INFLUENCE OF AIRSIDE AND OFF-AIRPORT FACTORS ON LANDSIDE CAPACITY

Robert L. Paullin, Research and Development Resources Management Division, U.S. Department of Transportation

OBJECTIVES

1. Identify all airside and off-airport factors that influence landside requirements.
2. Determine the relative importance of such factors with respect to airport landside capacity and level-of-service objectives.
3. Recommend a research and development program that will promote coordination of airside, landside, and off-airport activities.

PARTICIPANTS

Robert Horonjeff, chairman, James Andersen, Robert W. Bentley, Gene Brymer, Jack E. Clark, Walter Hart, John C. Kal, William V. Megee, Arthur J. Negrette, J. C. Orman, Robert L. Paullin, Revin Poka, David Sheftel, Richard I. Strickland, and C. P. Sweet, Jr.

For the purposes of this report, the airport airside is defined as a system of three components—runways, taxiways, and apron-gate areas—on which aircraft and aircraft support vehicles operate. The relations between aircraft and apron-gate areas dictate to a great extent the physical arrangement of the terminal complex and the processing of passenger and cargo. Air traffic control procedures (including those reflecting the effect of wake vortexes) are major factors that influence operations on the runway component; therefore, the runway component is defined to encompass the approach and departure paths to and from the runways. The landside is defined as those areas that are within airport boundaries and used for the passenger and air freight processing and circulation functions. The environs outside of the airport boundary are

referred to as the off-airport area.

In a geographical sense, the environs closer to the airport boundary have a more pronounced influence on landside capacity than does the geographical area farther from the airport boundary. In an institutional sense, however, the entire urban area around an airport has a major influence on the landside capacity of an airport. The airport boundary has been a barrier to total systems planning and should be deemphasized in future efforts. Multijurisdictional responsibilities for airports and their environs should be better coordinated.

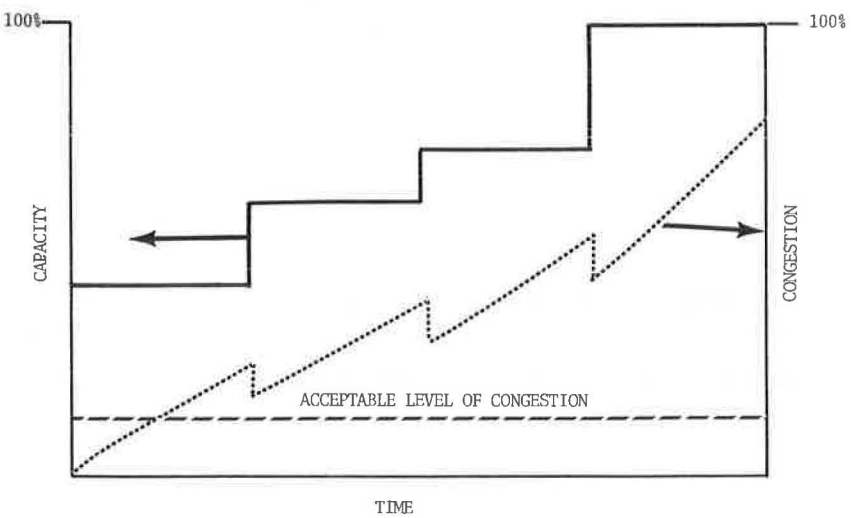
Airports are perhaps the first truly intermodal terminals in the transportation system. They provide an interface among air, highway, rail, and even waterway travel. They are an important part of the medium- and long-distance intercity transportation system.

The influence of airside and off-airport factors on on-airport landside capacity has been and is being experienced to varying degrees at airports today. Concern has been expressed that the capacity of major airports will be constrained in the future by off-airport and on-airport landside factors. The accuracy and magnitude of this concern have yet to be quantified and analyzed. The fact that those who are close to airport operation and to the interface between air travel and land and waterway travel have expressed concern is sufficient reason for researchers and planners to delve more deeply into the influence of the related parts of an airport on its capacity. This report identifies the significant airside and off-airport factors that do or can influence on-airport landside capacity. Recommendations are made regarding research, development, and demonstration programs dealing with airside and landside factors that influence airport capacity. These recommendations are aimed at promoting balance and coordination between airside and landside activities.

Airports are no longer merely runways and terminals for the interchange of passengers and cargo between automobiles and airplanes. They tend to be cities within themselves and to have a large population of passengers, visitors, employees, and those serving the needs of the airport users. In the interest of efficiently and effectively supplying service, the influence of airside and off-airport factors on landside capacity must be better understood. The discussion in the following sections of this report is aimed at developing that understanding.

The increase in congestion and the provision of additional capacity at major airports are different phenomena. Congestion growth is curvilinear, but capacity growth is a stairstep process. The 2 growth patterns are shown in Figure 1.

Figure 1. Congestion and capacity growth levels.



Capacity is increased by the addition of a new access road, for example. Such additions provide a major increase—thus, the stairstep growth. Congestion on the other hand is increased by added demand on an access road. Such additions in demand amount to the curvilinear pattern for congestion. The discussion in this report is focused at that point at which the demand cannot be met with an acceptable level of service.

The following discussion considers the national goal of most efficiently using the existing transportation system (e.g., in-place terminals, access roads, and ramps), energy, and financial resources; improving safety; and reducing environmental pollution. Further, both technical and socioeconomic research subjects are addressed.

AIRSIDE FACTORS INFLUENCING LANDSIDE CAPACITY

Airside factors influencing landside capacity can be categorized as physical, operational, financial, environmental, and social. They may act independently or jointly and be a function of a given airport size, type, and location. The major airside factors are

1. Availability of land for expansion for runways;
2. Availability of aids to navigation and air traffic control techniques that could result in reduction of separation between aircraft;
3. Noise;
4. Aircraft mix;
5. Load factor;
6. Exclusive use and mutual use of gates;
7. Eligibility under ADAP of airside facilities;
8. Availability of airspace;
9. Aircraft operations to maximize use of airfields;
10. Size, capacity, and location of gates;
11. Staffing, equipment, and procedures required for processing passengers, baggage, and freight;
12. Environmental regulation; and
13. Community attitudes toward airside operations.

The location of the apron-terminal complex and its overall configuration has a major effect on the landside capacity of an airport and a lesser effect on airside operation. If the terminal functions are spread over a large geographic area, access and egress facilities have to be expanded to accommodate the spread-out configuration of the terminal. If terminal facilities are grouped together, the access-egress facilities can be congregated into a smaller geographical area. The capacity of the landside is a function of the terminal design, which has a major influence on the relation between airside and landside capacity.

OFF-AIRPORT FACTORS INFLUENCING LANDSIDE CAPACITY

In the early days of aviation, most airports had only one road connecting the airport with the nearby town. Today airports, however, are often surrounded by the urban and suburban environment. In these cases, the off-airport factors and functions can have a significant influence on the landside capacity of a large airport. The possible range of off-airport functions and activities influencing landside capacity are

1. Off-airport access,
2. Off-airport parking,
3. Off-airport terminals,
4. Urban development pattern,
5. Multiple jurisdiction, and
6. Financial resources.

The subfactors of the off-airport access functions are

1. User and vehicle characteristics, e.g., occupants per vehicle;
2. Separate and preferential guideway subsystems;
3. Roadway traffic management;
4. Access link to major transportation corridor, e.g., freeway or expressway; and
5. Ground transportation connectors.

Airport access is that portion of an air trip that is accomplished outside of the airport boundary on the local and regional transportation system. As such, accessibility to the airport is predominantly a surface function; only a few major airports offer air access between the airport and its urban areas.

Off-airport access can be a factor in the traveler's decision to travel by air or by surface transportation, particularly if the trip is of short distance. The more accessible an airport is, the stronger will be its attraction to travelers.

One of the most significant factors that passengers consider in selecting a mode is the total trip time. If the access time to the airport plus the air trip time is greater than the total trip time by surface transportation, the passenger will often select the surface mode. Because of the peaking nature of airport access, which coincides strongly with urban traffic peak-hour demand, inadequate airport access can have an adverse effect on both urban transportation and the performance of airlines.

In analyzing off-airport access, one must keep the proper perspective between airport trips and nonairport trips. Airport trips are only a small part of the traffic demand on the roadway system in the vicinity of major airports. Combined nonairport and airport trips can result in road system overloads. Off-airport access improvement must, therefore, be coordinated with general road system improvements or include means of by-passing congested road system segments.

Off-airport access can be improved through roadway traffic management techniques, which can be applied to the major thoroughfares and corridors surrounding or near an airport and to the links between the airport and the major corridors. Ramp metering systems, incident clearing systems, and motorist information systems, which focus on surveying and controlling major urban traffic corridors, are being demonstrated in several areas throughout the country. They have not been applied to airports per se, but their influence on improving airport access could be great.

Sometimes a short link that connects the airport and the major transportation corridor and is often owned neither by the airport owner nor the owner of the main transportation corridor can significantly influence landside capacity. An example is a link that lies between a major urban airport and a freeway and is owned by a municipality whose residents are opposed to continued operation of the airport. The opposition stems from the environmental pollution considered to come from airport operations. Because of this attitude toward airports, the access link is given a low priority by the municipality in its overall urban transportation operation.

A separate influence on ground transportation stems from the private limousine, taxi, and bus operators who furnish multioccupancy vehicles for ground transportation connections between the airport origins and terminations in the urban areas. Publicly owned vehicles and systems are now forcing this group out of business in some places. Their influence on the off-airport and landside capacity balance should be reviewed from both an institutional and a capacity viewpoint.

Off-airport downtown terminals (either full service or transfer terminals) have been used in the past, but the trend is toward fewer locations. In the past, they were considered an asset to aviation in that they focused passenger choice to the air mode. Today, however, their indirect costs have offset their benefits. In addition, the air transportation industry has matured to the point that focusing passenger choice to air has considerably less payoff. A third factor is that today trip origins and terminations are spread throughout the urban area and not concentrated in the central business district. Although the CBD is still the largest single generator of airport trips, it now accounts for only 25 to 30 percent of them. The experience and data concerning off-airport terminals should be reviewed and collected so as to provide a ready source as

a means of positively influencing landside capacities.

RESEARCH DEVELOPMENT AND DEMONSTRATION NEEDS AND OPPORTUNITIES

The research and development recommendations of Workshop 4 are discussed below; they are oriented toward socioeconomic research and compilations of the state of the art.

1. Federal policy with respect to use of ADAP funds for balancing airport development. The current ADAP funding program favors airside elements of the airport more than landside elements. Consequently, the airside capacity may be larger than the on-airport landside capacity. It may be desirable for the FAA to study the implications of a policy that in effect would permit the FAA to withhold funds for airside projects that would disproportionately increase the capacity of the airside over the capacity of the landside. The implementation of such a policy at the field office level should also be analyzed.
2. Federal policy with respect to the use of ADAP funds for new and existing airports. A study should be made of the implications of an ADAP program that does not include the use of funds for acquiring land for (a) new airports to be developed in the future and (b) approach and departure paths for runways beyond that eligible today. The study should include the growth of the air transportation system with and without new airports and the measures to evaluate the magnitude of the land purchased for other than safety purposes. For example, the alternative of purchasing buffer land for noise pollution requires that measures for evaluating the compatibility of noise with the community be established. Such specifications or standards would be needed by field office personnel who are assigned the administrative responsibility of responding to sponsors for requests for the purchase of land outside the airport facility.
3. Aircraft mix. The impact of changing the size, combination of sizes, and number of aircraft on landside flow and performance should be investigated. Would adjustments in aircraft mix improve the flow and performance of the airport landside capacity? What are other impacts, e.g., economics?
4. Environmental regulations. Federal, state, and local environmental regulations have an impact on airport airside and landside capacity. The degree of the impact varies among states and airports. If more severe environmental regulations are promulgated, increased demands and constraints may be placed on the future airport developments and operations. The impact of existing and planned environmental regulations on airport capacity should be investigated. Alternative trade-offs should be proposed between the current airport standards and design criteria and the foreseen changes required by environmental regulations. The cost factors related to environmental regulations should be included in this study.
5. Community attitudes. Largely because of the impact of environmental pollution, many communities have a negative attitude toward airports. In most localities, the community near the airport directly influences the size and operation of the airport and, thus, governs in part the performance of the airport. An analysis of community attitudes, including their causes and impacts, regarding airports, airlines, and the aviation community in general should be conducted. Study factors should include environmental issues, labor disputes, socioeconomic concerns, and the airport influence on and benefit to the community.
6. Mutual use of aircraft gates at airports. Space for airport gates at most airports is limited, and the cost of adding additional gates is high. Existing gates might be used more efficiently if they were available to all airlines serving the airport. Research should be conducted to determine the practicality of the use of gates by all airlines during the periods of maximum operation. Airline operations with respect to aircraft servicing, enplanement of passengers and cargo, baggage claim, deplanement of cargo, and baggage transfer and the financial impact on the airport owner should

be included in this research.

7. Maximize use of existing airside facilities. Changes in the air traffic control procedures and equipment are being considered by FAA. Research should be conducted to identify and investigate the influence of possible changes on landside demand and capacity. Hourly capacities and delays of instrument and visual flight rules and cite-specific applications and payoff should be included.

8. Monitoring of off-airport user characteristics. Off-airport user characteristics include the types of vehicles, the number of occupants per vehicle, and the times the vehicles are in use. A general methodology should be developed to determine user characteristics at each location. The research should include methodologies to predict the future vehicle conditions on the airport landside and the relation between landside activity on and off the airport.

9. Potential for encouraging use of existing ground transport systems and vehicles to provide airport access. Buses, limousines, and taxis owned and operated by private companies furnish ground transportation services to and from airports. Increased use of this service by those now using their private automobiles for airport trips would decrease the demand for roadways, parking spaces, and terminal curb space. In addition, through-ticketing from origin to destination could possibly be developed; the private companies could be used as links in the system. A study should be made of the potential advantages and disadvantages of encouraging the increased use of existing ground transport systems.

10. Potential for using alternative transport systems and vehicles to provide airport access. Most airport access trips are made in private automobiles, taxis, and limousines. Alternative transport systems such as the demand-responsive vehicles and helicopters might supplement constrained landside and off-airport capacities. Particular groups of airport users such as employees might be more amenable to changing from the private automobile than would other types of users. A research study should evaluate existing alternative transport vehicles, identify conditions required to sustain airport access, investigate the existence of political or financial barriers, and investigate the advisability and effectiveness of existing ground transportation that promotes multipassenger movement.

11. Urban development patterns as factors in influencing airside and landside capacities and operations. Urban development patterns sometimes constrain airport expansion and at the same time impose greater demands on the services provided by airports. A study should be undertaken to analyze whether different land use patterns could determine the selection of access alternatives and hence air transportation service. A state-of-the-art document should be published to make the findings available to air transportation planners and the general public.

12. Analysis of financial resources impacting airport landside capacity. Several alternatives have been suggested for off-airport transportation needed to balance airport landside capacity. An analysis should be conducted of the financial aspects of the alternatives and include for each alternative or each set of alternatives total revenue and total costs presented in present worth terms. A methodology should be developed that is applicable to large airports and based on an existing large airport structure.

13. Improvements to ground access by easily implemented and low-cost traffic management techniques. Several existing traffic management techniques, such as traffic surveillance and control, changeable-message signs, and ramp metering, that might be used to improve airport ground access should be evaluated and perhaps demonstrated at an appropriate airport.

14. Airport access links to major transportation corridors. Access links between the airport boundaries and a freeway, expressway, or other major transportation corridor are often controlled by local entities that are not highly involved with airport operation. Processes should be developed to encourage interjurisdictional coordination and programming of interrelated projects.

15. Off-airport terminals, passengers, and cargo. Off-airport terminals may involve public transportation, ticket processing, baggage processing, or a combination of these functions. Although there has been a great deal of experience with off-airport terminals, it has not been documented. A project should be undertaken to bring to-

gether and publish all known facts concerning off-airport terminals for use by transportation planners and researchers.

16. Off-airport parking. The advantages and disadvantages of off-airport parking to airport landside capacity should be identified in studies of existing and planned off-airport parking operations.

SUMMARY

Airside and off-airport factors that influence airport landside capacity can be broadly categorized as technical or nontechnical, i.e., financial, institutional, and environmental. The recommendations in this report for research development and demonstration programs to relieve the constraints on balancing and expanding airport landside capacity pertain to the nontechnical factors. Knowledge and skills are needed in nontechnical areas, such as the management of transport systems, their financing, and the complexity of the environmental impact review process.

The first research and development effort should focus on a compilation of information on airside and off-airport factors that would be useful for (a) the development of policy with respect to federal funding and (b) planners and planning agencies in their work on airport development.