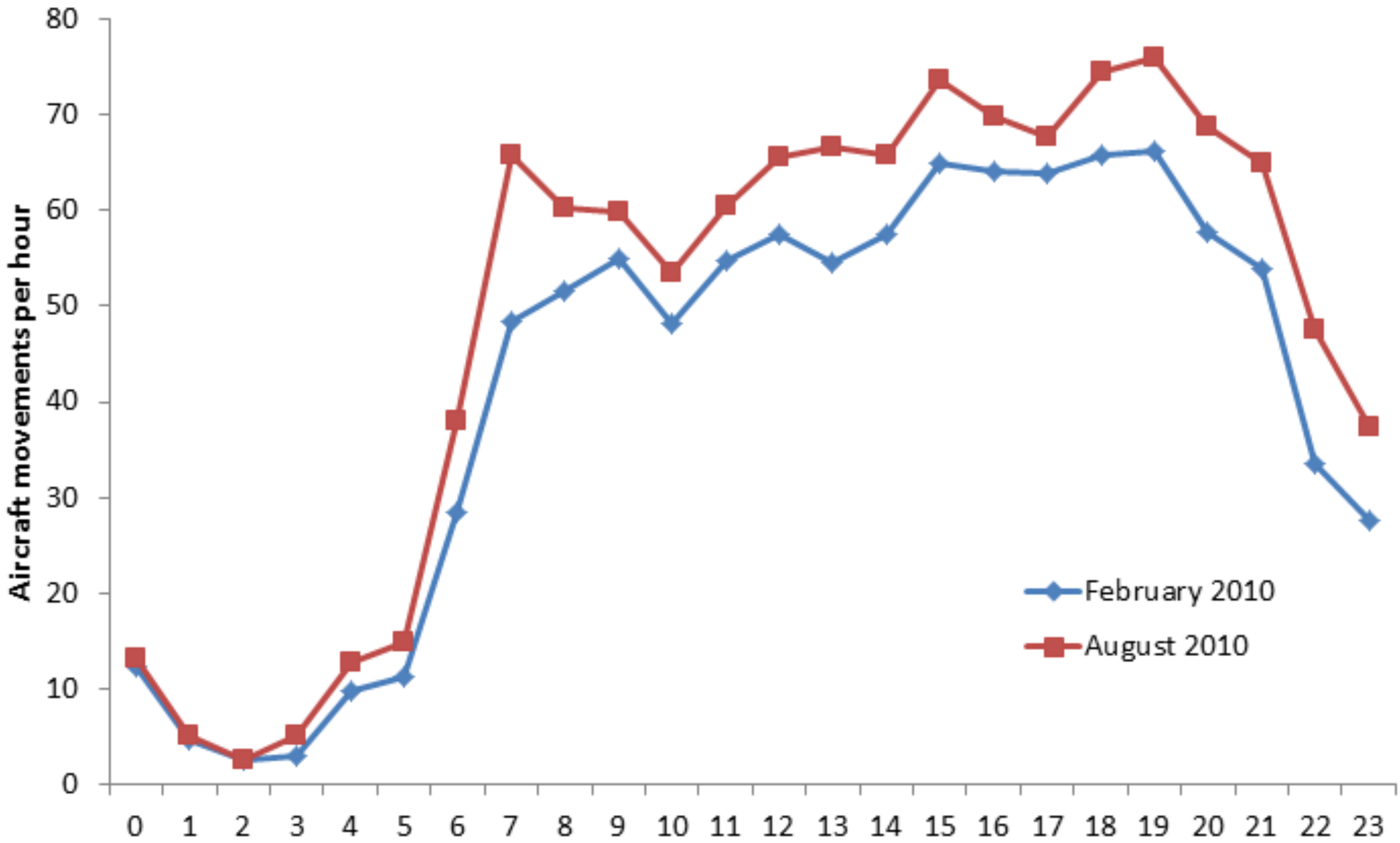
20+ million:	(1/365) x (1.18) x (0.09) = 0.000291
10 – 20 million:	(1/365) x (1.25) x (0.10) = 0.00034
1-10 million:	(1/365) x (1.35) x (0.12) = 0.000444

Peaking Characteristics of 80 Airports in ACI Survey (1998)

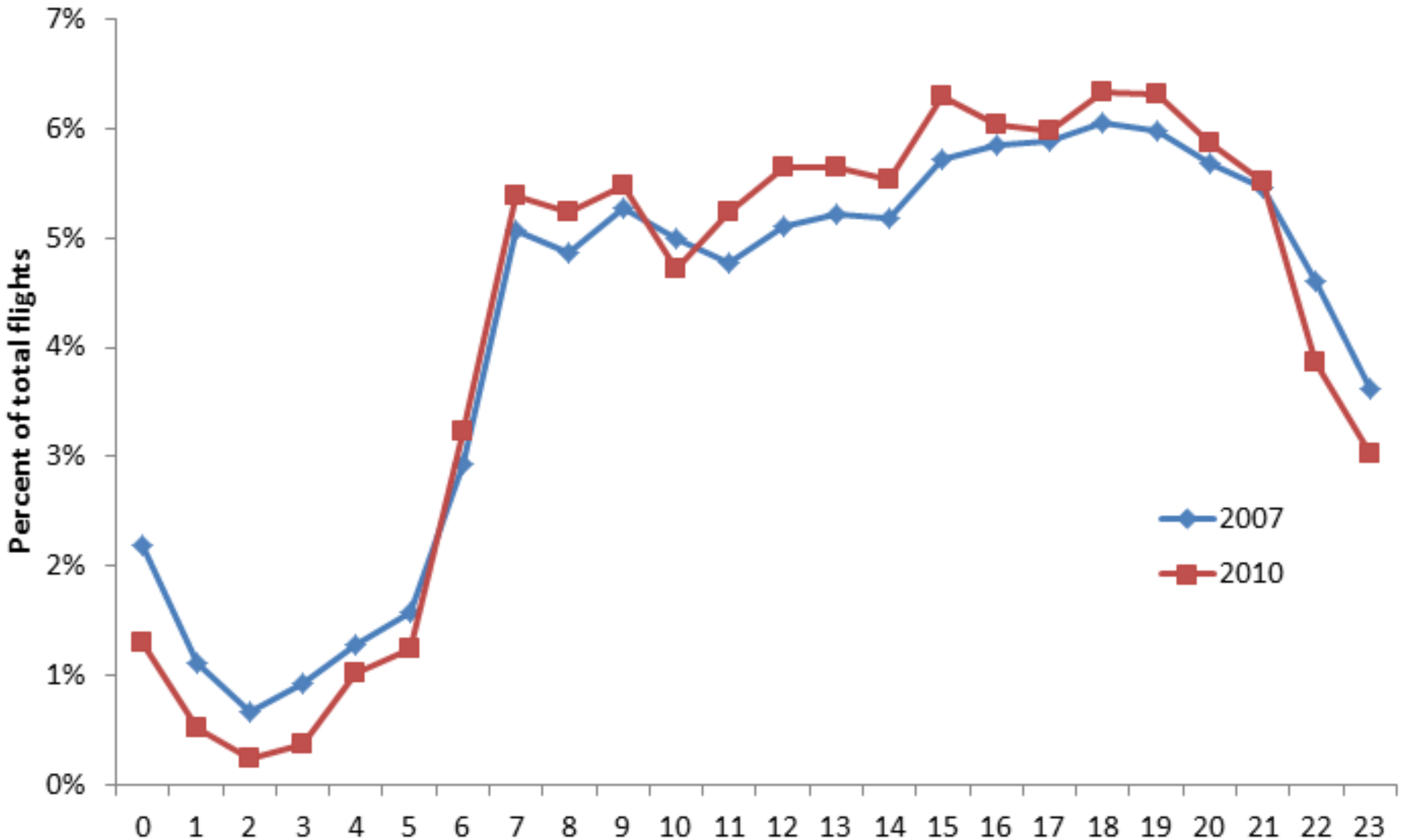
Total annual pax (million)	Sample size	Average monthly peaking ratio*	Range of monthly peaking ratios	Monthly peaking ratios greater than 1.2
>20	23	1.18	1.09 – 1.43	6 of 23 (26%)
10 – 20	13	1.25	1.08 – 1.55	9 of 13 (69%)
1 – 10	44	1.35	1.11 – 1.89	34 of 44 (77%)

* Monthly peaking ratio = (average number of passengers per day during peak month) / (average number of passengers per day during entire year)

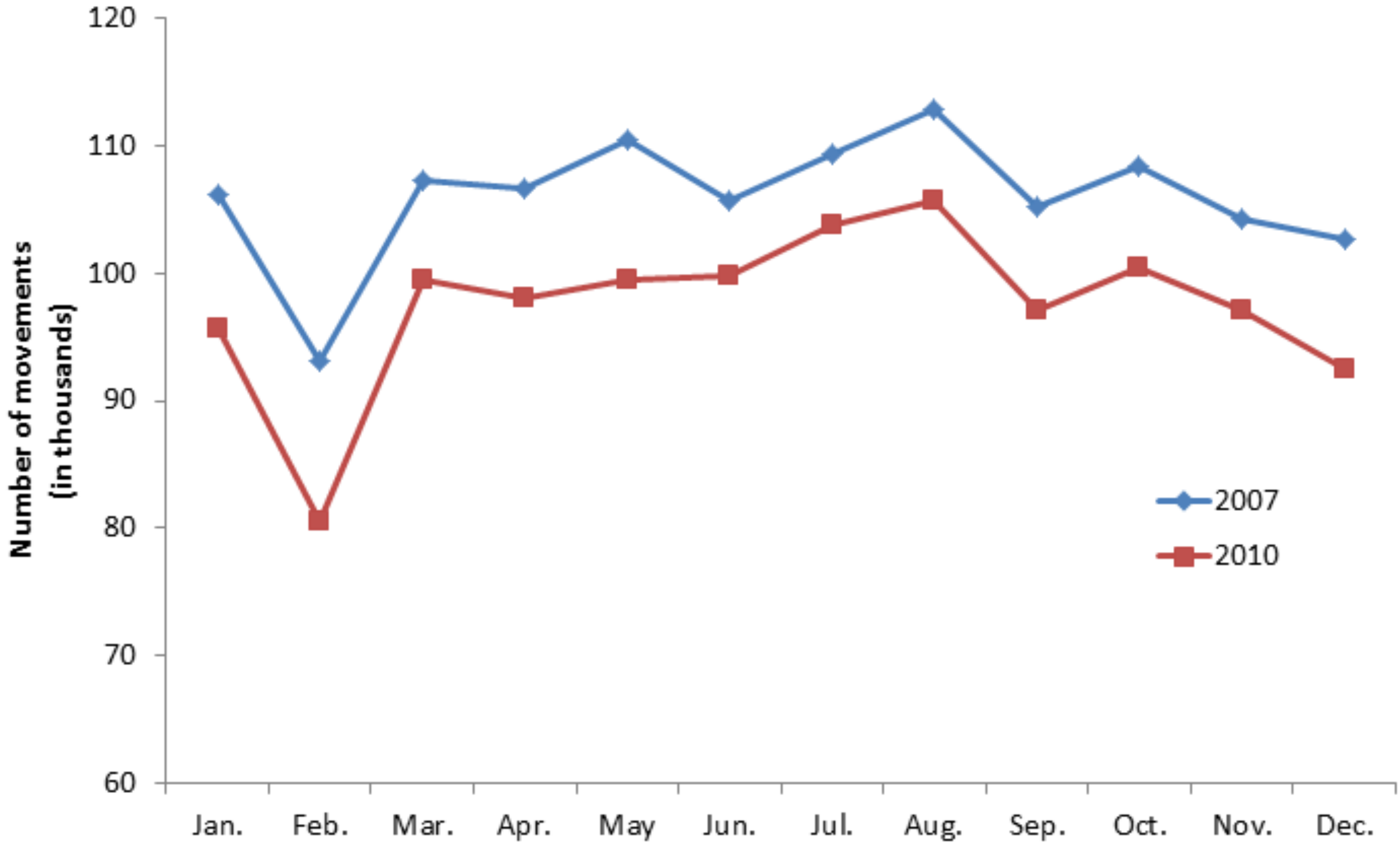
Daily Demand Profile: Newark Aircraft Movements



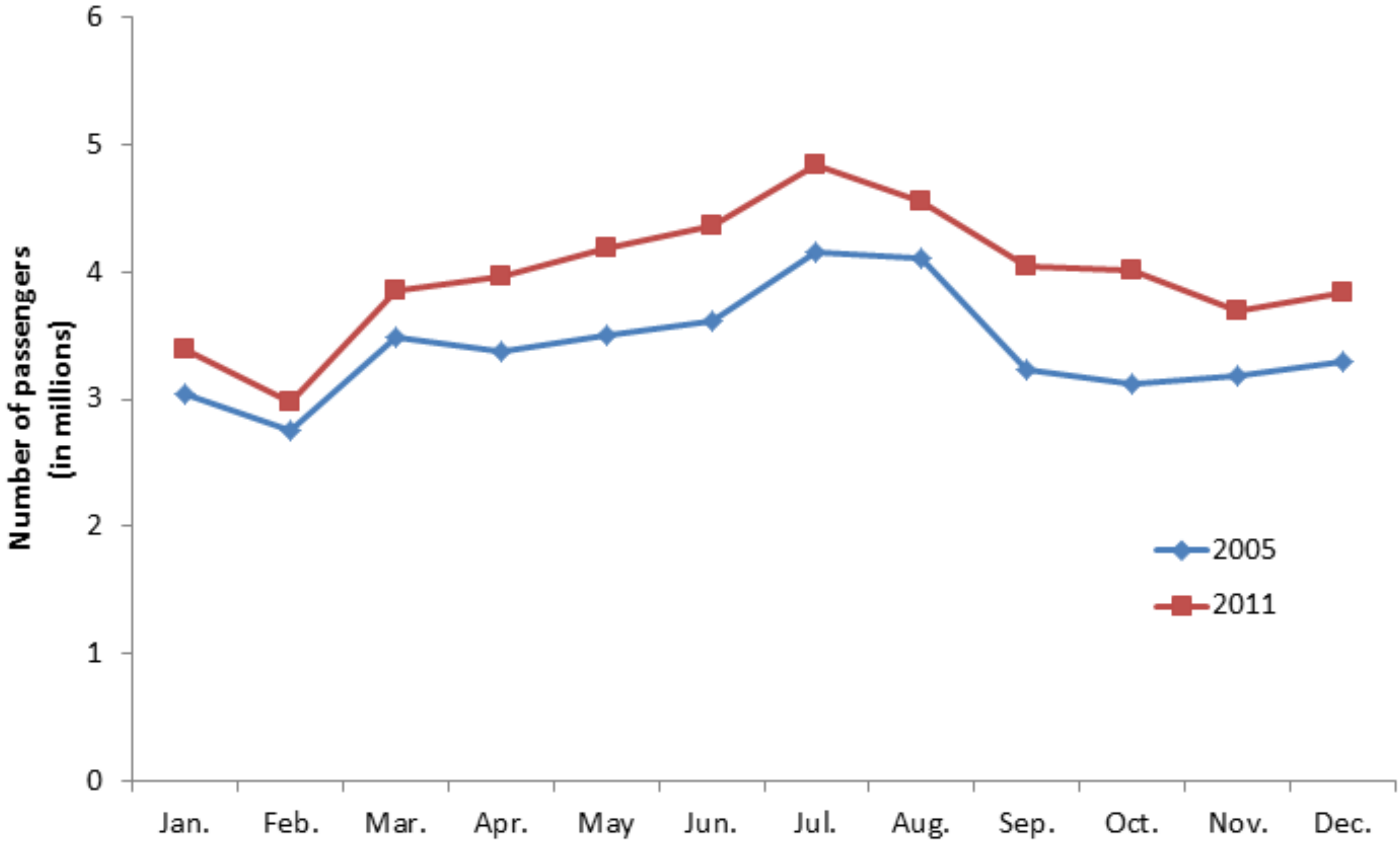
Daily Demand Profile: Newark Aircraft Movements (% of Daily Movements)



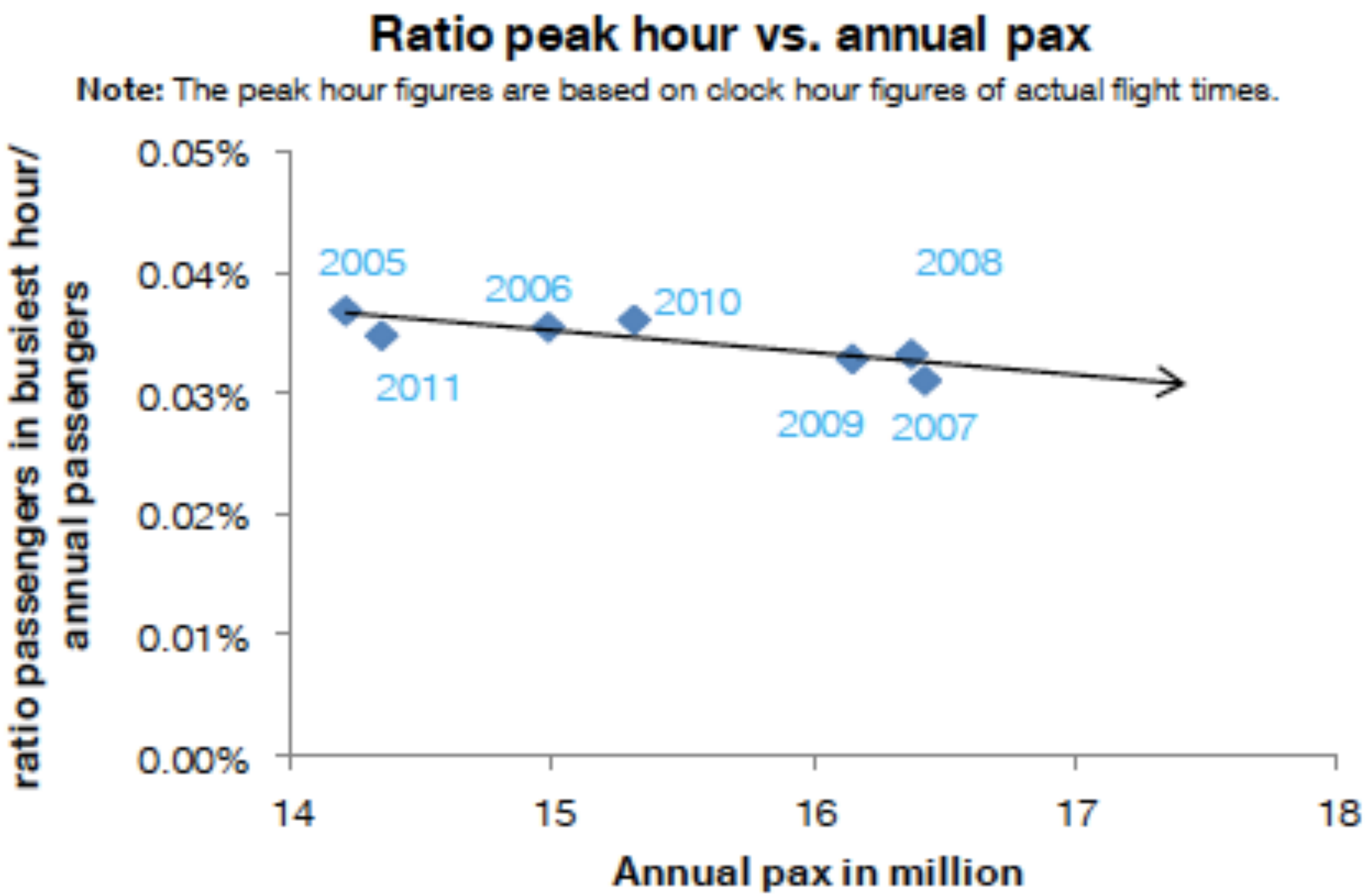
Stability of Monthly Patterns: Total Movements at the 3 New York Airports



Stability of Monthly Patterns: No. of Passengers at NY JFK

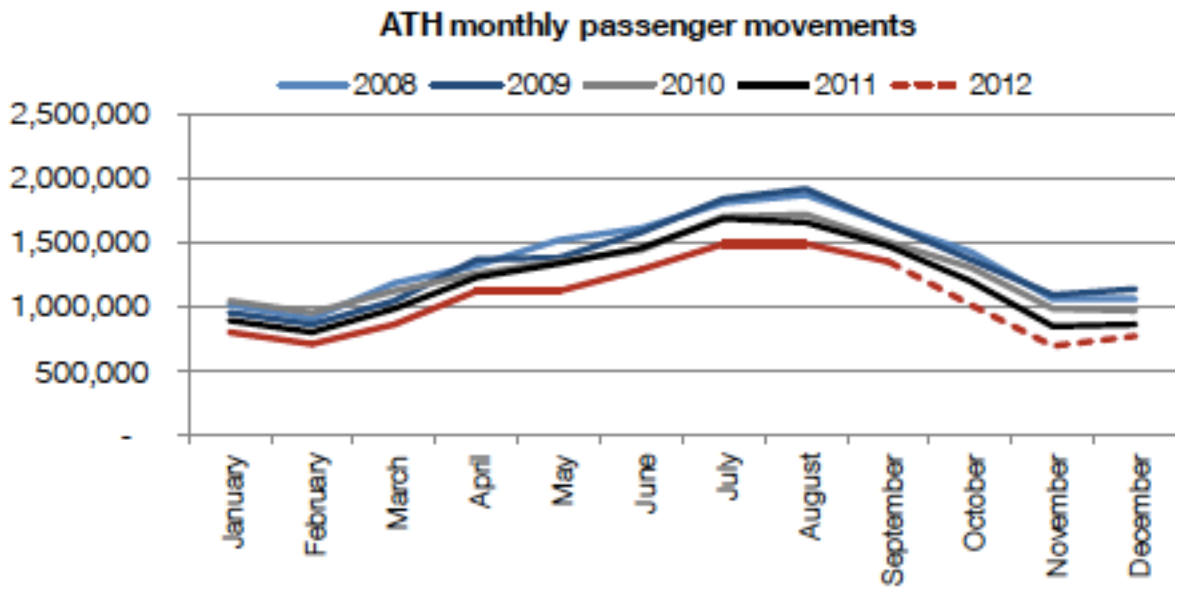


Athens: Pax in DPH as % of Annual Pax

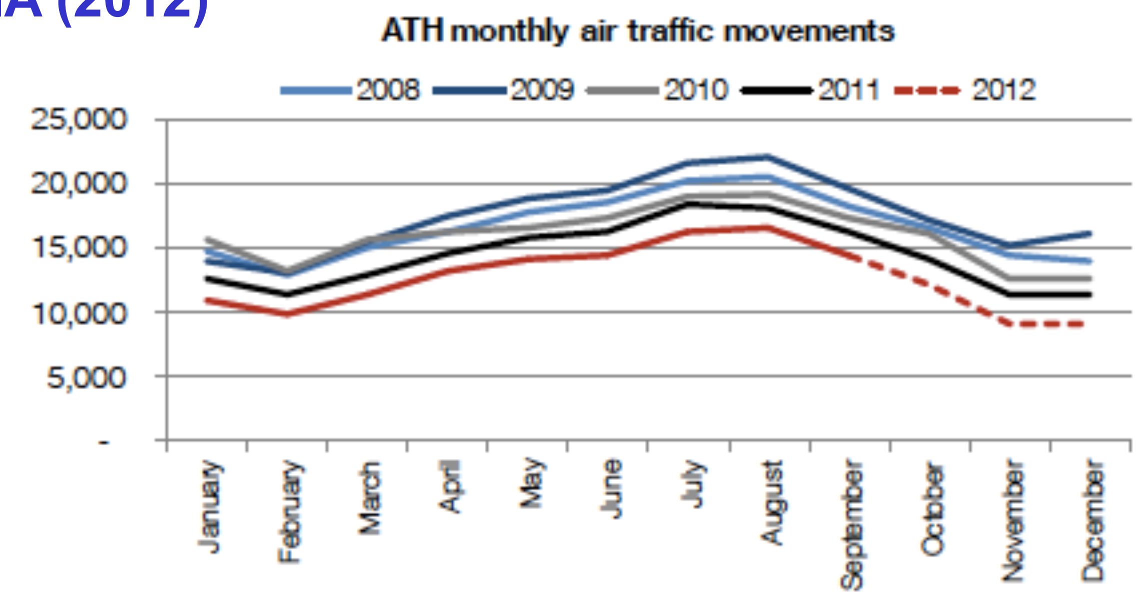


Source: AIA (2012)

Monthly Pax and Movements: Athens, 2008-2012



Source: AIA (2012)



Questions? Comments?