A Combined Quantitative and Qualitative Approach to Planning for Improved Intermodal Connectivity at California Airports (TO5406)

Status Briefing to MTC Staff on Development of Intermodal Airport Ground Access Modeling Tool

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Outline

• Overall Study Objectives
• Motivation for Developing the IAPT
• Airport Ground Access System Modeling
• Data Requirements
• Performance Measures
• IAPT Development
• Demonstration
• Discussion
Overall Study Objectives

- Develop techniques for analyzing the effectiveness of alternative strategies for improving intermodal connectivity at airports using a combined quantitative and qualitative approach
  - Quantitative: Analytical models of airport traveler and transportation provider behavior
  - Qualitative: Descriptive case studies and analysis of agency decision making processes

- Motivation:
  - Reduce reliance on single-party occupancy vehicles for airport trips
  - Improve coordination with regional transit services
Overall Study Objectives

- **Research products:**
  - Case studies of intermodal access projects at California airports
  - Prototype Intermodal Airport Ground Access Planning Tool (IAPT)
  - Use of IAPT to evaluate selected case study projects at California airports
  - Policy recommendations and planning guidelines
Motivation for Developing the IAPT

• Lack of available (non-proprietary) analytical tools for
  – Modeling airport traveler mode choice
  – Modeling transportation provider behavior
  – Performing comparative evaluation of alternative projects

• Need for a standardized user interface to assist in managing the large amount of data involved in airport ground transportation analysis
  – Air party characteristics influence mode use
  – Large number of different modes with service characteristics that vary geographically

• Need to generate a large number of different measures of system performance in a consistent and efficient way
  – Ad-hoc calculation of performance measures from the results of traditional airport ground access mode choice models is very labor intensive and prone to inconsistent assumptions
The four main parties and interactions in airport ground access modeling

**Decision makers**
- Airport authority
- Local government

**Passengers and airport employees**

**Transportation providers**

**Network traffic**

*One directional effect*
- The impact of airport-related traffic on the highway network performance is relatively small beyond the immediate vicinity of the airport.*

*Two directional effect*
Components of the Modeling Approach

1. Decision Maker
   - Define Alternative Projects for Improving Intermodal Connectivity

Graphical User Interface

2. Transportation Provider Behavior: service level decisions
3. Traveler Behavior: access mode choice

4. Transportation Network Flow Analysis: changes in highway travel times and traffic flow

- Analyze Results
  - Project Selection Decisions; Establish or Revise Policies

Airport specific data
Transportation network data

Model Components
Modeling Approach – Representation of Feedback Effects

- Model dynamic interaction between airport traveler decisions and transportation provider decisions
Modeling Approach – Mode Choice Model

• Role of mode choice model
  – Predict patronage on each ground access mode
    • Response to changes in ground access service levels
    • Implications for transportation provider revenue
    • Changes in vehicular traffic levels
  – Response to introduction of new services or modes
    • Enhanced intermodal connectivity

• Considerations
  – Need to reflect the factors that influence air party mode choice
    • Travel time, service frequency (waiting time)
    • Cost
    • Accessibility, transfers, etc.
    • Air party characteristics (party size, trip duration, trip purpose, etc.)
  – Need to distinguish between different market segments
    • Residents vs. visitors
    • Business vs. personal trips
Modeling Approach – Mode Choice Model

• General structure of the proposed model
  – Nested logit
    • Widely adopted for airport ground access mode choice
    • Allows for analysis of sub-modes and service choices
    • Permits different substitution patterns across different modes
  – Utility functions
    • General form: $a_0 + a_1 \times \text{var1} + a_2 \times \text{var2} + \ldots$
    • Variables
      – Cost/Income
      – In-vehicle travel time
      – Waiting time
      – Auto access travel time (to primary mode)
      – Walking distance
Modeling Approach – Provider Behavior Model

- Objectives for modeling transportation provider behavior:
  - Represent the response of transportation providers to the actions of air passengers, other providers, airport authorities and local government
    - Predict service decisions in response to
      - Fare and frequency changes by other providers
      - Addition of a new mode or service
    - Distinguish between public sector agencies and private sector operators
      - Importance of profitability to private sector providers
Modeling Approach – Provider Behavior Model

- Characteristics
  - Public providers:
    - Including: regional rail, transit bus, on-airport parking, airport shuttle bus and APM links
    - Subject to constraints from airport authority regarding access to terminals
    - May include airport financial support or government subsidy
    - Strategies may vary among providers
  - Private providers:
    - Including: rental car, off-airport parking, taxi, limo, shared-ride van, scheduled airport bus
    - Strategy: to maximize revenue (short-term) and profit (long-term)
      - Considering capital and operating costs
  - Special cases:
    - Provider service decisions based on other considerations: hotel courtesy van, charter bus
Modeling Approach – Provider Behavior Model

- Main factors affecting provider behavior
  - Public providers
    - Changes in revenues and costs
    - Passenger response to service characteristics
    - Availability of government subsidies
    - Local government policy and airport regulation
  - Private providers
    - Changes in revenues and costs
    - Passenger response to service characteristics
    - Policy and regulations: airport access restrictions, service area constraints, and airport fees
- Analytical approaches being evaluated
  - Service decisions based on operator perception of demand elasticity
  - Formal modeling of modal competition as a Nash Game
Data Requirements

• Airport Data
  – On-airport parking rates
  – Historical mode use data

• Highway Travel Time and Distance
  – MTC highway network

• Transit System Fares and Travel Times
  – MTC transit network
  – Explicit representation of BART and Caltrain fares and schedules

• Transportation Provider Data
  – Schedules and fares
  – Operating costs, capital costs
IAPT Development

- Current status of model development
  - Prototype version operational
    - Use of standard GUI features for ease of implementation
  - Simplified mode choice model
    - Multinomial logit model
      - 9 modes
        - Use of rental car and hotel courtesy shuttle treated as exogenous decisions
    - Model refinement in progress
      - Extension to nested logit structure
      - More detailed representation of modal utility factors
  - Transportation provider behavior
    - Nash Game approach (in progress)
  - Performance measures
    - Refinement in progress
IAPT Development

- Fit of current mode choice model
  - Oakland International Airport 2001

![Mode Choice Model Implementation](image_url)
IAPT Development – Mode Choice Model Enhancement

- Proposed nested structure

  - Private Auto
    - Drop-off (residents and visitors with residence trip origin only)
    - Park (residents only)
      - On-airport Daily lot
      - On-airport Economy lot
      - Off-airport lot
  - Rental Car (residents only – visitor rental car use modeled separately)
  - Exclusive Ride
    - Taxi
    - Limousine
  - Shared-Ride Van
  - Scheduled Airport Bus
  - Public Transit
    - Local bus
    - Regional rail (BART, Caltrain, VTA Light Rail)
Performance Measures

- **System Performance by Mode**
  - Number of passengers
  - Number of air parties
  - Revenue
  - Vehicle trips
  - Vehicle-miles of travel
  - Passenger travel times
  - Emissions: CO, NOx, VOC, PM10
  - Vehicle-hours of travel

- **Operator Performance (implementation in progress)**
  - Passengers/vehicle trip
  - Passenger-miles/vehicle-mile (load factor)
  - Revenue/vehicle-hour
  - Revenue/passenger
Performance Measures

• Connectivity Performance by Mode
  – Passenger waiting times
  – Passenger transfers
  – Connectivity-production cost
  – Relative accessibility
    • Weighted travel time by high occupancy modes to travel time by private vehicle
Demonstration

- IAPT functionality
  - Defining projects
  - Running the model
  - Viewing results

- Representative projects
  - Oakland Airport Connector
    - Service characteristics from DEIR
      - 6.4 minute travel time, 3.5 minute headway
    - Mode-specific constants relative to AirBART
  - Walnut Creek Off-Airport Terminal
    - Location in vicinity of SR 24/I-680 interchange
    - Express bus service to airport
      - $10 fare, 30 minute frequency
    - On-site parking at $5 per day
Discussion

- Further questions about IAPT functionality
- Potential use of IAPT in MTC and airport planning activities
- Desired features of IAPT and potential enhancements
- Implementation and usability considerations
  - Documentation
  - Technical support
  - Data
- Suggestions for further improvement