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

(Quarterly Meeting)

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Outline

• Project Status
• Case Study Analysis
• IAPT Development
• Next Steps
• Discussion
Project Status

- Objective
- Progress on Current Tasks
- Contents of Working Paper
Project Status - Objective

• 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’s behavior, traffic networks
  – Qualitative: Descriptive case studies and analysis of agency decision making processes

• Research products:
  – Case studies of intermodal access projects at California airports
  – Develop prototype Intermodal Airport Ground Access Planning Tool (IAPT)
  – Using IAPT to evaluate selected case study projects at California airports
  – Policy recommendations and planning guidelines
Project Status – Current Status

- **Task 1:** Review previous studies addressing ground transportation needs at California airports and select potential case study airports
  - Review of literature and previous studies continuing
  - Potential case study airports identified

- **Task 2:** Review potential case study airports with Caltrans and other agencies, confirm data availability, and select case study airports
  - Memo on potential case study airports prepared and reviewed with Caltrans
  - Presentation made to RTPA Aviation System Planning Working Group
  - Identification of data availability at case study airports in progress

- **Task 3:** Assemble data and analyze air passenger mode choice behavior at case study airports and potential use of intermodal connections
  - Assembly of data for Bay Area airports nearly complete
  - Assembly of data for additional case study airports in progress
  - Analysis of mode use at case study airports in progress
Project Status – Current Status

- **Task 4:** Prepare report on case study analysis of airport access issues and potential opportunities for improved intermodal connectivity
  - Preparation of draft working paper in progress

- **Task 5:** Define functionality and structure of modeling framework to analyze policy issues and potential intermodal projects
  - Preliminary design of graphical user interface completed
  - Planned functional specification of IAPT under development

- **Task 6:** Acquire and implement supporting software to perform transportation network analysis and assemble network data for selected region
  - TP+/Cube network analysis software acquired and installed on PATH computers
  - Bay Area highway network data files and transit travel time and cost skim trees obtained from Metropolitan Transportation Commission
Project Status – Progress on Current Tasks

<table>
<thead>
<tr>
<th>Number</th>
<th>Task Name</th>
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<tbody>
<tr>
<td>1</td>
<td>+ Document review and new research result monitoring:</td>
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<td>2</td>
<td>+ Review potential case study airports with Caltrans and other relevant agencies, confirm</td>
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<td>3</td>
<td>- Assemble data and analyze air passenger mode choice behavior at case study airport</td>
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<tr>
<td>3.1</td>
<td>Prepare a data collection plan identifying what types of data need to be collected, data sour</td>
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<td>3.2</td>
<td>Assemble air passenger survey data and/or other data on air passenger travel patterns from</td>
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<td>3.3</td>
<td>Assemble transportation provider data from transit agency and airport websites and other</td>
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<td>3.4</td>
<td>Analyze air passenger mode choice behavior at the case study airports and document current</td>
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<td>3.5</td>
<td>Develop a spreadsheet model to predict the potential attraction of air passenger trips to imp</td>
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<td>3.6</td>
<td>Apply spreadsheet model to evaluate the potential use of the improved intermodal connection</td>
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<td>4</td>
<td>+ Prepare report on case study analysis of airport access issues and potential opportuni</td>
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<tr>
<td>4.1</td>
<td>Prepare outline of working paper and assign sections to project team members to prepare in</td>
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<td>4.2</td>
<td>Prepare initial drafts of working paper sections and submit to task lead</td>
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<td>4.3</td>
<td>Integrate material into draft working paper and submit to Caltrans to review</td>
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<td>4.4</td>
<td>Revise draft working paper to address Caltrans review comments and produce final version</td>
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<td>5</td>
<td>+ Define functionality and structure of modeling framework to analyze policy issues and</td>
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<tr>
<td>5.1</td>
<td>Define functionality and structure of modeling framework including a detailed specification</td>
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<td>5.2</td>
<td>Develop a model of transportation provider behavior at a typical airport considering possible</td>
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<td>5.3</td>
<td>Identify and model the following interaction at an airport: (a) significant changes in ground</td>
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<td>5.4</td>
<td>Calibrate the model by comparing the observed behavior to that predicted by the theoretical</td>
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<td>5.5</td>
<td>Preliminary consideration of modeling transportation providers behaviors</td>
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<td>6</td>
<td>+ Acquire and implement supporting software to perform transportation network analysis</td>
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<tr>
<td>6.1</td>
<td>Review alternative network analysis and other software options for use in the project. Select</td>
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<td>6.2</td>
<td>Define the interface requirements between the different software components</td>
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<td>6.3</td>
<td>Acquire highway and transit network data files from the regional transportation planning ag</td>
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<td>6.4</td>
<td>Determine zone-to-zone highway and transit travel times and costs for use in mode choice</td>
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<td>6.5</td>
<td>Develop data conversion software if necessary for interface between different software parts</td>
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<td>7</td>
<td>+ Mode choice model analysis: Develop mode choice analysis module for the prototype</td>
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<td>8</td>
<td>+ Develop prototype IAPT and transportation provider behavior modeling: Develop prototype</td>
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<td>9</td>
<td>+ Prepare interim report</td>
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<td>11</td>
<td>+ Assemble data on existing mode use patterns and validate modeling framework for</td>
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<td>12</td>
<td>+ Identify potential strategies to improve intermodal connectivity at selected case study</td>
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<td>13</td>
<td>+ Discuss analysis results with Caltrans, RTPAs and airports, and develop draft recomm</td>
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<td>14</td>
<td>+ Review policy &amp; guideline changes with Caltrans Aeronautics</td>
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<td>15</td>
<td>+ Prepare final report and organize workshop</td>
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Project Status – Contents of Working Paper

Executive Summary
Chapter 1 Introduction
Chapter 2 Review of Recent Literature on Intermodal Access to Airports
Chapter 3 California Ground Access to Airports Study
Chapter 4 Intermodal Air Cargo Considerations
Chapter 5 Challenges and Opportunities for Improving Airport Intermodal Connectivity
Chapter 6 Analysis of Intermodal Opportunities at Selected California Airports
Chapter 7 Plans for More Detailed Further Analysis
Chapter 8 Conclusions

References

Appendices
A. Annotated Bibliography
B. Supporting Data for the Case Study Analysis
Case Study Analysis

Scope and Process
- Spreadsheet Analysis

SFO Data Analysis
Case Study Analysis - Scope and Process

- **Objective**
  - Preliminary evaluation of potential opportunities to improve intermodal connections at case study airports
    - Likely range of potential use of intermodal connections
    - Preliminary estimates of costs and revenues

- **Analysis approach**
  - Combined qualitative and quantitative approach
    - *Qualitative*: descriptive analysis and discussion of existing patterns of ground access mode use
    - *Quantitative*: spreadsheet analysis of potential changes in ground access mode use
  - Retrospective analysis of BART connections at Bay Area airports
    - AirBART shuttle bus connection at OAK
    - Direct service to airport station at SFO
Scope and Process - Spreadsheet Analysis

- **Trip generation and mode choice by zip code**
  - Calibrated to airport ground access data
    - Derived from air passenger surveys where available
    - Use of airport parking statistics where no survey data available
  - Use of simplified generic trip generation and mode choice models
    - Trip generation based on population and income
      - Separate models for four market segments
        » Resident business
        » Resident non-business
        » Nonresident business
        » Nonresident non-business
    - Mode choice based on travel times and costs
      - Assumes similar distribution of trip characteristics for each market segment
      - Mode choice based on random sample of 1000 representative trips
      - Travel times estimated from distance-based function
Case Study Analysis – SFO Data Analysis

- Study impact on ground access mode use of opening of direct BART connection to SFO in June 2003
  - Station entry and exits from BART
  - Ground transportation statistics from SFO
    - Parking lot exits
    - AVI counts
- Monthly trends
  - BART station exits
  - Parking lot exits
    - Short-term (6 hours or less)
    - Long-term
  - AVI counts
    - Taxi
    - Limousine
    - Door-to-door van
    - Off-airport parking shuttles
SFO Data Analysis

Ground Access Mode Use
San Francisco International Airport 2003

Exits / Riders / Vehicle Trips (per 000 pax)

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Ground Access Mode Use
San Francisco International Airport 2004

- Short Term Parking
- Long Term Parking
- BART Exits
- Taxi Trips
- Limousine Trips
- Door-Door Van Trips
- Off-Airport Parking Trips
SFO Data Analysis

Short-term Parking Use
San Francisco International Airport

Exits per 000 pax

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2000
2001
2002
2003
2004
SFO Data Analysis

Long-term Parking Use
San Francisco International Airport

Exits per 000 pax

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2000 2001 2002 2003 2004
SFO Data Analysis

BART Station Exits

Exits (000)

Jan 02 Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Jan 03 Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Jan 04 Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Colma
SFO
SSF to Millbrae
SFO Data Analysis

• **Conclusions**
  – BART use approximately equivalent to on-airport long-term parking
  – Some apparent diversion from long-term parking
  – No apparent impact on short-term parking

• **Data limitations**
  – BART exits do not distinguish between air passengers and employees
  – AVI counts measure vehicle trips, not passengers
    • No reliable vehicle occupancy data
  – Limited information on private vehicle drop-off and pick-up trips that do not involve short-term parking
Intermodal Airport Ground Access Planning Tool Development

- Overall Structure
- Graphical User Interface
- Functional Structure
- Data Collection
IAPT Development - Overall Structure

1. Decision Maker
   - Specifying a feasible alternative in the list for improving Intermodal connectivity
   - Result display
   - Analyzing results
   - Recommended changes in policies and guidelines

2. Mode & agency Model: agency activities
3. Customer model: Customer behavior – mode choice

4. Network analysis software for analyzing traffic flow

ITMS (Intermodal Transportation Management System)

Data request and receiving

Airport specific data
Transportation network data

Modeling block
IAPT Development - Graphical User Interface

- Provides users with a structured approach to defining and evaluating potential projects to improve intermodal connections at airports
  - Prompts for required information to perform analysis runs
  - Provides context sensitive help

- Use of a hierarchical structure of project alternatives to reduce data input needs
  - Child projects inherit attributes of parent project

- Allows for checking for data consistency and completeness before running model
Graphical User Interface
Graphical User Interface

**Intermodal Airport Ground Access Planning Tool**

- **Airport:** OAK - Oakland International Airport

**Select Project:**
- **New Project**
- 1 - BART Connector - baseline
- 1.1 - BART Connector - $5 fare
- 1.1.1 - BART Connector - $5 fare, 5 min hdw
- 2 - Improved AirBART Link
- 2.1 - Improved AirBART Link - free

Select project and press **OK** or press **Cancel** to return to previous screen.

**Select Existing Project**
Graphical User Interface

Intermodal Airport Ground Access Planning Tool

Airport: OAK  Oakland International Airport
Project: 1.1  BART Connector - $5 fare

Project Description:
Automated people mover connection between BART Coliseum station and airport terminal. Elevated guideway with one track in each direction. Each car carries up to 10 people. 3 car max. consist. Four intermediate stations. 10 minute headway. $5 fare between airport and BART, $2.50 to intermediate stations. {new text shown in blue}

Edit text and press OK to save changes or Cancel to return to previous screen

OK  Cancel

Edit Project Description
Graphical User Interface

Intermodal Airport Ground Access Planning Tool

**Airport:** OAK Oakland International Airport

**Project:** 1.1 BART Connector - $5 fare

**Select MOP:**
- - select one - -
  1. Add New Measure of Performance
  2. BART Connector Ridership
  3. BART Connector Revenue
  4. Other HOV Ridership
  5. Auto Vehicle Trips
  6. Auto VMT

Select Existing MOP
Graphical User Interface

Intermodal Airport Ground Access Planning Tool

- **Airport:** OAK Oakland International Airport
- **Project:** 1.1 BART Connector - $5 fare
- **MOP:** 3 Other HOV Ridership

**Output Measure:**
- **Passengers**

**MOP Description:**
Ridership on door-to-door vans, scheduled airport bus, and AC Transit. [new text shown in blue]

**Modes:**
- Auto drop
- Auto park
- Rental car
- Hotel courtesy van
- Taxi
- Limousine
- Door-to-door van
- Scheduled bus
- BART (Connector)
- AC Transit

**Edit MOP Definition**

- Edit text and mode selections and press OK to save changes or Cancel to return to previous screen
Conceptual Structure of IAPT

1. Define a Planning Problem
   For a specified airport

2. Passenger or freight

3. Determine Planning Level
   - 3a. Airport Level
   - 3b. Regional Level
   - 3c. State Level

4a. Select mode and services alternatives

4b. Select performance measures

5. Generate Passenger demand

6a. Run calibrated mode choice model

6b. Run Transportation Provider’s Behavior model

7. Calculate vehicle occupancy

8. Generate vehicle trips and time

9a. Load calibrated regional non-airport traffic

9b. Load airport Traffic

Traffic from airport

10. Run traffic mode

11. Output traffic parameters into file

12. Calculate traffic performance parameters including VMT, emission

13. Output to file

Stop

Travel time & distance
Generate passenger demand

- Air party characteristics for a sample of air passengers are provided from air passenger survey data
- Weights applied to each record in air passenger survey file convert survey responses to annual traffic (or other time frame)
- Future level of total airport traffic determined from external forecasts (e.g. airport master plans)
- Air party weights in sample survey data can be adjusted to match forecast traffic
- If there is an expected change in future composition of traffic, air party weights can be adjusted accordingly
IAPT Development – Functional Structure

- **Mode choice model**
  - Disaggregate choice model applied to a sample of air parties derived from air passenger survey
  - Nested logit structure computes probability that a given air party will choose each mode
    - Depends on characteristics of air party and service attributes of alternative modes
  - Sum of probabilities across all air parties in sample gives usage (passengers or air parties) of each mode
  - Weights applied to each record in the air party sample convert sample counts to annual traffic (or other time frame)
IAPT Development - Functional Structure

- Develop a transportation provider's behavior model
  - Using a game theory approach: What rules guide their behavior
  - To understand cooperation or competition between providers
  - Group providers offering similar services: collective competition
  - Principles for utility function definition
    - To distinguish private and public providers
    - To reflect each provider’s business goal
  - Private providers
    - Objective: maximize profit
    - Control parameters: fare and service frequencies
    - Secondary goal: reduce operating cost
    - Constraints: capacity, operating limitations (e.g. frequency of price changes)
  - Public transportation providers
    - Objectives: maximize service availability and quality
    - Secondary goals: increase ridership, reduce operating cost
    - Constraints: capacity, operating limitations (e.g. frequency of fare changes), available subsidy
IAPT Development - Data Collection

- **Data Requirements**
  - Air passenger characteristics
    - Bay Area data from MTC 2001 and 2002 air passenger survey
  - Transportation service data for different modes
    - Determines air party mode choice behavior
    - Modes
      - Parking
      - Taxi
      - Limousine/hire car
      - Rental car
      - Door to door van
      - Scheduled airport bus
      - Public transit (BART, Caltrain, Bus)
  - Transportation mode use data for different modes (same as above)
    - Calibration of mode choice model
      - Adjust for seasonal variation and changing market composition over time
IAPT Development - Data Collection

• Progress to date
  – Met with staff in landside operations or planning departments for three Bay Area airports
    • Obtained ground access mode service and use data for each airport
  – Obtained air passenger survey data and traffic network data from MTC
  – Obtained transportation service provider data by contacting individual agencies or from their websites, such as BART and door to door van companies

• Continuing activities
  – Air passenger data cleaning
    • Checking consistency of survey data
  – Additional service and mode use data collection
    • Follow up with airport staff and transportation service providers
    • AVI data from SJC and OAK
      – Waiting for response from SJC and OAK
      – SFO AVI data has been obtained
  – Putting all data in standard format
Next steps

- Complete case study analysis working paper
- Continue data collection for IAPT development
- Data cleaning
- Preliminary mode choice modeling
- Develop transportation provider behavior model
- Refine design of IAPT
  - Define data file structure
  - Define software functional specifications
Discussion

- **Role of qualitative approach**
  - Qualitative aspects of ground access mode choice
    - Comfort and convenience
    - Perceptions of personal security
    - Information availability
  - Qualitative analysis
    - Characterization of transportation provider behavior
    - Comparative assessment of case studies

- **Other issues**