IDENTIFICATION OF LEVELS OF SERVICE AND CAPACITY OF AIRPORT LANDSIDE ELEMENTS

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OBJECTIVES

1. Identify the dimensions of service relevant for expressing and assessing the level of airport landside operations.
2. Suggest level-of-service criteria for various users of airport landside capacity under the full range of congestion conditions.
3. For various airport development plans and strategies, determine the levels of service required to meet the needs of all airport users.
4. Recommend a research and development program that will be useful in determining acceptable levels of service for all users of airport landside systems and subsystems.

PARTICIPANTS

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Workshop 1 participants concluded that many elements, including passengers, baggage, visitors, employees, freight, and services, have a direct impact on airport landside capacity and levels of service and are in competition for space and services. However, the passenger is the most important of these elements, and all improvements should evolve around the passenger's needs for space and service. Many participants also indicated that, for conceptual purposes, capacity and level of service should be considered together. Capacity without a corresponding level of service does not serve a fully useful purpose, for the passenger is concerned more with the level of service provided than with the capacity of the airport landside.

Capacity may be defined in several ways. The following definition is given in the Highway Capacity Manual (1):

> Capacity is the maximum number of vehicles which has reasonable expectation of passing over a given section of a lane or a roadway in one direction (or in both directions for a two-lane or three-lane highway) during a given time period under prevailing roadway and traffic conditions.

The following definition was suggested by the workshop participants:

> Capacity is the physical provision required for a given demand at a given time at a specified level of service.

The general definition for capacity relative to aircraft operations on the airside is as follows:

> Capacity is the maximum number of aircraft that the airside can accommodate in a given period of time under a fixed set of conditions for a mix of aircraft types, runway configurations, and weather conditions.

Capacity in the latter sense is divorced totally from the demand profile. However, once the demand profile is imposed on the system for which the capacity is known, then one has a measure of the level of service. Although capacity relating to landside functions was not given a refined definition, several participants desired to relate capacity for landside operations to the level-of-service concepts.

When capacity is defined as ultimate or maximum capacity, it is generally associated with the lowest level of passenger service. Higher levels of passenger service are generally attained when demands are below the ultimate or maximum capacity of a system. The term "productivity" was offered as a substitute for the term capacity, but met with considerable resistance. Service volume was another term offered for consideration to reflect the different degrees or ratios of use of maximum capacity and received favorable response.

The landside boundary was defined as the area from the point at which the passenger enters the airport by whatever mode to the point on the apron at which the passenger enters the plane. The landside thus includes all the intraairport access roads and ramps, internal distribution systems, parking facilities, curbside loading and unloading, terminal buildings, and that part of the apron around the plane used to service the passengers.

CONCEPTS OF CAPACITY AND LEVEL OF SERVICE

Although the concepts of capacity and level of service and their interrelation have been understood, accepted, and widely used in the highway field for many years, their application to airport landside facilities has been fairly recent. The concepts are shown in Figures 1 and 2.

Figure 1 shows that service cannot keep up with demand and levels off at some maximum service rate somewhat below the demand. The curve represents the peaks occurring over a given time interval, perhaps a 24-hour period. One can either design a system to adequately serve the maximum demand (peaks) or some percentage of that peak demand. Different levels of service can occur at different times or even at the same time within large systems. However, the lowest level of service that occurs at the peak design period determines the overall operating level of service for a given facility. It should be pointed out that some facility elements are relatively more important than others (i.e., a missed plane is more critical than delayed baggage).

Figure 2 shows this process for levels of demand. At low demand levels, the

Figure 1. Relation of service and demand.

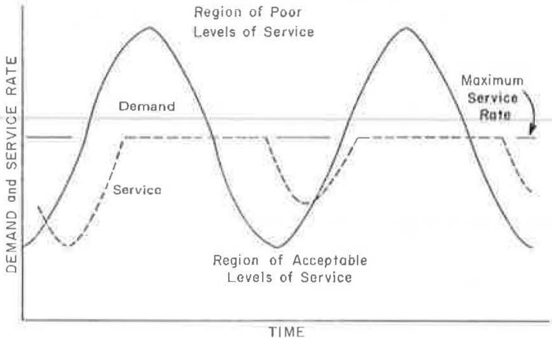
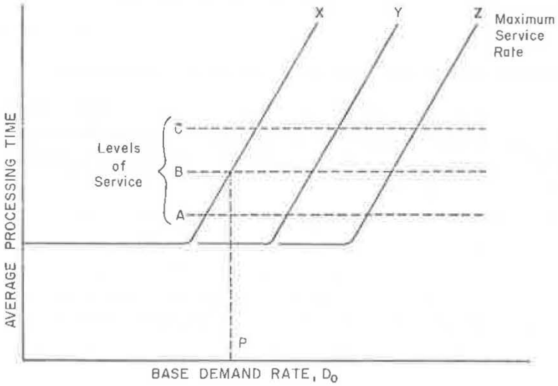


Figure 2. Relation of levels of service, demand, and capacity.



processing time is more or less constant; but at some higher level of demand, the processing time increases. For illustrative purposes, 3 levels of service and 3 service rates are shown. For a given demand rate, the average processing time can be determined. If the service rate for a given airport is defined by the curve X and if the airport desires to operate at a level of service B or higher, the capacity of the airport (or segment) is found at point P. Thus, the capacity measurement is directly related to a given level of service. If the demand increases beyond point P, the airport does not have sufficient capacity to provide a level of service B. If the demand is lower than point P, a higher level of service than B results. An optimum capacity ratio is determined not by the number of people who are processed through a terminal (landside facilities) but by the maximum rate that can be sustained for some period of time.

The curves do not reflect an exact portrayal when the airport becomes totally congested or when demand becomes high. For example, the service rate approaches a maximum as more and more people move into the system so that the actual throughput may decrease as demand increases. This demand or volume represents, in traffic flow theory, the point of critical capacity or the "jam" density.

DEVELOPING AND ESTABLISHING CAPACITY AND LEVEL-OF-SERVICE STANDARDS

Developing, establishing, and promoting levels of service for airports is not easy. For example, assume that an enplaning passenger can be processed through the airport from the boundary to the aircraft door in 17 minutes (5 minutes to check in and check bags, 3 minutes to clear the security check, and so on). The 17-minute processing time could be fixed as level of service A. But that service level has another aspect: How many passengers can be processed during a given time period, say a 15-minute interval, during the peak hour? Level of service A is now related to a capacity measurement. One hundred passengers may be processed through the terminal during the highest 15-minute interval during the peak hour such that no one takes longer than 17 minutes from the boundary to the aircraft door. Thus, capacity is related to a level-of-service measure.

Is the passenger entitled to the same level of service (17-minute processing time) at all times of the day or night? Some argue that passengers are entitled to the same level of service for paid tickets no matter what hour, day, or month they are processed through the airport. This argument may be irrelevant because the theoretical or desirable maximum capacity is based on peak conditions such as the highest 15-minute interval during the peak hour or design hour. Level of service A, if account is taken of convenience, possible delays, and maximum interference, should include the worst conditions permissible under that level of service. If operating conditions drop below this level (e.g., processing takes 20 minutes), then the airport is operating at some other level of service, even though it may be able to operate within the conditions set for level of service A for 90 percent of the time.

An airport designed to operate at lower levels of service may operate within the range of level of service A from midnight to 5:00 a.m. At a lower level of service, however, one could expect congestion, long lines, inconveniences, delays, interference, malfunctions, and slow processing. Level of service F would be experienced when complete breakdown occurs, such as when passengers miss their flights. To operate at a given level of service requires that certain standards be applied to the various influencing factors, elements, or components of the airport landside.

A level of service standard infers a ranking and rating of the airport. It may be given a rating of 20, meaning that it takes 20 minutes to process an enplaning passenger through the airport from the boundary to the aircraft door. (The variance in the average processing time may be a significant measure of the system's level of service; i.e., a large variance would indicate a poor system.) Before the airport can be rated, each component must be rated. This requires a determination of the path of the passenger in conjunction with the longest average processing time. For example, the passenger may enter the airport boundary in a private automobile, be alone, have bags to check, and have no ticket. He or she goes to a parking facility, obtains a parking ticket, finds a parking space, leaves the automobile, and walks to the terminal entrance at the curb (7 minutes); walks from the entrance to the airline ticket counter, obtains ticket, and checks bags (4 minutes); walks from ticket counter to escalator or elevator and to security check (3 minutes); passes through security check (2 minutes); walks or rides to gate area (1 minute); checks in and receives seat assignment (2.5 minutes); and walks to aircraft door (0.5 minute)—a total of 20 minutes. A passenger who has no bags or who is dropped off at the curbside may be able to clear the terminal in 18 minutes, not including any time spent at a concession stand, in a restaurant, or in a restroom.

Most of the participants agreed that the sum of the ratings for the various segments then becomes the overall level-of-service rating for the airport. Some disagreed with this method, however, because the segments are too dissimilar.

When airport capacity or level of service is to be improved, priorities will have to be established to decide which segments to improve. A weighting scheme for an overall value for level of service can be used to develop improvement priorities. An airport may have a satisfactory level-of-service rating while one of its segments functions at a low level of service and may not, therefore, receive funds for improvements. Management should determine when the level of service should be improved, even that for a small problem segment, and provide funds for improving it at any location. The criterion for improvement should not necessarily be based solely on the weakest link because certain large airports should be able to justify expenditures for improvements that could not be justified at small airports. Some airports have problems of delays with take-offs and landings, and others do not. Some airports are basically commuter airports, some are mostly connecting, and some are mostly originating and terminating. Some airports serve small communities with low densities; others serve large communities with extremely high densities. All of these factors must be considered when level-of-service standards are established and financial assistance is provided to attain the standards.

FAA is primarily interested in the level of service as it pertains to measuring capacity because that is what it perceives to be the basic problem. Airports that have demands beyond their capacity are a major problem in the national aviation system. FAA is responsible for solving these kinds of problems with the tax money collected from passengers. FAA has the dual role of both promoting and representing aviation and representing the passengers as airport users and serving as their advocate. Thus, FAA must see that the passengers obtain the best level of service possible (however the cost is spread) and must measure capacity so that future capacity problems can be alleviated and the role of aviation thus enhanced.

The airport landside operation is basically concerned with one element: the passenger. The passenger's perception of good service is contingent on the smooth functioning of the airport segments. On the segment basis, FAA could provide funds to an airline for specific improvements, such as baggage handling or operation improvements that are determined by the airline to be needed. The same process could be used to allow the airport operator to make the decisions as to how the funds should be spent. Regardless of who makes the decision, an application must be submitted for funds and must suggest how those funds are to be spent. To decide whether the funds will be spent appropriately, the funding agency must have guidelines by which it can evaluate the application and audit the progress at some future period after the project has been completed.

ISSUES

Seven basic issues or sets of questions were presented to the workshop participants for their consideration. Although they did not respond to each question in great detail, they felt that their responses did portray the general state of knowledge of airport landside capacity and levels of service. The participants felt that many of the questions required further study and research for the formulation of appropriate detailed answers.

Issues 1 and 2: Airport Users and Quantitative Dimensions of Level of Service

The passenger functions are defined as airport system user demands and are divided into 2 categories: (a) ground access and egress and (b) terminal building. The ground access and egress category is concerned with the vehicle and how it occupies the roadway and competes for various service functions until it is parked or arrives at the curbside. The terminal building category deals with the vehicle either parked or at the curbside and the demand for terminal building mobility, performance, capacity, and facilities for people and their baggage.

In Tables 1, 2, 3, and 4 the columns represent user demands and the rows represent facility functions. In Table 2, the fixed guideway transit includes dedicated right-of-way. In some cases, transit buses may operate on exclusive, dedicated right-of-way and use a separate station. A system operating on a dedicated right-of-way does not, however, include anything operating in mixed traffic at the common curb. The ground access and egress system is a combination of roadway, parking, and curbside functions. Problems encountered in developing Tables 3 and 4 involved methods for aggregating or disaggregating some particular function. An effort was made to avoid complicating either the terms or the matrix because of the desire for simplicity. One

Table 1. Level-of-service characteristics of ground access and egress system: automobiles.

		Private					
Facility	Type of Measure	Passenger	Well-wisher and Greeter	Employee	Rent-a-Car (passenger only)	Taxi (passenger only)	Limousine (passenger only)
Curbside	Quantitative	N.A.	Space availability Delay time in and out Service variability range Proximity to terminal entrance Lane width and number	N.A.	Space availability Delay time in and out Service variability range Proximity to terminal entrance Lane width and number	Space availability Delay time in and out Service variability range Proximity to terminal entrance Lane width and number Fare Privilege space Staging and loading Taxi availability and supply	Space availability Delay time in and out Service variability range Proximity to terminal entrance Available route Frequency Staging area Fare Baggage capacity
	Qualitative	N.A.	Safety Weather exposure	N.A.	Safety Weather exposure	Safety Weather exposure	Safety Weather exposure Comfort Identification route and carrier Signing
Parking	Quantitative	Entry cost Space availability Proximity to terminal Entry and exit delays	Entry cost Space availability Proximity to terminal Entry and exit delays	Dedicated	Space availability Proximity to terminal Entry and exit delays	N.A.	N.A.
	Qualitative	Security of lot Weather exposure Safety Signing	Security of lot Weather exposure Safety Signing	Security of lot Weather exposure Safety	Weather exposure Signing	N.A.	N.A.
Roadway	Quantitative	Safety Level-of-service criteria Adequacy of merging and diverging lanes	Safety Level-of-service criteria Adequacy of merging and diverging lanes	Safety Level-of-service criteria Adequacy of merging and diverging lanes	Safety Level-of-service criteria Adequacy of merging and diverging lanes	Safety Level-of-service criteria Adequacy of merging and diverging lanes	Safety Level-of-service criteria Adequacy of merging and diverging lanes Priority lanes
	Qualitative	System understandability Signing Safety	System understandability Signing Safety	System understandability Signing Safety	System understandability Signing Safety	System understandability Signing Safety	System understandability Signing Safety

Note: N.A. = not applicable.

Table 2. Level-of-service characteristics of ground access and egress system: trucks and transit.

			Transit	
Facility	Type of Measure	Trucks (passenger only)	Bus (passenger only)	Fixed Guideway
Curbside	Quantitative	Space availability Delay time in and out Service variability range Proximity to terminal entrance Lane width and number	Space availability Delay time in and out Service variability range Proximity to terminal entrance Lane width and number Availability Fare	Space availability Delay time in and out Service variability range Proximity to terminal entrance Lane width and number Availability Volume capability
	Qualitative	Safety Weather exposure	Safety Weather exposure Vehicle identification	Safety Weather exposure
Parking	Quantitative	Space availability Proximity to terminal Entry and exit delays	N.A.	N.A.
	Qualitative	Security of lot Weather exposure Safety Signing	N.A.	N.A.
Roadway	Quantitative	Safety Level-of-service criteria Adequacy of merging and diverging lanes	Safety Level-of-service criteria Adequacy of merging and diverging lanes Priority lanes	N.A.
	Qualitative	System understandability Signing Safety	System understandability Signing Safety	N.A.

Note: N.A. = not applicable.

Table 3. Level-of-service characteristics of terminal building system: passengers.

Facility	Type of Measure	Originating	Terminating	Connecting	Through	Standby
External walkway	Quantitative	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handicapped	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handicapped	N.A.	N.A.	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handicapped
	Qualitative	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	N.A.	N.A.	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment
Baggage check	Quantitative	Processing time Service variability range	N.A.	N.A.	N.A.	N.A.
	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	N.A.	N.A.	N.A.
Ticketing	Quantitative	Processing time Service variability range	N.A.	N.A.	N.A.	N.A.
	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	N.A.	N.A.	N.A.
Internal circulation	Quantitative	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger
	Qualitative	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Informations systems and signs Pedestrian density Cleanliness Security Environment
Public waiting	Quantitative	Number of seats Size of area Lighting	Number of seats Size of area Lighting	Number of seats Size of area Lighting	N.A.	Number of seats Size of area Lighting
	Qualitative	Seating arrangements Comfort Privacy Amenities	Seating arrangements Comfort Privacy Amenities	Seating arrangements Comfort Privacy Amenities	N.A.	Seating arrangements Comfort Privacy Amenities
Security	Quantitative	Processing time Service variability range Location re concessions	N.A.	Processing time Service variability range Location re concessions	N.A.	Processing time Service variability range Location re concessions
	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment
Departure lounge	Quantitative	Processing time Service variability range Number of seats Size of area Lighting Location re concessions	N.A.	Processing time Service variability range Number of seats Size of area Lighting Location re concessions	Processing time Service variability range Number of seats Size of area Lighting Location re concessions	Processing time Service variability range Number of seats Size of area Lighting Location re concessions
	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment
Boarding means	Quantitative	Walking distance Level Change Aids to handicapped	Walking distance Level Change Aids to handicapped	Walking distance Level Change Aids to handicapped	Walking distance Level Change Aids to handicapped	Walking distance Level Change Aids to handicapped
	Qualitative	Exposure to weather Safety Convenience	Exposure to weather Safety Convenience	Exposure to weather Safety Convenience	Exposure to weather Safety Convenience	Exposure to weather Safety Convenience
Baggage claim	Quantitative	N.A.	Processing time Service variability range Area size Pedestrian density Claim frontage Care of handling	N.A.	N.A.	Processing time Service variability range Area size Pedestrian density Claim frontage Care of handling

Table 3. Cont'd.

Facility	Type of Measure	Originating	Terminating	Connecting	Through	Standby
Baggage claim	Quantitative	N.A.	Aids to handicapped Proximity to curb			Aids to handicapped Proximity to curb
	Qualitative	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment Security Availability of skycap Location re concessions Seating	N.A.	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment Security Availability of skycap Location re concessions Seating
Information services	Quantitative	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped
	Qualitative	Understandability	Understandability	Understandability	Understandability	Understandability
Concessions and miscellaneous services	Quantitative	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes
	Qualitative	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities
International clearance	Quantitative	Processing time Service variability range	Processing time Service variability range	Processing time Service variability range	Processing time Service variability range	Processing time Service variability range
	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	N.A.

Note: N.A. = not applicable.

Table 4. Level-of-service characteristics of terminal building system: visitors, employees, and baggage.

Facility	Type of Measure	Visitor: Well-wisher and Greeter	Visitor: Other	Employee	Baggage: Check-in	Baggage: Carry-on	Baggage: Transfer
External walkway	Quantitative	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handicapped	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handicapped	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handicapped	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handicapped	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids for handicapped	N.A.
	Qualitative	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety information Systems and signs Pedestrian density Cleanliness Security Environment	N.A.
Baggage check	Quantitative	N.A.	N.A.	N.A.	Processing time Service variability range	N.A.	N.A.
	Qualitative	N.A.	N.A.	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	N.A.
Ticketing		N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Internal circulation	Quantitative	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	Walking distance Pedestrian assists Pedestrian density Direct flow Lighting Aids to handicapped Cost to passenger	N.A.
	Qualitative	Exposure to weather Safety Information system and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information system and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information system and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information system and signs Pedestrian density Cleanliness Security Environment	Exposure to weather Safety Information system and signs Pedestrian density Cleanliness Security Environment	N.A.

Table 4. Cont'd.

Facility	Type of Measure	Visitor: Well-wisher and Greeter	Visitor: Other	Employee	Baggage: Check-in	Baggage: Carry-on	Baggage: Transfer
Public waiting	Quantitative	Number of seats Size of area Lighting	Number of seats Size of area Lighting	N.A.	Make-up and storage area	N.A.	Make-up and storage area
	Qualitative	Seating arrangements Comfort Privacy Amenities	Seating arrangements Comfort Privacy Amenities	N.A.	Make-up and storage area	N.A.	Make-up and storage area
Security	Quantitative	Processing time Service variability range Location re concessions	N.A.	N.A.	N.A.	Processing time Service variability range Location re concessions	N.A.
	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	N.A.	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.
Departure lounge	Quantitative	Processing time Service variability range Number of seats Size of area Lighting Location re concessions	N.A.	N.A.	N.A.	Processing time Service variability range Number of seats Size of area Lighting Location re concessions	N.A.
	Qualitative	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.	N.A.	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.
Boarding means	Quantitative	N.A.	N.A.	N.A.	N.A.	Walking distance Level Change Aids to handicapped	N.A.
	Qualitative	N.A.	N.A.	N.A.	N.A.	Exposure to weather Safety Convenience	N.A.
Baggage claim	Quantitative	N.A.	N.A.	N.A.	Processing time Service variability range Area size Pedestrian density Claim frontage Care of handling Aids to handicapped Proximity to curb	N.A.	N.A.
	Qualitative	N.A.	N.A.	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment Security Availability of skycap Location re concessions Seating	N.A.	N.A.
Information services	Quantitative	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped	Consistency Redundancy Legibility Aids to handicapped
	Qualitative	Understandability	Understandability	Understandability	Understandability	Understandability	Understandability
Concessions and miscellaneous services	Quantitative	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes	Number and type Location and size Aids to handicapped Conformance with codes	N.A.	Number and type Location and size Aids to handicapped Conformance with codes	N.A.
	Qualitative	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities	Services provided Courtesy of personnel Environment Amenities	N.A.	Services provided Courtesy of personnel Environment Amenities	N.A.
International clearance	Quantitative	N.A.	N.A.	N.A.	Processing time Service variability range	N.A.	N.A.
	Qualitative	N.A.	N.A.	N.A.	Convenience Complexity of procedure Courtesy of personnel Environment	Convenience Complexity of procedure Courtesy of personnel Environment	N.A.

Note: N.A. = not applicable.

may view these various characteristics as the major influences on level of service.

In general, numerical measurements will be easier to obtain for items in the quantitative row than for items in the qualitative row. A substantial number of characteristics are difficult, if not impossible, to quantify, but this does not imply that no consideration will be given to the qualitative characteristics. For example, one should be able to quantify certain characteristics related to the parking of an automobile (i.e., entry costs, space availability, proximity to terminal, and entry and exit delays), but not other factors affecting level of service for parking (i.e., security of lot, weather, exposure, safety, signing). However, these qualitative characteristics have a direct impact on the level of service provided at the parking locations.

To determine the most appropriate quantitative and qualitative dimensions in which to express levels of service is difficult. The most suitable dimensions appear to be time, distance, area, cost, comfort, and convenience. Passenger attitudes are critical in these areas, and participants felt that attitudinal surveys were required to further explore these concepts. The airport complex is composed of many components, and a capacity and level-of-service rating will have to be determined for each component or segment. To aggregate the capacity and level of service of the individual segments into a single rating for the airport landside as a whole will be difficult. However, the majority of the workshop participants felt that a given airport should have a single capacity and level-of-service rating; a minority of participants felt strongly that this could not be accomplished. All participants indicated that each segment on the landside of the airport could have a capacity and level-of-service rating. Through the use of individual segment capacity and level-of-service determination, priorities in improvements can be established.

To obtain a rating on capacity and level of service for each segment and for the airport as a whole, the workshop proposes that

1. Data be accumulated on each landside segment for use in evaluating each such segment,
2. Each segment be weighted in order of its importance to the overall landside operation,
3. A proposed numerical value be arrived at for each segment and a rating for the airport landside level-of-service target,
4. The proposed values and ratings be reviewed with airport operators, airlines, concessionaires, and others,
5. The final results be distributed to all airports for use as a performance target of their landside levels of service both for segments and the overall airport operation, and
6. All airports and other users be notified of any changes that may be anticipated for each landside segment as a result of research and development studies.

Complex systems, composed of elements with different individual variations in service, will sometimes collectively produce the wide variations in service that are associated with poor performance. If the reliability of the performance of the individual elements can be increased, the total service performance will, in general, be increased. By analyzing system variability, one can develop planning and operating guidelines to reduce the probability of larger variations in service. Also in the determination of capacity and level of service, ranges of values are more desirable than average numerical values because they allow for minor variation. Composite measures of walking time, service time, and delay time fail to adequately measure the passenger tradeoffs of the different kinds of time. Waiting and delay tolerances are related to passenger expectancies, which may be different for the various elements of the system.

An examination of the patterns of peaking behavior should be made to develop measures of the effect of batching. That is, a single enplaning or deplaning 747 may have a completely different impact on the levels of service and capacity requirements from that of 2 or more 727s enplaning or deplaning simultaneously. A comprehensive, systematic analysis of peaking and its impact on capacity and levels of service should be conducted. Computer simulation techniques are useful in performing sensitivity analysis on the relative importance of variations in demand and service on the performance of the system.

Just as the configuration of aircraft and their arrival and departure schedules have an impact on capacity and levels of service, vehicle ground traffic at the curbside presents substantial problems. This situation should have the same kind of intensive treatment as any other portion of the airport landside area. Vehicles and passenger maneuvers at the airport curbside often represent a mix of various kinds of vehicles as well as a mix of those vehicles and people. The automobile has been traditionally favored to the point that curb space is often totally inadequate. As demands for surface transit at airports increase, the curb space requirements increase also. The bus, although it may be only 40 ft (12 m) long, requires some 60 ft (18 m) of space to maneuver without creating delay or hazard. Since many airports have been designed to serve the automobile at the curbside, integrating large buses into the same curb space is difficult. The original design of the airport landside area often hinders the increased use of surface transit. Often, highway and traffic engineering design and operations are not taken into adequate consideration in the design of the curbside portion of the airport landside complex. A comprehensive analysis should be made of this area for capacity and level-of-service determination. Computer simulation can be effective in performing the various sensitivity analyses required.

Workshop responses to the specific questions of issues 1 and 2 are given below.

1. Who are the users of the airport landside system and its various subsystems? There are 3 major categories: passengers, nonpassengers, and access and egress modes. These basic categories are further broken into subsets as follows:

Air passengers
- Originating, terminating, connecting, interline and on-line, through, and standby
- International and domestic
- Short haul (<500 miles) and long haul (>500 miles)
- Business, pleasure, and commuting
- Age, sex, income
- Group size
- User frequency
- Values of travel group
- Baggage (none, carry-on, checked)

Nonpassengers
- Visitors (greeters, well-wishers, and others including sightseers, shoppers, and restaurant users)
- Employees on-site (airline, airport, concession) and off-site

Access and egress modes
- Automobile—private (passenger, well-wisher and greeter, employee), rent-a-car, and taxi
- Limousine
- Bus transit
- Fixed guideway
- Truck
- Rail freight
- Pipeline
- Helicopter
- General aviation aircraft
- Water transportation

2. What constitutes the airport landside system? Participants generally agreed that the airport landside system should be limited to areas within the airport boundary.

On this basis, the landside was defined as the ground access and egress system (airport boundary to automobile parking or curbside) and the terminal system (automobile parking or curbside to the aircraft door). Access and egress outside the airport boundary are as important as access and egress within the airport boundary since, from the viewpoint of the passenger, the total trip normally begins and ends somewhere away from the airport.

3. What are the various subsystems for which levels of service must be considered? Tables 1, 2, 3, and 4 categorize these subsystems, which include all of the components of the airport landside complex that have an impact on the air travelers.

4. In what quantitative dimensions can level of service best be expressed? To determine the most appropriate dimensions is difficult. The dimensions best suited appear to be time, distance, area, and cost. Comfort and convenience are also important but are difficult to quantify.

5. To what extent are such dimensions dependent on aircraft fleet mix, peaking of demand, methods of passenger handling, types of passengers, and shift changes of airport employees? The dimensions of level of service are extremely dependent on aircraft fleet mix and peaking of demand, for both aircraft mix and demand peaks affect static and dynamic volumes of passengers. The use of large aircraft, coupled with peak demands, reduces the possibility of a desirable "trickle flow" of passengers and tends to produce extremely large batches that overload landside facilities. Methods of passenger handling are also critical factors in defining level of service, for these methods are responsible for many bottlenecks in the landside, particularly in the terminal building. However, the passenger processing dimension is interrelated with that of aircraft fleet mix and peak demands, for the higher capacity aircraft create batch loads and thereby compound problems at the airline ticket counters, security checks, and other places. The types of passengers, such as business or pleasure travelers, also affect level-of-service dimensions. Different types of passengers require different types of services, some of which are not compatible. Shift changes for employees can also create level-of-service problems particularly in the airport access and egress systems.

Issues 3 and 4: Level-of-Service Measures and Values

In the discussions of issues 3 and 4, a number of assumptions were made:

1. Level of service is a function of capacity,
2. A range of level-of-service characteristics can be defined,
3. Certain level-of-service attributes can be measured quantitatively,
4. Quality of service is a right of the public, and
5. Emphasis on level of service during airport landside system planning should be increased.

Based on these assumptions, one must recognize that level-of-service measures, design targets, and level-of-service targets are difficult to accomplish and require the involvement of airport management, operators, airlines, concessionaires, ground transport agencies, and those responsible for customs, immigration, and security matters.

Attaining a balanced level of service is further complicated by a multiple-actor infrastructure. FAA promotes airside level-of-service criteria that are not always compatible with those for landside capacity and levels of service. The ability of airline and aircraft manufacturers to change technology can also lead to an imbalance. Under present conditions, levels of service are the results of management prerogatives. Ground transportation, for instance, can be negotiated by airport management, but customs and immigration requirements cannot be. Other activities can be developed on a more flexible basis.

Conflicting and overlapping jurisdictions also complicate the implementation of level-of-service standards. The same agencies do not have jurisdiction over both the airside and the landside elements. As airports begin to reach their physical limits, a balance is needed between the airside and the landside to maintain the effectiveness of the whole system.

Financing level-of-service improvements can be accomplished with or without federal funding. If fairly stringent standards for levels of service are imposed, however, financial assistance from the federal government may be required by some airports.

Discussion of specific questions of issues 3 and 4 is summarized in the following comments.

1. How can level-of-service measures most effectively be promulgated? This question implies the establishment of a policy that determines who makes investment and operating decisions and who influences quality of service at airports. Whoever is responsible for providing landside levels of service at an airport would promulgate the measures. Some participants desired to change "promulgate" to "establish."

2. What agencies should publish such standards and enforce them? Publishing and enforcing are distinctly different and separate actions even though the same agency or group may do both. Once the question is answered of who is responsible for, who establishes, and who imposes standards, then the question must be considered of how strict the compliance should be. Enforcement could range from statutory requirements to completely passive methods such as workshops and training sessions. The answers to these questions will depend to a great extent on the financing process.

3. Should acceptable levels of landside services vary with the density and character of use of landside facilities? Many airports with the lowest demand for air travel provide the highest levels of service. The level and type of financial assistance would tend to influence the decision as to whether levels of service should vary with the density and character of use of landside facilities. The urgency with which level-of-service measures should be promulgated, published, and enforced is dependent on the method of funding. Many participants felt that without federal financial assistance no urgent move would be made nationally to improve levels of service. Concern with financial responsibility is related to the source of funds. These funds may be obtained from various sources such as general tax revenues, a ticket tax, or a tax on aircraft tires; these funds are indirectly provided by the user—an issue that is very sensitive. Questions then arise regarding general public or air system user benefit and regarding the willingness of users to pay for higher levels of service.

4. For various target levels of service, what are the policy issues associated with reaching such levels? How do these policy issues vary with the level of government at which they are addressed? What conflicts in policy might be anticipated? How can such conflicts be resolved? No specific answers were formulated for these questions. Participants felt that the answers to these questions should be linked with the method for financing improvements in levels of service.

Issue 5: Technological Alternatives

Issue 5 relates basically to mobility alternatives, passenger- and baggage-processing facilities, automation of international clearance and baggage inspection, standardization of communications, signing at terminals, and automation of shared services and facilities at terminals to improve level of service and capacity.

Automation of people moving and baggage handling has had limited success and has also resulted in a number of costly mistakes. In general, the successful technological advances have been relatively simple in scale and have included a reasonable degree of redundancy. The costly mistakes in some cases have been technologically extended, and some unsound solutions to complex problems have emerged without sufficient backup systems to meet the capacity requirements without involving substantial costs. Many technological alternatives are currently available and can be implemented.

Compared with similar manually operated systems, automated passenger- and baggage-handling systems at airports have increased service potential and reduced life-cycle costs mostly because of reduced labor requirements. For example, current operating costs of a fully automated people-mover system (such as at Tampa) average

\$0.60 to \$0.70 per vehicle mile, but costs of a bus system may be doubled. If such cost differentials, when service levels are equivalent or better, are valid, then automated systems will be most cost beneficial.

Increases in the flow rate of a product, either by quantity or speed, may overload some of the modal elements (such as ticketing) of a system. A passenger though may prefer to be moving slowly rather than waiting in a queue, and an increase in mobility in some areas may actually result in a perceived reduction in level of service by the passenger. For example, use of discrete passenger vehicles will produce cyclic demands on the processing or holding areas that can result in inefficient demands on the processing equipment. The discharge of passengers from a bus can create a high demand on ticketing and baggage reception that is then followed by a lull in demand. Unless these demand levels can be temporarily distributed without further impeding the passenger movement, then the increased performance in passenger movement will be negated by queuing in other areas.

These examples indicate the need to treat the system as a balanced whole and to improve the flow at the critical points. Funding to increase one segment of the flow beyond that capable of being handled by other segments will be wasteful, for example, speeding passengers from the aircraft to the baggage area only to have them wait for baggage to arrive. Thus, one must view the impact of technological improvements on the overall system rather than on individual segments.

Studies have found airport landside operations to be more labor intensive than those of any other industry except the health care industry. For example, if a 707 aircraft is used for a test reference, the ratio of the cost of labor including all fringe benefits versus the cost of maintaining, operating, and amortizing the equipment associated with an operation, baggage handling, and passenger processing was 7:1; the ratio was 0.2:1 for the crew operating a 707. In private industry, the ratio is about 0.1:1 for the cost of making paper and 2.5:1 for the cost of warehousing of luggage. This seems to indicate that there are possible applications of the many technological advances in automated equipment for improvements in handling and cost reductions. Research is needed on the costs and benefits of automation of passport controls and public health check-in procedures to determine whether it would contribute effectively to the level of service desired at high-demand international terminals. The use of automation in the immigration service function and in customs inspection should be examined. Passport processing should be improved through the use of mechanical and automated check-in and immunization cards, but baggage inspection may not be subject to automation because of its specialized requirements.

Elements of effective signing include simple terms, uniformity, transformation of the message into other language or terms, psychology, and human learning. Elements of good communication include simplicity of language confirmation, such as redundancy with trailblazer signs, communication of the terminal space itself, and flow signing that directs one along a predetermined path. Information centers could be used to convey the most commonly sought information including directions for ground transportation and fares. Information could be distributed via a handbook, brochure, map, a large screen, or a CRT with hard copy dispensed on demand. Variable-message signs may also be useful with appropriate sensors to indicate alternative access and egress routes, parking lot occupancy, and curbside availability. The different types and kinds of such automated devices can be determined, cataloged, priced, and compared.

Signing within the boundaries of most airport landsides is extremely weak. An international manual prepared in 1967 addresses signing and markings, and a new manual is in preparation that includes a number of standards, although they are not to be enforced at the present time. A publication similar to the Manual on Uniform Traffic Control Devices used for highways is needed for airports. Airports now use a number of different informational signs that may confuse passengers, reduce the level of service, and result in travel delay.

Signing for airports needs more research. Unfortunately, signs are often the last thing considered in terminal design, but they should be planned at the beginning because the communication problems that passengers are likely to encounter would thus be surfaced easily enough to be resolved through proper design. The lack of adequate signing and standardization results in substantially increased cost for personnel to supply the information. For example, at the new Dallas-Fort Worth Airport, personnel are provided at each airtrans station in part to overcome the inadequacies of the airtrans informational system; the terminal design makes adequate signing difficult to attain.

Participants made the following responses to the specific questions of issue 5.

1. What technological alternatives are available for meeting requisite levels of airport landside service? Many technological alternatives can greatly aid the improvement of landside capacity and level of service:

Mobility alternatives
Exclusive busways, moving ways, and fixed guideways

Passenger- and baggage-processing alternatives
Automated ticketing, boarding pass and seat assignment, issuance of baggage tags, boarding, claim, baggage inspection, international clearance, baggage handling, sorting based on machine reading of baggage tags, loading and unloading of containers, and transporting of interline baggage

Communication and signing alternatives
Signing standardization and communication improvement program

2. Where and under what conditions does selection of a technological alternative to meet a level-of-service criterion in one landside subsystem impinge on the alternatives available to meet the objectives in another landside subsystem? The principal impact of one technological alternative in one subsystem on another subsystem seems to be related to batching. In other words, a people mover can deliver 100 passengers to the ticket counter in 2 to 3 minutes and thus overload that operation. Batch control is needed if the subsequent subsystem involves individual processing, and parallel processing after batch delivery may be required.

3. What are the implications for governmental research and development policies and activities and for those of private sector entities? The cost of bringing the more expensive automated people-moving programs and baggage-handling systems on-stream is usually several times the initial estimate cost of the total system development. These costs place a strain on the individual airport authority and the carriers sharing that facility and result in a negative attitude toward the systems. Hence, future research and development efforts are impeded. The risk is not only technical but can also be institutional or even social. Most U.S. terminal facilities do not have shared service capabilities. Competition, product differentiation, and fear of trade restraints by the carriers tend to reduce the joint cooperation in research and development projects by the private sector.

4. Is there a need for a common self-service, automated, one-stop, check-in operation? What would be the functional specification and impact on improving the level of service? Participants added these questions to issue 5 because they felt that some research was needed in this area in the immediate future. The user or the consumer is becoming more and more technologically oriented in all phases of life, and the consumer expectation for service levels is being continually elevated. Technology is becoming available for airport automated check-in procedures that can be used by the experienced traveler and that require no personal interface with any airline agent or representative. This service issues the ticket, the boarding pass, the seat assignment, and the baggage tag, and, with the aid of the passenger, places the baggage into the system. At a turnstile at the gate lounge, the passenger gains entrance by inserting the ticket or boarding pass. Those on standby are admitted only as seats become available.

A completely automated processing system poses some institutional problems, including the acceptability by the airlines, airport operators, and users. Who will own the devices initially? Will the airlines each own one? Will the automated devices need to interface with the airline computers for reservations?

Issue 6: Airport Tenants

Concessionaires, air carriers, and airport management are all users of landside space and have an impact (either negative or positive) on level of service and capacity. The integration of these users of space must be done in such a fashion as to provide for the most economical, efficient, and comfortable movement of air passengers. At times, the objectives of each tenant group may be in conflict with one another. This conflict can result in a lowering of the level of service for the passengers.

The following are the specific questions and workshop responses for issue 6.

1. To what extent is achieving landside level-of-service objectives dependent on concession availability and performance? A hierarchy of concession importance arises because certain concessions are more critical to airport operations than others. Parking and ground transportation are probably the most critical. Facilities, such as food services, news and sundry concessions, and rest rooms, provide for the comfort and convenience of the passengers while in the terminal and are also important. Other facilities may add to the comfort and convenience of the passenger but may not be essential.
2. To what extent is achieving landside level-of-service objectives dependent on air carrier behavior and performance? The ability to maintain schedules has a significant impact on the number of people in the terminal at any given time. The scheduling of planes also has an impact. The assignment of inadequate personnel by the airlines can create queuing problems, delays, and even hostility by the passengers, who may take out their hostilities on other people in the system. Too few people may be assigned to the ticket counter or to baggage delivery. Complications occur when one carrier's actions interfere with the normal interaction among individual carriers. Thus, the air carrier's behavior and performance have a direct impact on the ability to achieve landside level-of-service objectives.
3. To what extent are airport tenant objectives consistent with or inimical to those of airport management seeking to meet level-of-service objectives for landside services? The tenants and the airport management share some common objectives; the major point of divergence is when the objectives of the airport managment tend to reduce profits of the tenants. The airport management, which is also concerned with financial stability, is concerned with the overall level of service provided to passengers. Airlines are not so vulnerable to conflicting objectives as are concessionaires. The amount of space and facilities, quality of service, and length of leases are other areas in which airport management and tenants might have differing objectives.

Issue 7: Forecasting Level-of-Service Factors

Traditionally, responsibilities for various activities in the airport complex have been assigned to federal and local governments and to private agencies (airlines, commissions) who are an integral part of the airport operation. However, for various reasons, such as financial support and standardization, the lines of clearly defined responsibility are fading.

FAA has had responsibilities pertaining to the airside, and local governments and private enterprise have shared responsibilities on the landside. However, as the requirements for air travel change, one might expect responsibilities and financial requirements to change also. New requirements often call for new approaches that may well require significant institutional and regulatory changes.

The following are workshop responses to specific questions of issue 7.

1. What factors most influence the levels of airport landside services that must be provided? The factors that influence airport landside levels of service have been previously discussed and will not be repeated here. The participants felt that the word "must" in this question should be deleted. The levels of service provided are trade-offs among the wide number of options, constraints, and factors.

2. With what accuracy can such factors be forecast? Table 5 was developed to indicate the accuracy of forecasts in demand factors, service rate factors, and level-of-service factors. The general consensus was that forecasting, at best, is not very reliable. Long-range forecasting seems to present the greatest problem because of the many variables to be dealt with. Factors such as jumbo aircraft, wide bodies, stretched fuselages, equipment changes, and fuel shortages have all had a significant impact on the number of air passengers. Some of these changes occur so quickly that forecasters and others are caught by surprise.

There is a great need to improve forecasting techniques. Although 1- and 2-year forecasts are extremely valuable, they do not help much in planning and designing facilities that must operate for 20 to 50 years; forecasts for both periods are needed. In passenger forecasts, attention should be directed toward technological changes, changes in equipment, changes in managerial and handling procedures, and the type of impact these changes will have. Even though the rapid growth period may be over, improvements in forecasting are still needed. The amount of variability in forecasts has also created the need to know how this variability affects the various elements in the system. Can the system be modified at a small cost or made more flexible to accommodate variability (errors) in forecasts?

To improve the development of forecast procedures requires an examination of the approaches, models, and procedures used in forecasting. Procedures used in forecasting changes in customs and immigration procedures are not scientific. Some of the demand factors given in Table 5 are ratios that serve as indexes to convert basic forecast variables to usable input data. But projections often are that these ratios will remain the same, i.e., visitors per passenger or bags per passenger.

The time periods used in forecasting must be carefully chosen and must take into account potential changes that could have an impact such as FAA's "upgraded third generation air traffic control system" that will be placed on-line starting as early as 1978. Consideration should be given to the time frame needed for modest changes as compared to the time frame needed to effect major changes.

The American Transport Association forecasts enplanements on an annual and

Table 5. Forecasting accuracy for various factors influencing capacity and level of service.

Factors	2 Years	5 Years	10 Years	20 Years
Demand				
Enplanements	High	Medium	Medium	Low
Peaking (monthly, weekly, hourly)	High	High	High	Medium
Aircraft mix	High	High	High	Low
Visitor and passenger ratio	High	High	High	Medium
Origin-termination-connect	High	High	High	Medium
Baggage	Medium	Medium	Low	Low
Nonair activities	Depends on space availability			
Employees	High	Medium	Low	Low
Vehicles	High	Medium	Low	Low
Service rate				
Airline processing	High	Low	Low	Low
Customs and immigration processing	Low	Low	Low	Low
Security procedures (ingress)	Low	Low	Low	Low
Access-egress modes	High	High	High	Low
Technical innovations	High	Medium	Medium	Low
Airport configuration	High	Medium	Medium	Low
Level of service				
Public expectations	High	High	High	Medium
Air passenger profile	High	Medium	Medium	Medium
Airline financial health	Medium	Medium	Low	Low
Level of funding available	High	Low	Low	Low
Competition from other modes	High	Medium	Medium	Low

Note: High < 10 percent, medium < 25 percent, and low > 25 percent.

monthly basis and the aircraft mix on a monthly, daily, and design-hour basis. For design purposes, enplanement forecasts should be for annual, weekly, daily, and hourly volumes. FAA uses aircraft mix and the peak hour for design purposes on the airside; the peak hour and design hour are based on the forecast year. A distinction should be made between the air carrier fleet and all other aircraft types; FAA includes all aircraft types in its aircraft mix forecasts.

Airline processing procedures, customs and immigration processing procedures, security procedures, access and egress modes, technical innovations, and airport configuration are all factors that affect the maximum service rate of an airport. Current forecasting of these factors is unreliable (Table 5). Forecasting for service rate factors also needs considerable research.

3. How can the accuracy of such forecasts be improved, especially for factors to which landside service levels are especially sensitive? The suggested approaches to forecasting accuracy improvement are

a. Development of data series for level-of-service factors at major airports,
b. Performance of selected cause and effect research,
c. Application of state-of-the-art econometric techniques,
d. Less reliance on a single 15- to 20-year forecast for design if flexibility is required, and
e. Determination of the effect of forecasting errors on design and service.

The lack of data series on the various activities at the major airports makes it difficult to accurately forecast. Causal modeling that proceeds beyond elementary regression is needed. Applications of the state-of-the-art econometric techniques need to be applied in some of the forecasting work. The development of a flexible forecast procedure that does not rely entirely on a single, long-range forecast is needed to provide for flexibility in design and operations.

4. Who should bear what responsibilities in projecting airport landside requirements for the airport system as a whole and for individual airports? Suggested responsibilities are as follows:

Funding

- Federal role: intercity air travel forecasts, level-of-service definitions and guidelines, and analytical methodology development
- Local role: level-of-service decisions, analysis and design, and input to federal compilation

Research and development

- Local role: needs assessment
- Industry role: low-risk research and development
- Federal role: high-risk research and development

5. How can changing requirements regarding levels of service best be discerned and made an integral part of the development plans and practices supporting both the national airport system and individual airports? The expectations of passengers with regard to levels of service will likely change with time. Low levels of service may be tolerated for a while but will be expected to improve. Comprehensive planning for airports should take into account and include goals for better or improved levels of service. Staging improvements during the life of the airport will also improve levels of service in stages. Target levels of service should be established for the national airport system as well as for individual airports.

SUMMARY

1. The passenger is the most important entity in the airport complex and should always be given highest priority when improvements to capacity and level of service are considered.

2. Capacity and level of service are interrelated and should always be considered together. Several different levels of service can be defined for a given maximum capacity service rate.

3. Individual elements of the airport complex should have capacity and level-of-service ratings. Capacity and level of service can have different dimensions (i.e., time, distance, space) depending on the particular elements that are under consideration.

4. Each air carrier airport should have a composite capacity and level-of-service rating. This should be a single weighted rating by which an airport can be compared with other airports. A minority strongly disagreed with the concept of a composite capacity and level-of-service rating.

5. The 3 major categories of airport users are passengers, nonpassengers, and access and egress modes.

6. The airport landside system is limited to areas within the airport boundary and includes the access and egress system (airport boundary to automobile parking or curbside) and the terminal building system (automobile parking or curbside to the aircraft door).

7. All of the components of the airport landside complex have either a direct or indirect impact on air travelers and should be given consideration in determining levels of service.

8. In general, the dimensions best suited for levels of service appear to be time, distance, area, cost, comfort, and convenience.

9. Levels of service are extremely dependent on airline fleet mix and peak demand.

10. The responsibility for promulgating (i.e., establishing), publishing, and enforcing (or encouraging the use of) standards for levels of service should be given to the agency that has the financial capabilities and responsibilities for implementation.

11. Levels of service for airport landside areas will definitely vary with the density and character of the landside facilities.

12. Policy issues related to achieving target levels of service should be related to the entities having the financial capability for implementation. Significant policy alternatives depend on whether the federal government is given landside funding authority.

13. Many technological alternatives are available for meeting requisite levels of airport landside service and can be categorized into mobility alternatives, processing alternatives, and communication and signing alternatives.

14. The use of a technological alternative to improve the level of service for one element of the airport complex can result in serious consequences for other elements within the airport complex.

15. The cost of bringing the expensive people-moving and baggage-handling systems on-stream is several times the initial cost estimates for the total system development. These costs impose a strain on the airport authority and the carrier sharing that facility. Thus, for high-risk or new development programs, the federal government should play a strong role in the technological developments for the landside of airports.

16. A common, self-service, one-stop, automated check-in operation is needed.

17. Some concessionaires do not appear to serve a critical role relative to obtaining various levels of service. Parking and ground transportation are the more critical and essential concessions operating at the airport.

18. The behavior and performance of the air carriers have a direct impact on achieving specified levels of service.

19. The tenants and the airport management share common objectives up to a certain point. The major point of divergence is obviously when the airport management tends to reduce profits.

20. Some of the factors that influence the levels of airport landside services can be quantified, but others are of a qualitative nature.

21. Greater accuracy is needed in forecasts of factors that affect level-of-service

improvements.

22. Forecast accuracy can be improved by developing data series for level of service at major airports, performing selected cause and effect research, applying econometric techniques, and relying less on a single 15- to 20-year forecast for design if flexibility is required.

23. In projections of airport landside requirements, the federal government's role is related to intercity air travel forecast, level-of-service definition guidelines, analytical methodology developments, and high-risk research and development; the local government's role is related to level-of-service decisions, analysis and design, and input to federal compilation; and the private industry's role is related to low-risk research and development.

24. Level-of-service expectations of passengers change with time, and airport planners should ensure that future levels of service are better than those existing at the present time.

REFERENCE

1. Highway Capacity Manual. HRB Special Rept. 87, 1965.