Combined Quantitative and Qualitative Planning for Improved Intermodal Airport Ground Access in California

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The efficiency of air transport is important for the fast growing globalized economy. The capacity of an airport is mainly determined by two factors: air traffic and ground transportation for access/egress the airport. A major airport is usually a very sophisticated intermodal station for ground transport of goods and passengers. The Bay Area has three such airports: San Francisco International (SFO), Oakland International (OAK), and San Jose International (SJC). They are naturally interconnection parts: (a) air passenger and airport employee travel choice behavior based on existing data sources; (b) transportation provider’s behavior (decision making for services and fares); (c) traffic network analysis software; (d) cost benefit analysis for evaluation for decision making on proposed projects to improve intermodal connectivity at airports. Based on the results of this case study analysis, policy recommendations and planning guidelines will be developed and reviewed with Caltrans and other stakeholders. The goal of developing the IATP is to ensure a consistent approach to analyzing alternative projects and simpli-

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Airport Ground Access Planning Problems

Ground egress/access to airports is divided into passenger (including airport employees) and air freight in planning. Although, operation and planning are essentially different, they affect each other. Operation is subject to the constraints of policies and guidelines recommended by the planning processes. The performance of execution of the policy and guideline deduced from the planning will necessarily feedback to the decision making for further improvement of ground access through planning processes (Fig. 2). In different levels of planning and operation, it is necessary to have coordination between each party of different levels and across the levels to optimize the performance of the overall system.

Stage 1 - Strategic planning: Provides long run and higher level planning [2], usually conducted with a qualitative method with assistance of quantitative analysis such as simple aggregated data analysis. It identifies the problems, deficiencies and needs in the institutional issues, political relationships, funding strategies, recommendation principles, recommended policies and guidelines to solve those problems and to amend the gaps. However, strategic planning does not provide ways to evaluate a practical project and to make decisions if it should be funded. Particularly, it does not point out the best way to plan a project under specific circumstances.

Stage 2 - Refined (implementation related) planning: To conduct planning in this stage, a quantitative analysis is necessarily emphasized more than in strategic planning. It is to answer the questions as how to solve the problems, to amend the gaps, and to remedy the deficiencies. The outcome is to provide the optimal solution to practical problems under specific circumstances. Since the end result of planning is to provide some recommendation and guideline changes, it is necessary to combine the quantitative analysis with a qualitative method such that the policy and guidelines thus recommended fit the practical situation.

Stage 3 - Real-time Operation (Coordination): The function of coordination is prominent for both quantitative approach and qualitative approach for optimal planning and operation for a large scale system, like the intermodal airport ground access system. It may involve the coordination in the same level and across different levels. However, the coordination has different meanings in qualitative and quantitative approaches. In a qualitative approach, coordination means some institutional and political relationships among all the relevant government and planning agencies. A higher level government agency is necessary to conduct such a coordination process. In a quantitative approach, it means the coordination of all the modes involved in the intermodal connections to optimize the performance of the overall system, for example, in travel time, cost and traffic impact.

A Combined Quantitative and Qualitative Approach

Traditionally, most planning uses a qualitative approach. Although some quantitative modeling has been proposed in research, they are seldom combined with qualitative considerations in practice. This project suggests using a combined approach which adopts the advantage of both quantitative and qualitative approaches. The combined approach is to capture the characteristics of the system with models as much as possible with available data and to account for those factors with a qualitative approach, which are difficult to quantify.
Qualitative Approach

The function of the qualitative approach here is to identify the most relevant factors in the implementation related planning, which are difficult to take into consideration in the quantitative modeling, to study how those factors would affect the improvement of airport ground access in California, and to combine those factors with the results from quantitative analysis. Those factors include political relationships, institutional issues, and information to passengers and transportation providers, which are often difficult to incorporate in the modeling. It may involve some data analysis which can only describe some characteristics of the system qualitatively. Obviously, such a combination is absolutely necessary for the application of policy and guideline changes thus obtained in the practically situations and to evaluate their performance.

Quantitative Approach

This approach is to use models to capture the characteristics of the system to the extent possible with the available data. The main parties involved in airport ground access planning include: (a) Passenger (air passenger and airport employee) behavior; (b) transportation providers at the airport (primary modes) and those in relevant zones (secondary modes); (c) decision makers: airport authorities and government in different levels (city, county, and the State); (d) traffic networks (highway and rail) that connect the airport and the influence zones of the airport. There exist some interactions among the four parties. Mathematical models need to capture the behaviors of those parties and the interactions [3]. The overall picture for modeling is depicted as the shaded parts in Fig. 3.

Passenger Behavior Model: This model is to capture the characteristics of mode choice behaviors of air passengers and airport employees [1]. Different passengers with different travel purposes will weight differently the following factors when they make a decision as to choose which mode for airport access/egress: price, travel time, comfort, and service frequencies. Customers make decision for mode choice may subject to their income level, distance to travel, purpose of travel, car ownership, seasons, large events like 9.11.

Transportation Provider Behavior: Transportation providers are divided into public and private sectors. They have slightly different characteristics in operation although they all hope to attract more customers. Transportation providers may affect customer mode choice by varying price and services such as adding/reducing service path and areas (nodes) and adjusting service frequencies. Customer mode choice behaviors will back affect the transportation provider behavior through ridership and eventually the revenue and profit returns. Transportation providers are basically competing with each other within a mode and between modes for the fixed demand – the passengers who access/egress the airport. However, some collaboration exists between some modes and/or services if they belong to the same alliance.

Highway Traffic Networks: Compared to general road traffic, the traffic generated by the airport ground access/egress of both passenger and goods is a small amount in some distance away form the airport. However, it may have significant impact on the traffic at the airport and its vicinity. The highway network traffic would affect passenger mode choice decision and the provider’s services in cost and travel time.

Regional and State Government: Government needs to consider the factors from social, economic, and environmental cost and benefit aspects. The role of government in different levels is to affect airport planning through policies and guideline for funding of new projects which may involve establishing some new modes, improving current mode services, enhancing information systems to customers and transportation providers, and building some new roads. The expected effects of policy and guidelines involve relieving traffic congestions, reducing air pollution, and optimizing land use.

Challenges in Modeling:

Prediction for Planning: For planning purposes, the model is required not only to capture the system characteristics at the time point when the data are available, but also to predict the changes of the system when some critical factor changes. At least it should have the capability for prediction in the following cases: (1) changes in services for some mode(s) or transportation provider(s) such as capacity, scheduling, fare, and routing; and (2) some new mode(s) created. Under those circumstances, it is necessary to answer the questions as how the customer will change their behavior in mode choice and how the transportation providers to change their strategies in operation. It is also required to predict over time: how to model those behaviors to forecast the situation for some years to come.

Dynamic or Static Modeling: The relationships among the four parties involved are dynamical in nature. For prediction, we need to answer the question as how to capture the dynamics in the model. A preliminary consideration is to consider the system at their equilibrium similar to the traffic network modeling.
IAPT Design and Software Development

This project proposes to develop a computer tool (IAPT) for assisting airport ground access planning. This tool would use a graphical user interface (GUI) to link the decision maker, cost-benefit analysis, passenger, transportation provider and network traffic models to evaluate several types of alternatives for comparison of the relevant Traffic Analysis Zones (TAZ) for the specified airport. This comparison will allow the decision maker to choose the optimal project for improvement in airport ground connectivity. The block diagram of the IAPT is depicted in Fig. 3.

Concluding Remarks

To improve airport ground access for both air passengers and airport employees and air freight, integrated planning and coordination among decision makers of all levels is necessary. To evaluate the system performance over different alternatives for decision making, it is necessary to predict the system characteristics over a time period and the changes of several key factors. This requires a combined quantitative and qualitative approach. The quantitative part is to model the behaviors of main parties (passenger, transportation provider, traffic network, and decision maker) involved and interactions between them based on available data. The qualitative part is to address the factors which are difficult to quantify such as institutional issues, political relationships, and information factor. This project will eventually develop a computer tool IAPT to assist decision makers to evaluate different alternatives.

Acknowledgement:

This project is funded under the Caltrans-PATH Program TO5406. Other researchers in the team are: Dr. Geoffrey D. Gosling, Prof. Avishai Ceder, Dr. Steven Shladover and Jing Xiong (GRS).

References:


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