Forecasting for Aviation System Planning

DAVID RUBIN AND NEIL D. LERNER

Aviation system planning forecasts, unlike other aviation forecasts, require information on the geographic distribution of activity to make possible evaluation of the trade-offs between nearby facilities in the attraction of activity, such as originating air passengers or based general aviation aircraft. To obtain forecasts of this geographic distribution, it is necessary to develop base demographic data and forecasts for defined geographic areas within the study area. Using these demographic forecasts, bottom-up forecasts of aviation activity can be generated, often controlled by a top-down control total. These activity forecasts are then assigned to airports on the basis of accessibility and service level considerations, using either manual or computerized methods. Demographic forecasts for small geographic areas are difficult to obtain and often must be generated from current data and larger area forecasts. The exceptions to this are the urban transportation planning data sources for most urban areas. The federally mandated urban transportation planning process includes the forecasting of variables that affect urban travel at a Transportation Analysis Zone level. Aviation forecasts were recently completed as part of the Continuing Florida Aviation System Planning Process and the Ohio Aviation System Plan Update, using the techniques of top-down forecasts controlling bottom-up distributions, with the bottom-up data based, for the urban areas, on urban transportation planning data and, for the rural areas, on current data and regional forecasts.

Aviation forecasts are done for several reasons by aircraft manufacturers, airlines, investment analysts, the Federal Aviation Administration (FAA), airport owners, and state and local governments. Each of these forecasters brings to the task an agenda of needs, data sources, and expectations. The forecasts differ accordingly. For instance, the forecast being used to determine the viability of a bond issue is inherently more conservative than the master plan forecast being used to determine land acquisition needs, as well it should be because the consequences of erring on the high side are much greater. Aviation system planning also has a particular set of needs to forecast and special data requirements to meet those needs.

Aviation system planning forecasts are special cases because it is not sufficient to simply develop a forecast of future demand. It is also necessary to determine where this demand will come from in order to formally include competition between facilities in meeting the demand. Not all system plan forecasts have appropriately addressed these special needs. This paper is a discussion of some of the unique requirements, processes, and data needs of aviation system plan forecasting, illustrated by recent examples.

Aviation system planning, as mandated by the FAA, is the analysis of the need for and location of airports within a geographic region, usually a metropolitan area, substate region, or state *(1)*. To plan for a system of airports and determine the future activity levels at the airports in the system, the relationship between aviation activity and the location of aviation users must be determined. Aircraft owners, pilots, and air passengers choose the airport they use, and that choice is based on a multiplicity of factors, including travel time from points of origin, costs, and accessibility to the desired service—be it a tie-down space for a single-engine aircraft or a commercial flight to Los Angeles. System planning is intrinsically based on an analysis of that choice, and the forecasting process must therefore facilitate the analysis of the choice.

The methods for analyzing choice drive the process of forecasting. Most of the current methods are derived from urban travel planning and use data available from urban travel simulation models. These models are in use in nearly every metropolitan area and have generated data bases of socioeconomic data by small geographic area (Transportation Analysis Zones or TAZs) that can be used for aviation forecasting. They also have travel time data from each of these zones to all other zones, often for peak and off-peak travel by car, bus, or rail. The steps of generation and distribution can be used with these data for air carrier trips, based aircraft, or pilot activity.

REQUIREMENTS OF THE SYSTEM PLANNING FORECAST

To plan for a system of airports, the activities that determine airport capacity and congestion must be forecast. These are the same activities that master planning forecasts require, although there is a need for greater detail for master planning. They include aircraft movements and basing requirements and the passenger movements that determine terminal and access needs. For system planning, the interaction of several airports affects how activity is allocated to each. Therefore, if forecasts are to be generated before alternatives are developed and evaluated, they have to be independent of the system. It could be argued that the system itself will affect the forecasts. Accepting that argument would require a reiteration of the forecasting process for each alternative to reflect the induced activity caused by increased convenience or the lessened activity caused by a loss of facilities. Most system plans have not forecast induced or restrained demand.

The way to forecast aviation activity independent of the airport is to forecast it where it begins—in transportation planning parlance, where it is "generated." Air passengers begin trips at home, at the workplace, or at a hotel. Owners of based

COMSIS Corporation, 11501 Georgia Avenue, Wheaton, Md. 20902.

aircraft begin either at home or at work—depending on how the aircraft is used. The trip to the airport is an essential part of the air trip, and the choice of airport is affected by that ground trip as well as the available services at the airport.

After air trip generation forecasts have been made, the trips must be distributed to facilities. In regions with multiple commercial airports in competition with each other, such as Washington-Baltimore, New York–Newark, or San Francisco–Oakland, the choice of airport has been studied and is a function of travel time, choice of modes, fares, and schedules of available flights at the alternative airports. People will drive past one airport to get to a more distant airport with a convenient flight. Airport choice has been modeled *(2, 3)* as has airport access mode choice *(4)*. These models are patterned after the mode choice models of the urban transportation planning process. Decisions about which airport to use to base an aircraft or from which airport to rent an aircraft are based on similar considerations—travel time, facility level, availability and cost of aircraft storage and maintenance, and capacity and congestion factors. These, too, have been modeled *(5)* but are more commonly considered in a qualitative manual process *(6)*.

PREDICTOR VARIABLES

Whether done manually or by computer, the distribution process requires a forecast based at the origin of the trip, not the chosen airport. This necessitates a basis for forecasting activity within the region. There are two ways to accomplish this, either top down or bottom up. In a top-down forecast, the region as a share of the nation or the state is forecast, and this control total is allocated to zones within the region. In a bottom-up forecast, aviation activity is forecast for the zone on the basis of the socioeconomic characteristics of that zone, and zonal forecasts are accumulated to obtain a regional forecast. The two methods can be used independently or together, with one controlling the other. Either way, the distribution of activity to zones requires the availability of forecasted predictor variables.

One of the difficulties that distinguish system plan forecasts from other aviation forecasts is the need for predictor variables that are applicable at the zone level. The best predictors for commercial air travel, at the national and international level, are national economic variables such as Gross Domestic Product or National Income. These become useless for forecasting even at the state level because no historic data or forecasts are available. There are few economic activity forecasts below the state level. Population forecasts are often the only ones available at county and municipal levels because of their importance for educational facilities planning. Employment, income, sales, and other economic activity forecasts are generally not available.

The exceptions are the variables forecast for urban transportation planning. Thanks to the federally encouraged urban transportation planning process *(7)*, nearly every urban area with a population of more than 100,000 has done a transportation study using the standard four-step urban transportation planning process or a modification thereof. The four-step process includes trip generation, trip distribution, mode choice, and trip assignment. Trip generation requires socioeconomic forecasts by zone, and the other three steps require travel times between zones on the highway network. As a minimum, trip generation requires population; employment; and an income surrogate, often automobile ownership. In more sophisticated studies, retail employment, school enrollment, density measures, transient accommodations, and other factors are also forecast and used in the modeling process. (Many studies include consideration of special generators such as airports and major institutions. They then need the airport activity forecast as an input.) Thus, as a by-product of the urban transportation planning process, there often exist forecasts of local demographic and economic variables as well as coded roadway networks with travel times.

If these data are readily available, they can be used in aviation activity forecasting. Historical air travel activity correlates well with population and employment, and the coefficients of these regression equations can be used as a basis for distribution. Income surrogates are especially useful in predicting the origins of aviation activity, which correlate strongly with upper-income areas. Specific employment forecasts are preferred to general ones because the trips generated by different types of employment are quite different. Office employment generates an order of magnitude greater number of air carrier trips than manufacturing employment *(8)*.

For areas for which these data are not readily available, they can be developed from population forecasts and current data if the assumption of continuing current relationships can be made. This is particularly useful in a region in which many of the counties have an urban transportation planning process with available data and the remaining rural counties do not. Forecasts from the Bureau of Economic Activity (BEA) of the U.S. Department of Commerce for the nonmetropolitan portions of the BEA region *(9)* are useful. These forecasts provide control totals for employment and income and can provide forecast growth rates.

SURVEY DATA

Trip generation is substantially easier with survey data. An inventory of the ownership of based aircraft will provide a base-year distribution that can be correlated with the available predictor variables to develop the coefficients to use in forecasting changes. A survey of departing or arriving passengers can provide the base-year distribution and the basis for forecasting changes. An air passenger survey can also provide data on the choice of airport access mode; the basis for choosing among airports; the trip generation rates of individuals (e.g., how many air trips have you taken in the last 12 months?); and the attractiveness of unusual land uses that do not lend themselves to ordinary treatment, such as resorts, retirement communities, or large institutional land uses. The air travel generated by Disney World or the Pentagon is not readily ascertained by traditional forecasting techniques without the benefit of a survey. Many airports regularly conduct surveys of departing or arriving passengers, within the terminal or on the aircraft, for use in airport facility planning. These surveys can be modified to provide the data needed for system planning.

If there is a strong basis for allocating base-year activity to zones, the distribution of forecasts can be used to allocate only the changes. This prevents anomalies from occurring when the forecast equations do not properly replicate the base year for a particular zone or group of zones.

EXAMPLES FROM RECENT EXPERIENCE

Forecasts have recently been completed for the Continuing Florida Aviation System Planning Process *(10)* and the Ohio Aviation System Plan Update *(11)*. These forecasts are both based on statewide control totals projected using top-down methodology based on national and state regression equations using available forecasted socioeconomic variables. In Florida, population, employment, and accommodations are the three socioeconomic variables. In Ohio, they are population, employment, and total personal income.

In both states, zone systems were developed to distribute the aviation activity. Zones in the metropolitan areas with urban transportation planning processes are aggregations of TAZs. Zones in rural areas are counties or census enumeration districts within larger counties. For each zone, current and forecast values were required for the three forecast variables. These data were available from the urban transportation planning data bases but had to be developed in the rural areas. BEA forecasts for multicounty areas were apportioned to the zones within those areas on the basis of current data.

Activity was then distributed to zone using, for most forecasts, the coefficients from the regression equations as a basis. For the Florida origination forecast, data from a Florida tourism survey were used to develop trip generation rates. Each forecast socioeconomic variable was then multiplied by the appropriate coefficient to calculate a forecast. The sum of the forecasts for all zones was normalized to the control total. If current activity data by zone were available, only growth was forecast for each time period. For general aviation aircraft, the FAA's Census of Civil Aircraft was sorted by county and zip code and assigned to zones as base data. Growth was then distributed and added to the base. For air carrier originations for which there were no survey data, total values were forecast for each year.

The forecasts by zone were then assigned to airports—in Florida using computer models and in Ohio using manual methods. Travel time and availability of services were the major factors considered in the assignment process. The base-year assignment was balanced to base-year, airport-specific data as a model calibration exercise.

REFERENCES

1. *Planning the State Airport System*. Advisory Circular 150/5050-3A. FAA, U.S. Department of Transportation, June 1972.
2. Simat, Helliesen and Eichner. *A Study for the Development of Stewart Airport*. Metropolitan Transportation Authority of New York, January 1973, Vol. 4.
3. *Passenger Origination Demand Assignment Model (PODAM)*. Planning Research Corporation, New York, 1975.
4. *Airport Access in the Washington-Baltimore Region*. Peat, Marwick, Mitchell and Co., March 1971.
5. *General Aviation Demand Assignment Model (GADAM)*. Planning Research Corporation, New York, 1975.
6. *Ohio Aviation System Plan, General Aviation and Air Carrier Forecasts*. Ohio Department of Transportation, Columbus, June 1987.
7. *The Urban Transportation Planning System (UTPS)*. UMTA, U.S. Department of Transportation, 1985.
8. *Maryland Aviation System Plan Technical Report*. Maryland Department of Transportation, Annapolis, March 1976.
9. *OBERS BEA Regional Projections*. U.S. Department of Commerce, 1985.
10. COMSIS Corporation. *Aviation Demand Forecast Documentation*. Technical Memorandum. Florida Department of Transportation, Tallahassee, May 1986.
11. COMSIS Corporation. *Ohio Aviation System Plan Update*. Ohio Department of Transportation, Columbus, 1988.

Publication of this paper sponsored by Committee on Aviation Economics and Forecasting.