Using TAAM in Airline Operations and TAAM Analysis of EWR Capacity for Parallel Arrivals

Presentation to the Transportation Research Board

Patricia Massimini
MITRE Corporation

Tim Stull
Continental Airlines

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Airline Applications For TAAM

- **Facilities Design**
  - Allows you to validate design concepts before they are built
  - Support studies for regulatory projects
- **CDM / CR**
  - As a test-bed for potential solutions
- **Scheduling**
  - Schedule integrity studies
  - Schedule impact studies
  - Bank design concept studies
- **Operations and AOC**
  - Ops scenario analysis

Why Work Together?

The most successful simulation efforts are cooperative in nature

- Cooperation can save time (lots of it)
- Cooperation can enhance accuracy
- Cooperation can smooth implementation effort
- Cooperation can create opportunities

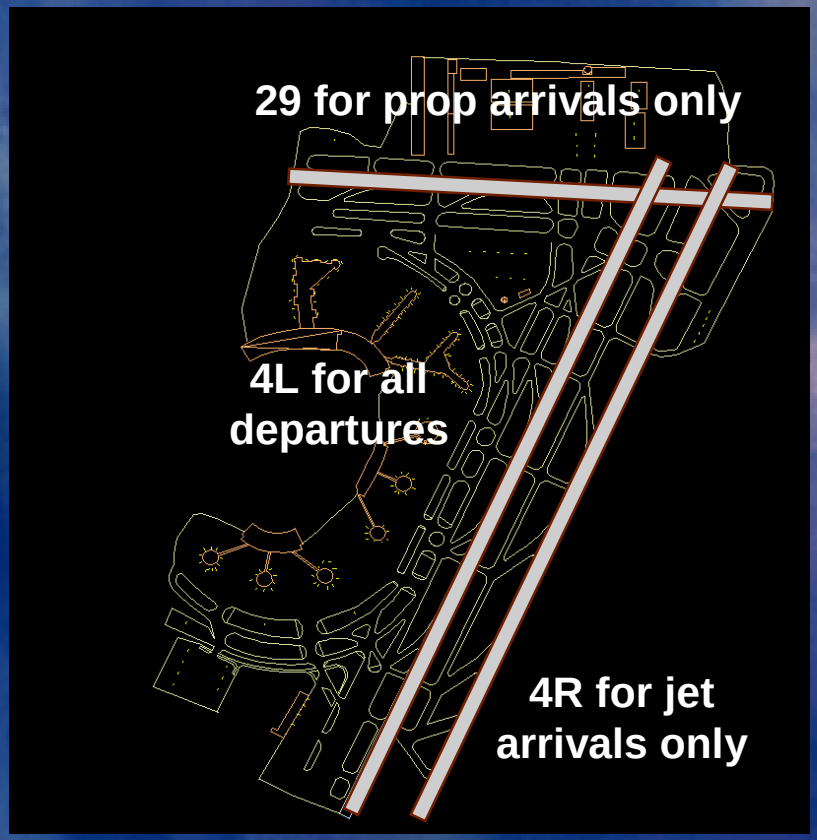
Analysis of EWR Capacity for Parallel Arrivals

Overview

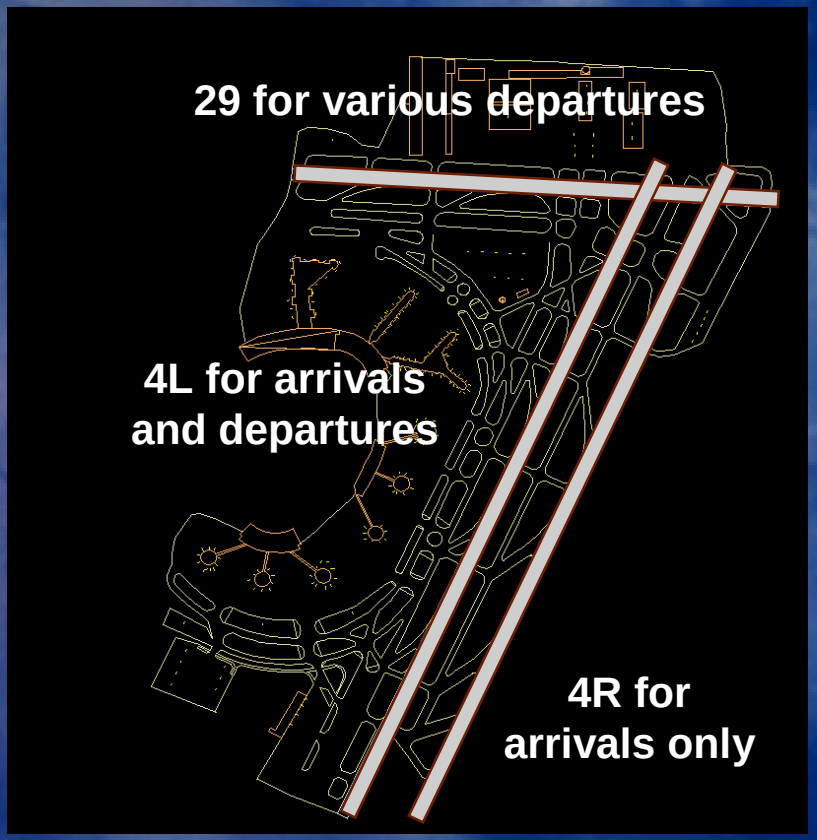
- The problem, questions, and objectives of the study
- Study approach, assumptions, and metrics
- Cooperation among study participants
- Results
- Observations on the use of TAAM

Adding a Second Arrival Stream

Baseline
Single arrival stream for jets



Alternative
Dual arrival streams (visual or SOIA/PRM)



Dual Arrivals

- The alternative scenario would eliminate arrivals from 29, shifting them to 4L or 4R.
- Departures would be shifted to 29, whenever possible.
- Under this scenario, it is assumed that visual approaches or SOIA/PRM procedures to runways 4L and 4R are available.

Questions

- How much improvement would the new procedure provide with respect to arrival delay?
- To what extent would additional arrivals impact EWR departures?
- Would there be sufficient gate, taxiway, and parking capacity at EWR to handle additional arrivals?
- Would an increase in traffic change these results?

Objectives of the Study

- Determine the effect the new procedure on EWR delays and capacity.
- Provide input to FAA's report to Congress regarding feasibility of the new procedure.

Approach

- Use TAAM to model runways, taxiways, and gates.
- Use 2003 airport configuration--additional terminal building and changes to taxiways and parking areas.
- Simulate runway operations for both scenarios without gate and taxiway operations as constraints.
- Add taxiway and gate usage to identify their impact separately from the runway constraints.

Scenarios

	Traffic	Alternative Runway Configuration (Dual Arrival)?	Gates and Taxiways?
1	2003	No	No
2	2003	Yes	No
3	2003	No	Yes
4	2003	Yes	Yes
5	2003+10%	No	Yes
6	2003+10%	Yes	Yes
7	2003+10%	Yes	No

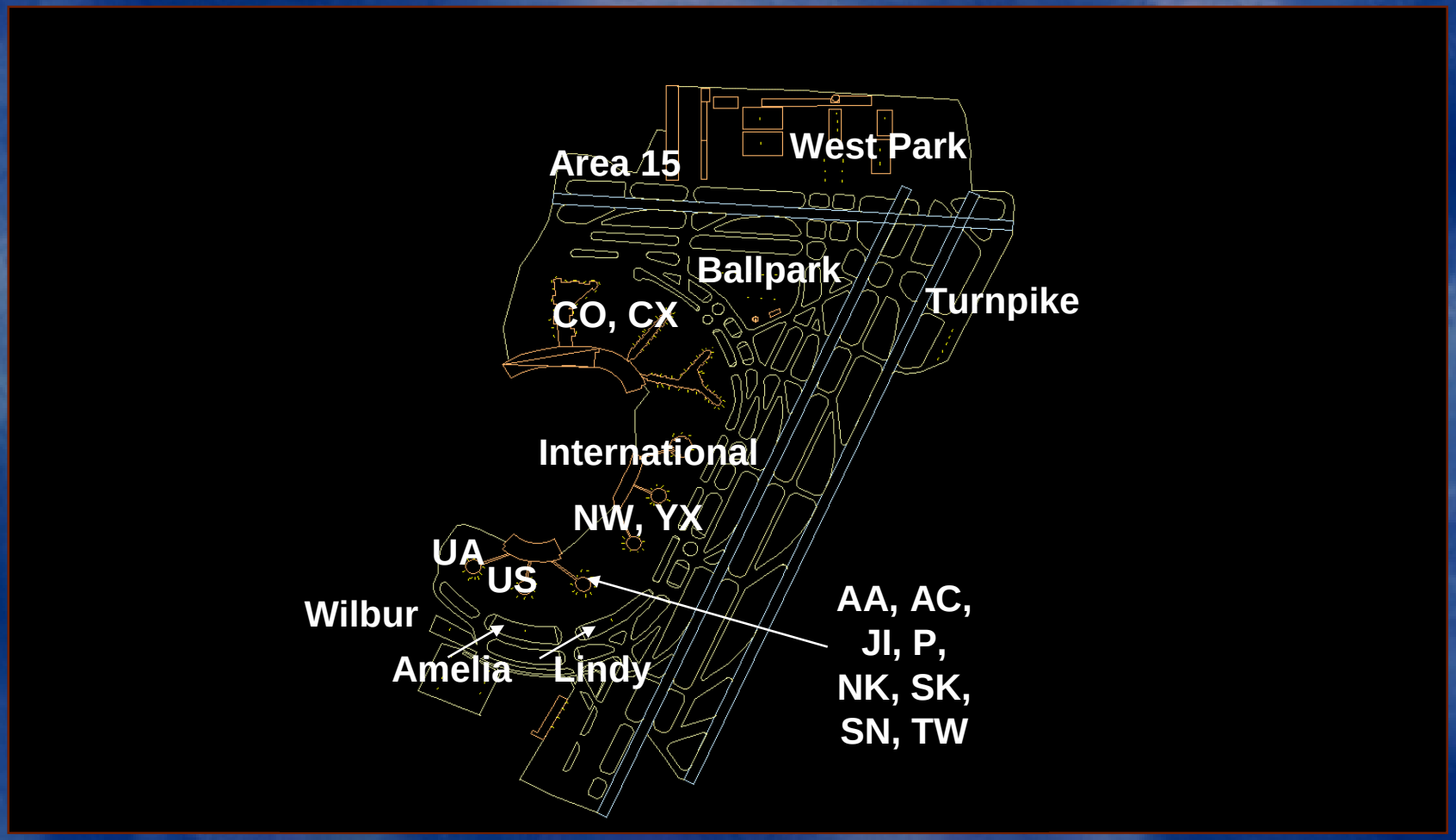
Assumptions

- NW winds / NE flow, operation on 4L, 4R, and 29.
- Airport configuration for 2003
- No airspace constraints on arrivals or departures
- No interactions with any other airport
- No traffic flow intervention to balance flow to airport
- No noise restrictions
- Visual separation

Team Effort

- Continental Airlines
  - 2003 airport layout
  - COA schedules for 1999 and 2003
  - Gate service times for COA flights
  - Restriction on use of runway 29 (AC type, range, fix)
- FAA
  - Current ARTS data; historical, current and future traffic counts
  - Validation of runway, taxiway, gate and parking area usage
- MITRE
  - Data coordination and synthesis
  - Analysis and interpretation of results

Example Input Data: Airport Layout



Example Input Data: Runway Dependencies

- Departures on 29 must be through the intersection with 4L/R before arrivals on 4L/R cross the threshold.
- Departures on 29 must wait until departures on 4L have passed 29 (and vice versa).
- Departures on 29 must wait until arrivals on 4L/R are at taxi speed.
- Stagger parallel arrivals.

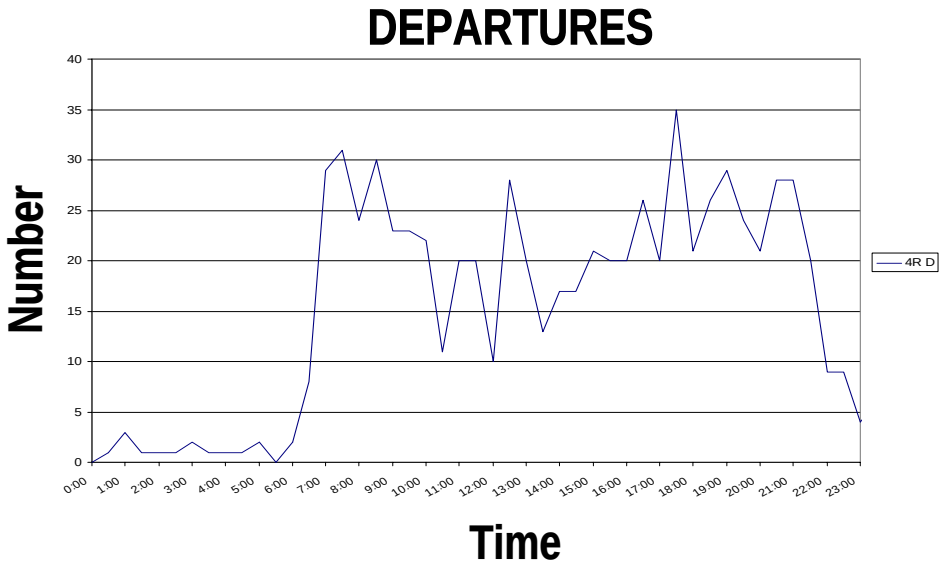
Metrics

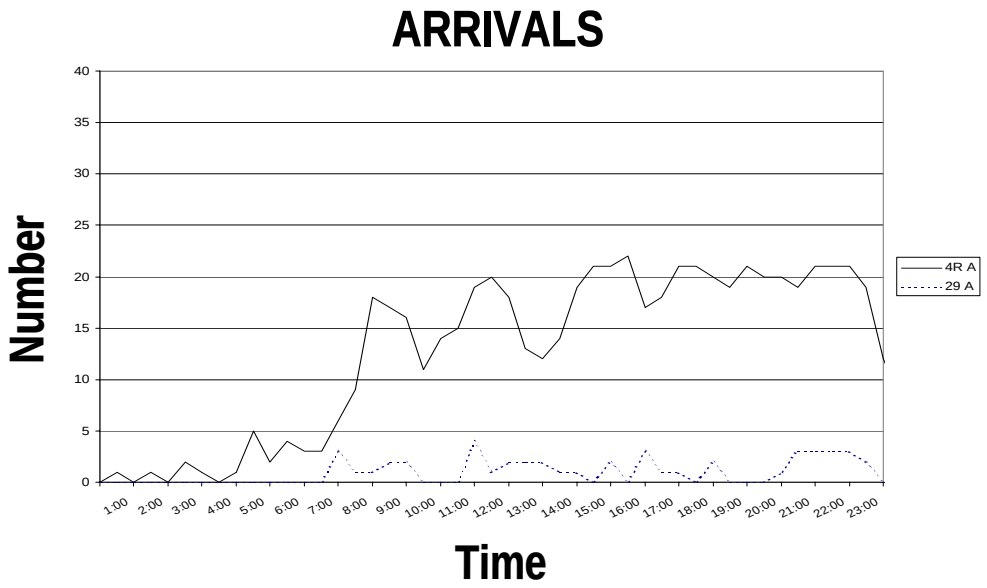
- Arrival and departure rates by runway
- Arrival and departure delays
  - Average per aircraft
  - Cumulative over the 24-hour period

Results

BASELINE RUNWAY CONFIGURATION

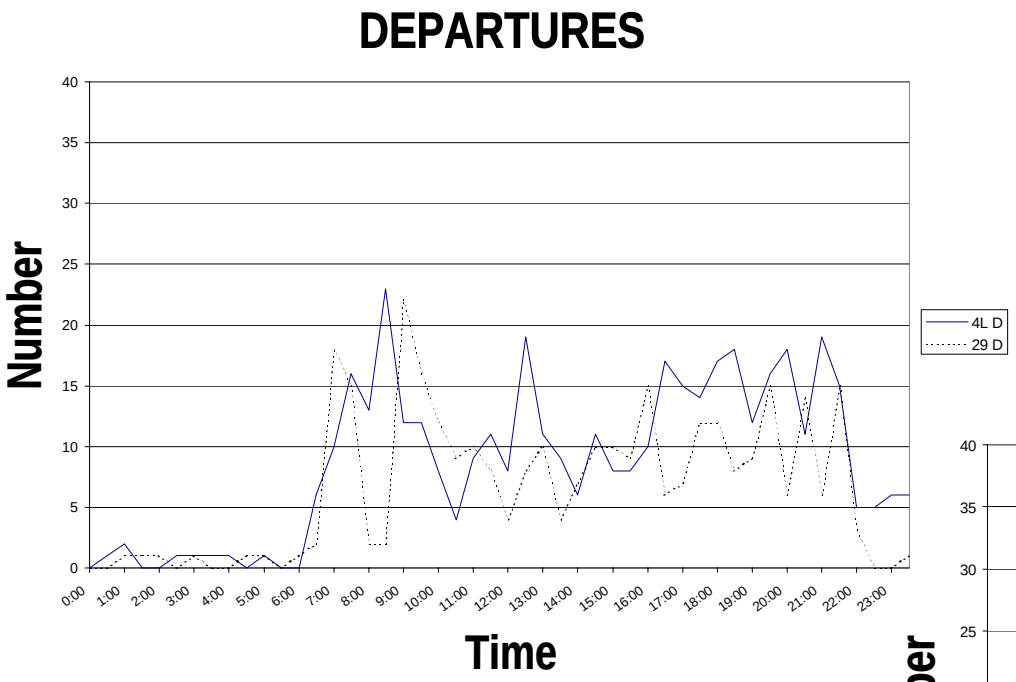
- 04R at full arrival capacity for most of the day
- 29 underutilized for arrivals (props only)

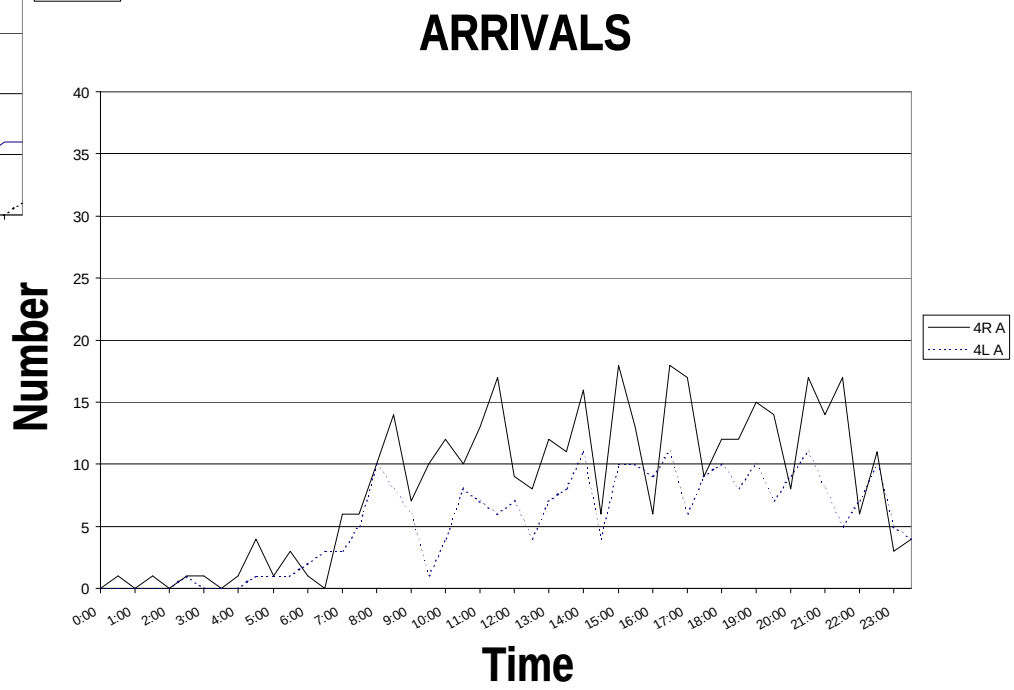




DUAL ARRIVAL RUNWAY CONFIGURATION

- Balanced runway operation
- Lower peaks for both departures and arrivals





Summary of Results

	Traffic	Alternative Runway Configuration (Dual Arrival?)	Gates and Taxiways?	Average Delay per Aircraft (min)	Cumulative Delay Over 24 Hours (min)
1	2003	No	No	10.9	11,700
2	2003	Yes	No	7.6	8,100
3	2003	No	Yes	11.8	13,100
4	2003	Yes	Yes	9.0	9,600
5	2003+10%	No	Yes	16.2	21,600
6	2003+10%	Yes	Yes	13.8	17,500
7	2003+10%	Yes	No	8.3	10,100

Observations for 2003 Traffic Level

- The alternative scenario reduces delays significantly as compared with baseline operations (24%-31% reduction).
- Adding gates and taxi operations to the runway model adds delay, but not an unusually large amount (8-18% increase).

Observations for 2003 Traffic + 10%

- Delays increase significantly from 2003 traffic levels (37-53% increase).
- The alternative scenario still reduces delays as compared with baseline operations, but not as much (15-19% reduction).
- Ground operations contribute significantly to delay at this traffic level (40-42% increase).

Observations on Use of TAAM

- Capable tool for modeling runway capacity and ground operations
  - Arrival and departure separations
  - Runway dependencies
  - Runway restrictions by type of aircraft, departure fix, range
  - Taxi paths (normal and off-normal), restrictions
  - Gate assignments, turn times
  - Parking was less satisfactory, but acceptable

Observations on Use of TAAM (continued)

- Good tool for interacting with controllers and study team.
  - Tower and ramp controllers were able to identify problems with the modeling assumptions during validation.
  - Visualization of simulation gave study team members (including controllers) confidence that the model was correct.

Demonstration