Airport Ground Transportation and Landside Simulation
Challenges and Opportunities
Agenda

- Simulation as integral part of airport planning process
- Typical airport landside components, demand, and simulation tools
- Airport landside special simulation cases – Curbside roadways
- Airport landside trends and new technologies
  - Impacts of TNCs and AV/CV
Elements of the Airport System

- Airfield
- Terminal
- Landside
Simulation Tools Typically Used in Airport Planning

- Runway Delay Simulation Model (RDSIM)
- Airport Delay Simulation Model (ADSIM)
- Airport and Airspace Simulation Model (SIMMOD)
- ATAC’s Simmod PLUS! and PRO!
- AirportTools’ Visual SIMMOD
- Jeppesen’s Total Airspace and Airport Modeler (TAAM)
- AirTOpsoft’s Air Traffic Optimization (AirTOp)
- Comprehensive Airport Simulation Technology (CAST)
- Fast-time airport terminal, airside and landside simulation (ARCport)
- Airport Passenger Flows (INCONTROL)
- Terminal Simulation Software (ServiceModel)
- Simulation Software (ARENA)
- Simulation and Modeling Software (LEGION)
- PTV Group Pedestrian Simulation (VisWalk)
- Event Discrete Model
- Comprehensive Airport Simulation Technology (CAST)
- Fast-time airport terminal, airside and landside simulation (ARCport)
- Stochastic Microsimulation Models
- PTV VISSIM
- AIMSUN
- Others…
The Landside Component of the Airport System

- **Airport = Intermodal Facility**
  - "*inter*" fr. L. = between
  - "*modal*" fr. L. = manner
  - "intermodal facility" = one between two manners of transportation
  - Without the landside, there is no other mode

- **Integration**
  - Basic competition for scarce physical space
  - Interconnected parts of same system
  - People and vehicles

SOURCE: Los Angeles World Airports – Official website. Future pedestrian plaza with the People Mover train above. Pedestrian plaza with an LED curtain wall. Entrance to the Intermodal Transportation Facility
The Landside System

- Access and Circulation Roadways
- Curbside Roadways
- Parking garages, and lots (employee, public)
- Rental car facilities
- CV facilities (curbs, roads, staging areas, passenger waiting areas)
- Cargo areas and other airport ancillary facilities
- Ground transportation centers
- Rail transit facilities
- CV facilities

Landside Simulation – Demand Estimates

- Driven mostly by passenger activity
- Different peaking patterns with off-airport roadways
- Different peaking patterns for different landside facilities
  - Access and circulation
  - Parking
  - Curbside
  - Rental Car
  - Employee facilities
  - Cargo Facilities
- Sub-modal behaviors
Landside Simulation – Demand Estimates

**Demand Levels**

- Peak of the peak (e.g., Thanksgiving week)?
- Average day of the average month?
- Average day of the peak month?
- Busy day of the peak month?
- Facility peak? (e.g., curbside vs. parking)
- Off-airport roadway peak?

**Design Hour**

- Number of enplaned and deplaned passengers departing or arriving on aircraft in an elapsed hour of a typically busy (design) day.
- Typically does not correspond exactly to a clock hour such as 7:00–7:59 but usually overlaps two clock hours (e.g., 7:20–8:19), reflecting airline scheduling patterns.

**Typical Approach for Roadway Planning**

- 90th or 95th percentile busiest hour of the year
- The peak hour of the average day of the peak month (PHADPM)
- Peak hour of the busiest day in a week of the peak month
- Specific peak hour by facility (for facility planning)
**Demand Estimate Methodology – The Four Step Process**

- **Trip generation.** Estimating the traffic volume generated by each on-airport land use during the future airport wide peak hour(s) as well as the peak hour(s) of activity for each land use.

- **Mode-choice analysis.** Analyzing the travel mode choice patterns of passengers and employees.

- **Trip distribution.** Determining the points where trips generated by each airport land use enter the airport roadway network.

- **Trip assignment.** Assigning the estimated traffic volumes to the on-airport and regional roadway networks.
Users of the Airport Roadways

**AUTOS**
- Private Vehicles (POV)
- Rental Car Vehicles (RAC)
- App–based Shared Rides (TNC)

**COMMERCIAL VEHICLES**
- Taxis/limos (On demand, reserved)
- Courtesy bus (hotel, rental car, etc.)
- Door-to-door vans
- Airport parking shuttles
- Employee parking shuttles
- Off-airport parking
- Charter buses

**SERVICE VEHICLES**
- Employee buses
- Delivery vehicles

**OTHER**
- Rail
- Public transit
- APM
Commercial Vehicles – Types of Operation

**ON-DEMAND**
- Taxis
- Limousines
- Door-to-door vans
- Charter buses
- Misc. service vehicles

**FIXED OR POLICY HEADWAYS**
- RAC shuttles
- Parking shuttles
- Hotel shuttles
- Transit buses
- Intercity buses
Airport Roadways

HIERARCHY OF AIRPORT ROADWAY CLASSIFICATIONS

- Terminal Area Roadways
  - Terminal approach roadways
  - Curbside roadways
    - Private vehicle roads
    - Commercial vehicle roads
- Driveways and facility internal circulation
- Special roadways (e.g. parking entry and exit plazas)
- Recirculation roadway
- Service roadways
- Access roads
- Regional roadway network (off airport)
What Makes Airport Roadway Operations Unique?

- Low speed uninterrupted flow
- A high proportion of unfamiliar motorists
- Large number of complex directional signs
- Stressful conditions
- High proportion of large vehicles
- Mix of experienced and inexperienced drivers

SOURCE: VISSIM Animation for Existing Conditions, AM Peak Hour Operation at Doha International Airport – DRAFT – For illustration purposes only. Ricondo, 2018
What Makes Airport Roadway Operations Unique?

- Recirculating traffic
- Inconsistent driver behavior, large speed differentials
- Different peaking patterns compared to commuter off-airport roads patterns
- Greater amount of weaving and merging
- Most Federal/State design standards are not applicable

SOURCE: Miami International Airport – Taxi and TNC Relocation Options – PM Peak Hour Operation – DRAFT VISSIM Animation – For illustration purposes only. Ricondo, 2018
Airport Landside – Simulation Special Cases

- Curbside Roadways
  - Driver behavior
  - Curbside attractiveness, signage
  - Dwell time distributions
  - Pedestrian interaction
  - MOEs

- Commercial Vehicle Facilities
  - Staging areas, dispatching mechanisms
  - Waiting areas, Ground Transportation Center (GTC)
  - Curb allocation and operational protocols

- Parking Facilities
  - Public vs. Employee
  - Entry and Exist Plazas, internal circulation, parking capacity, searching algorithms

- Rental Car Facilities
  - Ready and return areas, QTA, circulation, car shuttlers, pedestrian interaction
Curbside Roadways – A Special Case for Simulation

- Terminal approach and curbside roadways
- Terminal frontage sidewalk
- Curbside check-in
- Levels, segregation of traffic
- Inner and Outer, Islands
- Curb allocation
- Pedestrian crossings
- Curb management, enforcement
- Security
Graphical Depiction of Curbside Congestion

### Curbside LOS – Dual Lane Loading

<table>
<thead>
<tr>
<th>LOS</th>
<th>SINGLE LANE LOADING</th>
<th>DOUBLE LANE LOADING</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>A</td>
<td>0% - 70%</td>
<td>0% - 90%</td>
<td>EXCELLENT: Drivers experience no interference from pedestrians or other motorists</td>
</tr>
<tr>
<td>B</td>
<td>71% - 85%</td>
<td>91% - 110%</td>
<td>VERY GOOD: Relatively free flow conditions with limited double parking</td>
</tr>
<tr>
<td>C</td>
<td>86% - 100%</td>
<td>111% - 130%</td>
<td>GOOD: Double parking near doors is common with some intermittent triple parking</td>
</tr>
<tr>
<td>D</td>
<td>101% - 115%</td>
<td>131% - 170%</td>
<td>FAIR: Vehicle maneuverability restricted due to frequent double/triple parking</td>
</tr>
<tr>
<td>E</td>
<td>116% - 130%</td>
<td>171% - 200%</td>
<td>POOR: Significant delays and queues; double/triple parking throughout curbside</td>
</tr>
<tr>
<td>F</td>
<td>&gt;131%</td>
<td>&gt;201%</td>
<td>FAILURE: Motorists unable to access/depart curbside; significant queuing along entry road</td>
</tr>
</tbody>
</table>

**Curbside Utilization** = \( \frac{\text{Required Curb Length}}{\text{Available Curb Length}} \times 100 \)

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Curbside Simulation Analysis – Case Study – SMF Terminal A

Terminal A Peak: 12:15 PM – 1:15 PM
Average Speed (mph)

Curbside Reporting – Case Study – ATL TNC Reallocation

TNC North Lower Curb Zone

Utilization Rate

Simulation Time (Hour:Minutes)

TNC North Curb Zone - Peak Hour LOS Distribution

Time (Minutes)

Statistics

<table>
<thead>
<tr>
<th>LOS</th>
<th>Average Utilization</th>
<th>85th % Utilization</th>
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<tbody>
<tr>
<td>B</td>
<td>85%</td>
<td>107%</td>
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LOS Distribution

<table>
<thead>
<tr>
<th>LOS</th>
<th>Time (min)</th>
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<tr>
<td>A</td>
<td>16</td>
</tr>
<tr>
<td>B</td>
<td>22</td>
</tr>
<tr>
<td>C</td>
<td>13</td>
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<tr>
<td>D</td>
<td>7</td>
</tr>
<tr>
<td>E</td>
<td>2</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
</tr>
</tbody>
</table>

ATL Domestic Terminal - North Curb – Lower Level
VISSIM Curb Output Tool – COT – Beta version

- Tool computes parking occupancy (number of vehicles parked) by parking zone
- Allows user to determine data collection period and aggregation period
- Export results to a spreadsheet for quickly post-processing of results
Airport Curbside Simulation – Opportunities for Improvements

- Coordination and cooperation with PTV for VisAir Landside Demand Generator
- Development of new COM tools for enhancing:
  - VISSIM Curb operation behaviors
    - Parking and maneuvering
    - Dwelling strategies
    - Operation at saturation conditions
    - Dynamic signing
    - CV/AV
  - MOE outputs
- Need for specific curbside behaviors based on observed curbside vehicle trajectories
Airport Landside Simulation Special Cases – Rental Car Facilities

- RAC Model needs to:
  - Calculate operating capacity of RAC components
  - Measure impacts on customer service levels as operating conditions change
The transportation revolution

Mobility as a Service

Autonomous Vehicles

Electric Vehicles

- Self-driving drone taxis
- Maglev trains
- Hyperloop transportation systems
- Satellite-based air traffic control systems
- Self-driving electric buses
- Elevated buses
- Flying hotel pods
- Smart roads
- Ground level pedestrian lights

SOURCE:
Challenges and opportunities facing airport operators?

What will be the Impacts of AV on Airport Facilities and Operations?

- Storage, staging sites?
- Operating Rules, regs, and restrictions?
- Curbside operations?
- Maintenance responsibilities
- AV and non-AV mixed operations?
- Impacts on airport and landside activity?
- Ownership?

What do we do with TNCs?

- Storage, staging sites?
- Drop-off/pick-up curbside operations?
- Changes in the use of other modes?
- Use of geofences?
- Enforcement/tracking methods?
- Impacts on airport and landside activity?
Questions?