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AIRPORT AND AIR SERVICE ACCESS

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16. Abstract The problems of airport and air service access are investigated in this report. Airport access, primarily an urban transportation system problem, is investigated using data obtained from the Cleveland-Hopkins Airport Access Study and other surveys and studies. The nature of airport access and of passenger behavior with regard to it is investigated to determine what governmental policies might be appropriate. Many of the factors that determine how passengers choose their access mode and, consequently, how they would use a new mode that might be provided cannot readily be affected by governmental action. Massive investment in access modes is not a cost-effective method of changing passenger flows to the airport; improvements in these modes should be of an operational nature.

Airport access is a subset of air service access; attention to problems of the latter may provide more chance to improve service for the air passenger. This study investigates two aspects of the air service access problem: air network configuration and the use of satellite airports. Using aggregate delay time as a measure of effectiveness, the most efficient network was found to be one in which traffic is concentrated, reducing network connectivity. However, tradeoffs between average quality of service & distributional effects must be considered in policy making. Satellite airports may seem to be a convenient means to improve access to air service in a region, but competitive economic forces discourage both airlines & air passengers from using satellite airports and impell them to concentrate at major terminals. Satellite or reliever fields will not be used significantly by air carriers without some form of governmental coercion.

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PREFACE

The study described in this report was prepared by the Department of Civil Engineering of the Massachusetts Institute of Technology for the U. S. Department of Transportation Office of the Secretary under contract to the Transportation Systems Center, Systems Analysis Division. The study was done as a part of the larger task of arriving at the most expedient processes for increasing access to air service, that is, convenient door-to-door transportation where aviation is the primary mode.

The objective of this study is to assess the problem of airport and air service access. The problem is investigated using data obtained from the Cleveland-Hopkins Airport Access Study and other surveys and studies. The results of this report are an input towards the formulation of policies for improving the national airport and air service access systems.

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1. SUMMARY AND CONCLUSIONS

1.1 Types of Access

This study deals with the problems of obtaining air transportation services. These can be divided into two parts: those specifically related to airport access and the more general factors of air service access.

Airport access is the ground trip to or from the airport. It is generally thought to be a problem primarily for the air passenger, although it also may be a problem for their greeters, airport employees, and other airport visitors. Fundamentally, it is an urban transportation problem, but it has unique features due to special air passenger characteristics and the need to connect with the air transportation system at specific times.

Air service access includes problems for the air passenger resulting from the quality of service offered by the air transporation system through network structure, service frequency in city-pair markets, and competitive behavior of airlines under regulation.

1.2 Purpose of the Study

This study attempts to determine the nature of the airport and air service access problems to facilitate formulation of rational policies in these areas. Specifically:

a. Airport Access. Using the Cleveland Hopkins Airport Access Study (CHAAS) (1) and other such studies (2,3,4) to investigate the factors affecting the behavior of passengers in selecting their access modes, other characteristics of the airport access trip, characteristics of access modes, the potential role of these modes, and the general nature of the airport access problem.

b. Air Service Access. To explore the problems of access to air services concentrating on air network configuration and the potential role of satellite airports.

c. Policy. To explore the implications of the above for transportation policy and for further investigations and demonstrations.

1.3 Airport Access

The nature and extent of the airport access problem varies with the time of day and the trip origin and destination. Airport access problems occur most often in large metropolitan areas during morning and evening peak hours. Congestion at the airport is, perhaps the most noticeable problem. It may be temporarily eased by incremental adjustments in access mode operations and flow techniques, by major change in terminal design, or by flattening air travel peaks.

The dispersal of air passenger origins and destinations in the airport market area cause many other airport access problems. Only transport systems with high connectivity can serve this distributed demand effectively. In most U.S. cities this means that only highway modes are successful in serving airport access trips; although a few U.S. and foreign cities have extensive transit systems that may be able to serve a considerable share of these trips. Fixed right-of-way modes usually cannot be justified for airport access from demand, economic, or equity standpoints. Generally, modes that carry many people efficiently (e.g. rapid transit, bus, and limousine) can serve only limited passenger group and geographical markets. These public modes will draw primarily those passengers without private automobiles available. Most passengers will be from within a short distance of the station. Limousine or airport bus stations are much more easily and inexpensively established than rail rapid transit networks and can draw a sizeable market share in dense areas.

Access modal choice by air passengers correlates with many personal and air trip characteristics. If a privately owned automobile is available,it generally is used unless it is very inconvenient or another mode is very convenient. The availability[1] of primary

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[1]Availability in this case is defined as the proximity of the nearest primary access mode stop to the passenger's location and the availability of secondary access modes.

modes other than private automobile is a key factor in their selection. Air passengers are generally thought to be highly sensitive to the time of the access trip, thus high speed solutions, e.g. TACV, are proposed. However, evidence from Cleveland and New York data indicates that air passengers may be more sensitive to the price and reliability of the access trip than its travel time. Convenience and knowledge of a mode are other factors in airport access modal selection.

Airport access has received considerable attention, but it is a real problem for a limited group of air passengers only. Changes in access mode choice behavior and improvements of airport access modes will aid relatively few people. The basic problems of airport access are found in the urban and air transportation systems. Most major "solutions" to problems of airport access will be part of major improvements to these systems. Realistic short term improvements in airport access will be small and possible only in the operation of existing access modes and in passenger processing. Air service access may offer better opportunities for improving the air passenger's trip.

1.4 Air Service Access

Among the issues in air service access are: network configuration, flight frequency, equity in the distribution of services, regional development, and optimal use of various air transportation facilities. Considerable investigation of these issues appears to be warranted.

A simple fleet allocation model developed by researchers in the Civil Engineering Systems Laboratory gives insight into the effects of different network configurations. Regional feeder systems having low connectivity (tree-shaped networks) are shown to minimize average passenger delay in the air transportation system. Networks with high connectivity, such as those provided by an extensive use of satellite airports each serving city-pair markets directly, have higher average delay times for the same fleet and costs but reduce the extreme delay times of some passengers.

Satellite airports have been advocated as solutions to airport and air service access problems, particularly those of ground congestion and access distance. When used as parts of an air feeder system satellite airports may improve average access time, but this use may not be possible due to air traffic congestion and high costs. Furthermore, for any type of use, the competitive position of the airlines and the response of passengers to flight frequency share, reduces the feasibility of the satellite airport solution. Without external intervention, market forces impel the airlines and air passengers to cluster at one large airport. Satellite airports will naturally serve little of the regional demand for air transportation, and may be cost-ineffective.

1.5 The Equity Issue

A primary issue for both airport and air service access is that the system presently is efficiently configured. Changes from the present situation, such as rail access or satellite airports, generally seem not to be cost-effective. The problem of poor quality air service still exists for many people. The problem is, largely, one of poor distribution of service rather than of generally poor service: a problem of service equity.

The policy issue is, then, how much should be spent to improve access to air service for the few who, in certain places or at certain times, cannot reach this service conveniently. Designers of the air transportation system face a tradeoff between improved distribution of service and improved average service. It is important to determine just how significant these tradeoffs are.

1.6 Potential Solutions

Solutions, particularly fixed systems, involving new technology and large capital expenditures, appear inappropriate for reasons of economic efficiency and the wide spatial distribution of demand. These systems are not likely to be financially self-supporting ,and air passengers as a group seem not to warrant subsidies. Fixed right-of-way and other public systems generally have markets limited to the vicinity of their stations. Fixed systems also will be difficult to match with existing airport terminals. More distributional public access modes, such as limousines or even buses used either as a collecting system for a fixed system or as a primary airport access mode, may be successful but consideration must be given to the modal selection behavior of air passengers.

Any improvements in airport access will aid only a limited group of air passengers. Minor operational changes should be sufficient to cope with most airport access problems to the extent that they are solely access problems. Many are, more realistically, urban transportation problems common to many kinds of trip-makers, and must be analyzed as such.

Satellite airports may provide limited improvement of both airport and air service access but seem not to be fully workable without institutional change or use of regulatory powers.

All potential solutions have effects on other parts of both the urban and air transportation systems. These solutions to airport or air service access problems may merely shift the problem elsewhere. System effects of any proposed solution must be analyzed before implementation.

1.7 Policy Implication

Airport access has received enough study that major emphasis should be shifted to air service access. Demonstrations of potential solutions to various airport and air service access problems should be made to determine their effects and effectiveness, and to fill gaps in information and keep it current. These demonstrations should be on a relatively small scale and limited to obtaining explanatory information to clarify specific elements of uncertainty rather than massive and expensive all-inclusive survey efforts.

More inter-modal planning and policy are called for, not only within the urban context of airport access, but between ground and air modes. This requires greater information, analysis, and coordination than has been available so far.

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   Wilder Limousine Service 2, January 1970, By Robert Skinner, Frank Koller and John Yaney
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2. AIRPORT ACCESS

2.1 The Problem

In this section we explore the potential for improving air service access through airport access improvement; what should be done, what can be done, and how it can be done. Since we are concerned with access to air service, the study is limited primarily to air passengers. Passengers, however, make less than one-third of all daily airport access trips (1), and the trips made by employees and visitors affect the access problems for the air passengers. The passengers' problems are unique and are the ones most often considered, but any solution attempt must consider other airport users also.

The airport access problem is one of expectation, location, and time of day. The air passenger expects his access trip to be as fast and comfortable as the rest of his air trip. Jet aircraft have reduced the already low times of the air portion of his trip. Access trip time at the ends of the air trip have not generally decreased; in fact, they may have increased due to the growth of the city, location of new airports farther from the city, and increased urban traffic congestion. Although the access trip quality is commensurate with normal urban trips, the air traveller remembers only that it took as much time to drive the few miles between the airport and his destination as it took to fly hundreds of miles.

Airport access is primarily an urban transportation problem for, with few exceptions, all access trips must use the multi-purpose urban transportation facilities[1]. Usually airport access is a major problem only in the largest cities. Here it takes two forms: congestion near and at the airport and distribution to the dispersed origins and destinations. Airport authorities report the congestion problem most often (1). Congestion is most apparent at airports where the major

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[1]Comparison of the "airport access problem" and the "urban transportation problem" can be used advantageously to study both. This is, in fact, a strong motivation for research on the limited problem of airport access.

routes to the airport are also major routes for the journey-to-work and other trips. When such a route is constricted, like the Sumner-Callahan tunnels between Logan Airport and most of the air passenger origins and destinations in the Boston area, the problems can be critical. Even in these cases, airport access becomes unreliable, taking much more time than planned, only at rush hours, when commuting and airport access peaks coincide. (Figure 2.1)

The usual response of airport authorities and others to the congestion problem is to call for rapid transit, most often to connect the CBD with the airport. This "solution" ignores the spatial distribution of demand. Typically less than one-third of the air passengers in a metropolitan area have their origin in the CBD (Table 2.1), up to a third in the rest of "the central city", and the rest in the suburbs and surrounding area. (1,5) An airport rapid-transit link would have to be part of a large network to serve conveniently an appreciable portion of the air passengers. Conversely, there are not enough air passengers to warrant a separate rapid transit link, much less a separate system. The peak hour passenger flow through the larger U.S. airports, is between 6,000-9,000 people. Only if all of these passengers had trip ends concentrated in the CBD, could a rapid transit system, with an hourly capacity of up to 40,000 people, begin to be justified.

The airport is one of the largest single traffic generators in an urban area, yet typically it generates less than two percent of all daily urban travel (5). Air passengers generate about half of this (their access trips plus those of their greeters). The provision of special service to this traffic generator and for the groups of people experiencing access problems becomes a real issue of equity.

One of the few ways in which the air passenger can influence his airport access problem is by choosing the mode that minimizes his disutility, which can be measured in terms of price, time, and inconvenience. The study of airport access thus becomes one of modal choice. The passenger often has few modal alternatives: usually private car, limousine, airport bus, taxi, or rented car. Rarely are there non-highway modes. In the U.S., only Cleveland and Boston have rapid rail transit to the airport, and in Boston one must ride a bus from the airport boundary to the terminal. Not all access modes are available to all passengers.

The Cleveland-Hopkins Airport Access Study (CHAAS) offers a unique opportunity to study the modal selection behavior of air passengers because it is detailed, has data taken before and after a major system change, and includes rail as well as highway modes (12). (See Appendix 3 for a brief description of this survey and some of its weaknesses.) Results of the analysis of this data were compared with results from four small surveys we have conducted in New York City (6,14,15,18), as well as with the numerous previous access studies examined. (See Appendix 1 for a partial list of references.)

Passenger modal choice behavior is studied not as an end, but rather as a means to determine if modal choice, and thereby access to air services at an airport, can be influenced by deliberate policies at various levels of governments and authorities. If passenger behavior can be influenced this way, it is interesting to know what effects certain policies or "solutions" to the airport access problem might have and how effective they might be.

One method of examining passenger modal choice behavior is by developing and testing mathematical models. A model for policy analysis indicates how certain variables act upon and through each other to achieve some effect. Technically, their relationship one to each other is known as the model structure. From any group of observations, there can be a very large number of combinations of variables, each implicitly defining a different structure, which can correlate well with the data. Although this number is smaller than all the possible combinations of variables, it is still very large, so there can be many plausible models between which it is impossible to distinguish (2,3).

A rational approach to modelling demand must combine dealing with simple, testable models and testing with time series data to give an explicit means for choosing between alternate structures. A complicated or detailed model is not the best approach, even if it is possible, for the fairly simple reason that it may be impossible to test, by actual application to a real issue, the correctness of its predictions about policy choices. Starting with a simple proposition and examining it with relatively simple models may ultimately yield more insight into the problem under study. This is because, by using testable models, we can hope to validate our understanding. Consequently, we have eschewed detailed models with many variables, attempting instead to determine by more direct methods the elements of passenger modal choice behavior.

2.2 Cleveland

Our initial analysis of the Survey Results (12) and contingency testing indicated that modal choice was influenced by virtually every passenger and trip characteristic surveyed. (Appendix 2) The airport access market is not easily stratified or modelled. Although there is a degree of correlation between the access mode and most other variables in the CHAAS, there are few clearly causal relationships. For example, there is a high degree of correlation between local land use and access mode; but the land use does not necessarily cause a mode to be chosen. Many such relationships can be used with caution for forecasting purposes through extrapolation of existing trends. But his approach becomes useless whenever the situation changes significantly. For example, although there was little change in land use in the CBD between the Phase 1 survey in 1968 and the Phase 2 survey in 1969, the modal share of access service provided by transit (bus in Phase 1, "Rapid" in Phase 2) changed from 3% to 30%. (Table A.2.14, Appendix 2)

There are other variables that do exert some causal influence on modal choice, but are not independently controllable variables. For example, the Rapid share decreased with an increase of the number of bags carried by the passenger. (Table A.2.25, Appendix 2) The decline in Rapid's share became pronounced with two or more bags. However, about 70% of all passengers carried no bags or one bag. For many of these, baggage did not appear to be a major factor in modal choice. About 42% of all passengers checked one bag and 44% of the rapid transit riders carried one bag. (12, page 26) Baggage was a reason for not selecting the Rapid, but had little effect between the highway modes. Consequently, it appears that a different policy towards baggage would not significantly affect airport access modal choice, and that expensive and complicated baggage handling systems for access modes would not be cost-effective.

For modelling, the problem then is to screen out the variables that are only correlative and not causal; and then, among variables that might be causal; to identify those that are controllable and may be influenced by policy. One soon concludes that the variables most affecting the selection of an access mode are modal characteristics, e.g., availability, fare, time and reliability. These variables are also the most easily affected by policy. Most personal and flight characteristics of air passengers have little effect on modal choice: for nearly all such variables reported in the CHAAS there was no appreciable change between Phases 1 and 2, yet there was a considerable change in modal share. The demand characteristics can show general passenger behavior characteristics of which policy-makers must be aware to promulgate reasonable policies that will have the desired effect. Our efforts have been to isolate some of these general characteristics.

The dispersal of air passenger origins and destinations in Cleveland is, if anything, wider than the "average". (Table 2.1) Relatively little traffic is generated by the CBD and about 20% comes from outside the SCOTS cordon area. (Map, Fig. 2.2) Portage, Stark, and Summit counties (PSS), for which the Akron-Canton facility is a more accessible airport, generate about 13% of the Cleveland-Hopkins Airport passenger traffic. Given the efficiency of handling large concentrated loads and the costs of a rail rapid transit system, one questions whether such a service would be cost-effective in Cleveland.

The analysis particularly considered the area shown in Figures 2.3 and 2.4. This "primary market area" for the rapid transit encompasses all SCOTS zones within two miles of the rapid transit lines and contains about 40% of the air passengers surveyed. This is the area where the Rapid provides real competition with private cars. Considering a smaller area also, of course, reduced the amount of data to be processed at any one time and allowed for a more extensive analysis for the budget.

2.3 Behavior Characteristics

2.3.1 Availability of Private Automobile

One of the more important factors in airport access modal choice is the convenient availability of a private automobile.[1] If a car is available the passenger is at least twice and often nearly four times as likely to use it as any other mode. (Tables 2.2 and 2.3) This demonstrates the normal preference for personal transportation and automobiles. If the availability of private automobiles is a strong factor in modal choice, passengers using non-automobile modes should have lower levels of automobile availability. The Cleveland Phase 1 data demonstrates this in that on the average among the non-automobile users, two do not have automobiles available to every one that does. (Table 2.4) This conclusion is in line with the findings of Koller and Skinner in New York (6).

Availability and use varies with area. (Table 2.2) Private cars, expectedly, are least available and least used in the CBD. Their availability and use increase in the suburbs where more of the trip-ends are residences. Proximity to the airport increases the availability and particularly the use of private automobiles. (Table 2.2: "West" area) Thus one could expect residential areas within 5 to 10 miles of the airport to be poor areas to attempt to entice air passengers out of their cars by providing an alternate access service.

Availability has two aspects: having a private car to drive and park at the airport and having a private car to be driven to or from the airport. Residents generally have both, whereas non-residents may have the latter. Most of the departing non-residents who have a car available to them are driven to the airport.(Table 2.5) This accounts for the high availability rate for non-residents (Table 2.3), which might, otherwise, seem surprising.

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[1]NOTE: The variable used for this section was coded only for Phase 1 data, thus comparisons with Phase 2, when rapid transit was a competing mode, must be made with care. Availability is probably similar for both times, but a comparison of alternate modes used and the draw of the Rapid are not possible. Availability data is for departing passengers only. (See Appendix 3)

The passenger surveys of the Wilder Limousine Service in New York (6,14,15) support this finding on automobile availability and provide additional information not available from CHAAS data. A disaggregate model developed by Koller and Skinner (6) reaffirms the importance of automobile availability for non-resident passengers of the Wilder Limousine Service. Departing residents enjoy a relatively high level of automobile availability: about 64% stated they had an automobile to drive to the airport and park during their trip, 54% had someone who could drive them, and 83% had either or both available. (Tables 2.6 and 2.7) Only 29% of the departing non-resident businessmen (Table 2.6) and 46% of all departing non-residents (Table 2.7) had someone available to drive them. Non-residents surveyed had a low degree of automobile availability, therefore many are, as expected, "captive" riders of non-automobile modes. They choose their mode according to behavior characteristics to be discussed subsequently. Residents, on the other hand, appear to have a high degree of automobile availability, why then do they not use their automobile as we would expect?

First, this was a survey only of limousine riders, so the number of all air passengers from Westchester who had automobiles available and used them is not known. Still, many people with private automobiles available use a non-automobile mode. Responses to survey questions support our conclusion that people will use their automobiles if reasonably available unless another mode is more convenient. Because of the chances of theft and vandalism, less than 50% of those departing residents surveyed who had automobiles to drive and park stated they would risk parking their car at the airport (Table 2.6). Thus these resident air passengers no longer consider driving their private automobiles a real choice; they are no longer "available". In the Wilder 3 and Carey 1 Surveys (18), limousine and bus passengers who had a private automobile available to drive and park or to be driven to or from the airport gave explanations that show it was not reasonably available or that the alternate mode was considered more convenient. (Tables 2.8 and 2.9) Convenience of the rapid transit in Cleveland for passengers with automobiles available cannot be shown from the CHAAS data; however, data does exist to study the effects of accessibility and proximity to rapid transit and other public modes.

2.3.2 Accessibility to Modes other than Private Automobile

An air passenger will turn to private automobile first; if that is not conveniently available, he then will select from the available public modes. Key measures of availability for modes with stations, e.g., rapid transit and limousine, are the proximity of the nearest station and the means of access to that station. Taxi and rented car do not have stations and are generally more available to their limited passenger market (Table A.2.19) than are the other public modes.

Modal share of the rapid transit declines with distance from the service. The rate of decline varies with the secondary modes used and the density of the market area. (Table 2.10) In dense market areas, e.g. the CBD where many passengers have no automobiles available and walk to the station (Tables 2.2 and 2.11), even a quarter of a mile difference is important. In low-density residential areas, such as Shaker Heights, few people live close to the station, so private automobile is the usual secondary access mode (Table 2.11). The critical distance here is about two miles; if a person has to drive more than that, it appears that he is more likely to continue to the airport in his car. (Table 2.12) This distance also depends on the proximity to the airport. Passengers in the "West" generally use their automobiles to go the fewer than ten miles to the airport, and their critical distance from the CTS stations is about one-half mile. (Tables 2.2, 2.10, and 2.12) The CTS-East area is mixed: many people walk to the stations, particularly the University/Cedar Avenue Station. Windermere and University Stations act as collection points; many passengers are driven from Euclid, Shaker Heights, and other areas to the north and west. About one-third of the rapid transit riders from what one would expect is the market area for the Shaker Heights Transit drive to the Cleveland Transit System. (Compare Table 2.11 and Table 2.13.)

A surprisingly high number of passengers walk to the Rapid. It might be assumed that most would use a taxi or, in the Cleveland CBD, use the CTS loop bus, for which there is a free transfer from the Rapid.

Secondary modal shares are similar in the Carey and Wilder Surveys. (Table 2.14) (6,14,15,18) Nearly all Carey passengers come from within two miles of the two stops on Manhattan. Fewer people walk and more use taxi than in Cleveland, but this study generally confirms the propensity of passengers to walk and the concentration of public mode market areas around their stops. This despite subway connections, high service frequency and airport service times that are nearly competitive (station-to-station) with taxi. The Wilder Surveys also confirm the indications from Cleveland that the private automobile is used extensively as a secondary access mode in suburban areas.

In Cleveland, the downtown limousine stops, all at hotels or motels, have limited market areas, rarely over 1/2 mile from a stop (Figure 2.5 insert). About 80% of the limousine passengers stated their origin or destination was a hotel or motel in the same SCOTS zone as the stop (i.e. the same hotel or motel). There are seven limousine stops in the CBD, seemingly enough to cover the market well. There is only one Rapid stop in the CBD. Limousine had a market share of more than half as much as the Rapid in the CBD. (Table 2.12) In 1969, the fares were $1.60 for limousine and $.40 for the Rapid. Rapid had a total trip time of under 30 minutes, whereas the limousine had 15 to 30 minute headways during the day and at least 30 minutes travel time. Given the fare and time advantages of the Rapid, it appears that limousine had as large a market share as it did because of its locational advantage.

Suburban limousine services have larger market areas, but airport access demand is less dense. Those services in the Cleveland suburbs have many of their passengers concentrated at the hotels or motels used as stops, but many others, usually residents, come from other SCOTS zones, not all of them near by (Figure 2.6). The Wilder Limousine Service in New York has a similar market: some concentration at the hotels used for stops, but with many passengers who drive or are driven to the stop from some distance. (6,14, 15,18)

Limousine service is considerably more flexible and much less expensive to set-up and operate than rapid transit. With sufficient stops in a concentrated area, where walking is a secondary mode, it can capture a significant market share, even with strong competition. It also has the capability of serving a widely distributed market in suburban areas, particularly where the distance to the airport is great enough to discourage the use of private cars, which instead are used to feed the limousine service.

2.3.3 Time

Access time is generally considered the most important attribute of an airport access mode and a major problem in airport access. Departing passengers are presumed to be in a hurry to reach the airport and their flight. Arriving passengers may have less reason for time to be important, depending on appointment times and the arrival time of the aircraft. They, too, suffer from the "speed and time of the air trip compared to those of the access trip" syndrome. The idea that time and speed are important in airport access has led to the call for rapid rail transit, TACV, VTOL, and similar "solutions" to the airport access problem. In general, airport access times are comparable with travel times for other trip purposes, particularly journey to work trips, in a metropolitan area. The penalty for arriving late at the airport can be much larger, however. Generally, air travel is not very sensitive to airport access time: in most markets, air passengers will not use another primary travel mode just because airport access is difficult. Trips of a short distance, for example Washington D.C. to New York, may be an exception if a good alternate mode is available. Major efforts to reduce airport access times constitute assistance to a generally wealthy subset of the population (air passengers) and raise serious questions of equity and priorities.

Before more expenditures for faster airport access modes are made, policy-makers must determine how concerned air passengers are with time and how much of a factor it is in selection of an access mode, to know the effect of introducing a new mode to the present situation. Evidence from both Cleveland and New York suggest that time is not as important as is normally presumed. Air passengers often are concerned about access time, but it is probably not a major factor in access mode selection.

The CHAAS Phase 2 does not have data for access travel times, nor can any be constructed using available variables, so we do not know the travel times for users of the Rapid. Phase 1 data does have this information; it was estimated by departing passengers for the access trip they had just finished. There appears to be no correlation between travel times and the market share of an access mode (Table 2.15). The data also shows that passengers especially non-residents, do not accurately estimate their travel times. Some reported times are physically impossible or unbelievably long. The standard deviations for the travel time by a mode from a SCOTS zone is often larger than the average time. Each mode and many zones have this inaccuracy. If passengers cannot recall accurately the travel time of a trip they just experienced, it may mean that they are not very interested in their travel time or that time is not very important in modal choice.

In New York, about 80% of those passengers surveyed on the Wilder Limousine Service from Westchester County to La Guardia and JFK airports estimated their access trip time by the limousine was longer than by private car. (14) Reasons other than access time must have convinced them to select the limousine.

One indicator of the importance of time that is available from the CHAAS Phase 2 data is the amount of time a departing passenger waits at the airport before his flight is scheduled to leave. This waiting time can be divided into the time necessary for checking in, extra time planned into the access trip for unforeseen delays, and a desire for early arrival at the airport. For ticket and baggage processing reasons, airlines usually request passengers to arrive at the airport thirty minutes before a domestic flight departs. Data from the CHAAS indicate that between 60 and 70% of the departing passengers arrive by this time. (Figure 2.7) New York passengers tend to arrive earlier, possibly because of the greater uncertainty and congestion associated with the access trip in a larger metropolitan area; and, in the case of JFK, because of the longer processing time required for international flights. This processing time request can be, and obviously is, ignored without penalty in the United States. Airlines have a baggage cut-off time, usually 15-20 minutes before departure, but a passenger can often still make the flight if he arrives at the gate anytime before the aircraft is scheduled to depart. A large majority of passengers, then, actually have enough of a time margin that time itself need not be a critical factor. Only a small percentage of the passengers use up their planned extra time in enroute delays or value their time so highly that they deliberately arrive at the last minute.

Many passengers purposely arrive at the airport significantly earlier than any mandatory time. Often these are non-business passengers who are nervous about the flight and want to be sure to be on time. These people will depart for the airport as early as necessary to arrive at what they consider to be "on time". Faster access modes might not change their arrival time appreciably, since their anxiety would remain. Non-resident businessmen often have extra time after they finish their business and before their flight departs. They may go to the airport to wait, perhaps hoping to catch an earlier flight. Access time generally would not be critical to them either. Countering these examples are the often cited cases of a businessman leaping out of his cab and running down the concourse making his flight just on time. One questions whether these few people, who may be in such a hurry because of unrealistic planning of their access trip, should or could be aided by a fast access mode.

There appears to be no discernable correlation between waiting time at the airport and either modal share or travel time. (Compare the distributions of Figure 2.8 with the modal shares of Table 2.16)

Time does affect the passenger's modal selection but models calibrated with data from the Wilder 2 (6,15) and Carey 1 (18) surveys show it to be less important than cost. In a model calibrated for non-resident businessmen using the Wilder Limousine service between Westchester County, New York, and La Guardia and Kennedy airports, Skinner and Koller found passengers were twice as sensitive to relative changes in price as in time:

$$\frac{V_L}{V_{to}} = 0.68\left(\frac{P_L}{P_t}\right)^{-2.33}\left(\frac{T_L}{T_t}\right)^{-1.23} \quad ; \ (R^2=.59) \qquad (2.1)$$

where: $\frac{V_L}{V_{to}}$ is the market share of the limousine,

P_L, T_L are the fare and travel time respectively of the limousine,

and P_t, T_t are the fare and travel time respectively of taxi.

Using a similar form to avoid the normally high degree of collinearity between price and time, Yaney (18) calibrated the following model for non-resident businessmen using the Carey Transportation bus service between mid-town Manhattan and the two airports:

$$\frac{V_c}{V_{to}} = 0.123\left(\frac{P_c}{P_t}\right)^{-1.01}\left(\frac{T_c}{T_t}\right)^{-0.22} \quad ; \ (R^2=0.56) \qquad (2.2)$$

where P_c, T_c are the fare and travel time of the coach service.

Non-resident businessmen are commonly assumed to be very sensitive to time and on expense accounts so that price should not matter. These assumptions appear, from the models, to be incorrect. At least limousine and bus airport passengers seem to be relatively insensitive to changes in travel time. However, for most people the anxiety of making their flight is probably a key issue. Perhaps, then, making access modes more reliable is a more valuable goal than increasing their speed. Passengers may be persuaded to use an access mode if they knew it would get them to the airport "on time", as they define it. This may, however, merely move the anxiety to making the access mode on time and move the waiting point from the airport to the access mode station. Reliability has not been studied sufficiently (the CHAAS data does not permit its analysis) and is one of the few remaining aspects of airport access that warrants specific study by a survey or demonstration project.

2.3.4 Price

The models from the Wilder and Carey surveys, discussed briefly in the previous section, indicate that for certain groups of passengers, the price of the trip is more important than the time. Although the data for both models were obtained in New York, the locations, suburb and CBD, were considerably different, giving more credibility to the conclusions. Non-resident businessmen, the passenger group used for the models, normally are assumed to be the least price sensitive group; nevertheless, their price elasticity of demand is higher than their time elasticity. Therefore, one might assume other passengers would be at least equally sensitive to price.

Air passengers seem to be sensitive to the relative level of prices. The Wilder limousine fares vary from $6.25 to $8.50 and taxi fares for comparable trips vary from $13 to $30. The passengers' fare sensitivity in the Wilder model (Eq. 2.1) is twice as great as in the Carey model (Eq. 2.2) where the absolute level of fares is $2.00 to $15 for coach and taxi respectively. Air passengers behave similarly to time: the greater the relative amounts the greater the sensitivity.

The passengers sampled in the surveys from which these models were calibrated are not random, as they all chose to use limousine or bus instead of taxi or rented car, generally more expensive modes. All modes were surveyed at Cleveland providing additional information about the importance of price to this group and others.

Taxi is the most costly airport access mode for service to most locations. Its highest market shares are in the "West", where the distance is shortest, and in the CBD (Table 2.12). The fare between the CBD and the airport was at least $7.00 without tip, and taxi trip times approximate those of private automobiles. Limousine fares to the CBD were $1.60 with about half-hour headways adding to the trip times of automobiles. Rental car costs were about $1.00 plus the daily rental charge, and trip times were the same as private automobile. Of these modes, taxi lost the greatest share to the Rapid, followed by rental car, limousine and private automobile. (Table 2.17) As times are similar, the loss of market for the purely public modes appears to be proportional to the fare. Rented cars are used almost exclusively by non-resident businessmen, often because they have multiple origins and destinations during their stay. Moreover, it is likely that passengers using their cars or being driven in a private car, do not consider any but out-of-pocket costs. Therefore it appears that air passengers are somewhat price sensitive. This simple analysis cannot be continued in the suburbs, because of larger time differences due to longer headways of the limousines; but this may explain why limousine is the largest loser in the suburbs. (Table 2.18)

2.3.5 Other Characteristics

The market share of airport access modes is affected by the distance to the airport. (Table 2.12) The closer the air passenger's origin (or destination) is to the airport, the less likely he will use rapid transit, particularly where he has to drive to the transit station. Taxi is more likely to be used when the origin is close to the airport because the fare is not so prohibitively high. The market share of limousine services depends more on the number and location of stations. Distance alone has only a minor effect on the use of private car; most air passengers coming from the Akron-Canton area use private cars. However, when there is a major impedance to highway modes, in this case the Cleveland CBD, and an alternate mode that overcomes this impedance, the Rapid, many passengers will use the alternate mode. The combination of distance and impedance can have a significant effect on market share. Compare, for example, the market shares of private automobiles and the Rapid in western Cleveland, where distance and impedance are low, with their market shares in the CTS-East and Shaker areas, where distance and impedance are high. (Table 2.10) Distance and impedance to automobiles aid in the success of rapid transit airport access service.

There is asymmetry in the use of access modes; they are not equally used for access and egress. (Figure 2.9 and Table A.2.31) Availability and convenience appear to explain these differences, for price and time remain the same.

Private automobiles are used more by departing passengers than by arriving passengers (43% to 32% modal share, respectively in Phase 2). Arriving passengers are not always certain of their exact arrival time and may be hesitant about asking someone to pick them up.

Taxi and limousine usages are reversed; they have about a 10% modal share for departing passengers, but a 16% share for arriving passengers. This can be explained in part by the obvious availability of these two modes at the airport, whereas one must usually call a taxi or go to a limousine station away from the airport. Another factor works in their favor at Cleveland: the location of their stands are between the baggage claim area and the Rapid station. (Figure 2.10) Aggressive limousine operators, poor signing, and possibly an unknown distance to the Rapid (whereas the taxis and limousines are in view) influence the passenger in choosing taxi or limousine. This, also perhaps, is one cause of the slightly lower arriving passenger market share of the Rapid.

In CHAAS Phase 2, arriving passengers were asked in the in-flight survey if they had already selected their access mode. About two-thirds of these passengers replied that they had and listed the mode they planned to use. (Table 2.19) A significant number of the passengers using limousine and taxi come from those passengers who do not preselect their ground mode, perhaps showing the effects of the visibility and aggressive salesmanship mentioned above. Slightly more residents preselect their modes than non-residents, about 75% to 69% respectively in our sample. Nonetheless, advertising for an access mode at the airport can capture only a limited number of people.

The number of transfers intuitively would be expected to deter use of public modes, particularly rapid transit. The CHAAS data does provide some evidence in this area, but it is by no means conclusive. Nearly one-third of the air passengers from Shaker Heights who use rapid transit use CTS stations and avoid the Shaker Heights Rapid Transit System (SHRTS). There are several possible explanations in addition to the transfer between lines: the headways on the SHRTS are about twice those on the CTS and the CTS cars are considerably newer and more comfortable, particularly for someone with baggage. By driving or being driven in a private car to the CTS and at a low perceived cost, the passenger avoids the SHRTS fare and the additional transfer. Most potential SHRTS passengers must drive to that line anyway; many probably feel the marginal cost to go to the CTS, where there is a higher level of service, is very low. The transfer between the SHRTS and CTS is a difficult one and it probably is a factor in diverting Rapid passengers directly to a CTS station to avoid SHRTS.

Most passengers riding the rapid transit modes transfer once; only those who walk to the station do not. (Table 2.20) Although rapid transit has the highest percentage of transfers, it has the second highest modal share. In New York City, relatively few people use the subway and then transfer to a Carey bus, although there are good connections at Grand Central Station. More than one transfer, a likelihood when several public modes are used, may well have a detrimental effect on their modal share. This should be determined before airports are connected at high cost to extensive subway systems.

2.3.6 Supporting Evidence: Port of New York Authority's Phase 3 Cleveland Survey (11)

In October 1971, the Port of New York Authority had two surveys conducted in Cleveland, one of air passengers and one of transit passengers. (See Appendix 3) These surveys were considerably smaller than the CHAAS Phase 1 and 2 Surveys, and there are some problems in comparison, but the Phase 3 Survey provides a valuable third point in time to test theories. This is particularly interesting because the Rapid fare to the Airport was raised from $.40 to $.75 between Phases 2 and 3. In addition, some direct questions were asked which shed light on the attitudes and behavior of air passengers with respect to modal choice, and specifically to rapid transit as an airport access mode.

The questions giving most direct insight into passenger access modal choice behavior were asked of departing passengers who did not ride the Rapid. They were asked whether they had used the Rapid before and why they did not on this particular trip. The major responses are shown in Table 2.21.

As discussed in Sections 2.1 and 2.2, the availability of a private car is a most, if not the most, important factor in modal choice ("other mode more convenient" and "was driven"). The availability or convenience of other modes is also important if a private car is not conveniently available, for example, the limousine and taxi riders of "other mode more convenient" and the "limousine" riders of "used courtesy bus". The market for rapid transit is generally located near the stations. Thus "too far from station" and "not in Rapid market area" appear to be important reasons for not using the Rapid.

Luggage is shown to be an important reason for not selecting the Rapid, although this is not as clear from the CHAAS results. Many passengers with one bag, or more, ride the Rapid. Table A.2.25 shows it to be of less influence in selecting other highway modes. Having to make a transfer appears as an important reason only in the primary Rapid market area (Two-Mile East). Luggage appeared to have an effect on this. Few passengers who gave this reason used the SHRTS; most seem to be talking about the transfer from a car to the rapid. Neither cost nor time was given by a significant number of psssengers as a reason for not using the Rapid.

The reasons given and the percentages of those who had used the Rapid before appear somewhat ominous for the potential use of rail rapid transit for airport access in other cities and the future of Cleveland's rapid transit airport access service. Indeed, the Rapid's market share has declined while that of the private automobile has increased. (Table 2.22)

The Phase 3 data may be helpful in understanding passenger behavior and even more helpful in the testing of models. It should be included in detail in any future analytic efforts.

2.4 System Effects

The air passenger, like the typical urban traveller, seems to prefer his car when it is available. The existence of a competing mode draws people from their cars in any number only in the area close to that mode. One wonders whether rail, rapid transit or limousine can appreciably reduce the number of passengers using their cars and if the reduction is valuable. Phase 3 data seems to indicate that fewer air passengers are using transit, primarily because of lack of convenience. Even if it maintained a one-third market share in its primary market area, where it solves the distribution problem for only a select group, would it appreciably solve the congestion problems that are more often cited as important? The answer appears to be that it would not. Wohl (17), found that the rush-hour automobile peaks at the points of greatest congestion are not affected significantly by the reduction of airport traffic. The effects on urban transportation of improved airport access will generally be small. Moreover, rail rapid transit is a costly "solution". Wohl's analysis shows the airport service in Cleveland is not self supporting and confirms Mierzejewski's general analysis that rail rapid transit is not a cost-effective answer to the airport access problem (8). For comparison, it may be noted that the Kennedy Airport Access Project in New York City, designed to provide rail service from Kennedy Airport to Pennsylvania Station in New York, would cost about $300 million in 1972, and is estimated to serve only 8 million passengers a year (about 3000 in a peak hour) by 1990. Other subway projects in New York are expected to serve five times that number.

The desirability of changing the access behavior of air passengers is also questionable. Airport access "problems" are those of the air passenger. Institutions and passengers have adapted to operating around these problems; any change must consider these institutions as well as the passenger. The institutions to be considered are private transportation companies, airport operators, airlines, and the governments and authorities regulating or licensing these groups.

Limousine, airport bus, taxi, and rented car companies have structured a significant portion of their business around the airport. Any policy change might favor one of these groups, or another mode, and upset competition or unfairly harm the operators. The distribution of costs as well as benefits must be considered. Institutional resistance must also be weighed, particularly if a demonstration is to be used to help formulate policy.

The airport operator may not benefit from a large change in access behavior, particularly if that change includes a significant reduction in the use of private cars. Airport parking lots generate large concession revenues and airport operators will be loathe to lose these funds. Despite space problems, more lots are under construction at many airports. Off-airport parking with shuttle service is often a possible parking solution.

Airport terminals have been designed to handle many cars (although not always efficiently) but not transit or people movers. Terminal redesign and construction are additional costs of a major policy emphasis on new access modes. The interface of fixed right-of-way access modes with existing terminals, or even new ones, is a major problem with very expensive solutions. Cleveland is a relatively small terminal that can be served by a stub-end transit station. A rapid transit stop only in the terminal area does not serve many of the airport employees who might otherwise use the transit service. People using the Metro to Washington-National will have a long walk and a level change between the Metro station and the terminal area. Various plans have been considered for joining the proposed rapid transit links and the large terminals or group of terminals at the San Francisco International (BART), Chicago-O'Hare, Newark (PATH), and JFK International Airports. The "solution" appears to be a transit station outside the terminal area and a people mover to distribute the passengers and others within the airport. The people movers will add to the airports' capital and operating expenses. This transit solution adds at least one more transfer, with its time and baggage handling disadvantages, to the access trip. It therefore might not draw as large a market as expected.

Other concessions may suffer if passenger access behavior changes. The departing passenger now arrives early and often spends money at the concessions in the terminal while waiting. The availability of a more reliable access mode may cause departing passengers to arrive at the airport shortly before flight time and the concessions would be less used. These concessions also produce revenue for the airport operator. The arriving passenger wants to leave the terminal as rapidly as possible and may not use the concessions. However, it is unlikely that any solution to the airport access problems will aid only the arriving passenger.

The airport operator and airlines require larger terminals to hold passengers if they arrive early. The exact amount of this extra space cannot easily be determined. Its costs are possibly balanced by the extra processing costs that would be incurred if access modes were made more reliable and if most passengers arrived just before their flight. (Figure 2.11) The congestion within the terminal, and especially at the service facilities, would be greater, and queuing problems could become critical. The last-minute processing problems caused by significantly improved access might, in fact, cause passengers to return to their present behavior and come early to avoid the rush. Airlines have adapted to the present operating situation and are not likely to want to trade it for a pronounced peak; nor are passengers (4).

Improved airport access modes may not help the employee or airport visitor. Employees tend to locate their residences so that their journey-to-work trip is not difficult; often they live near the airport or near major highways leading to the airport. At most airports, over 90% of the employees use their private cars to go to work (1). The Rapid service in Cleveland has not made a significant change in their access behavior (12). On-airport distribution is a problem. Slightly over one-half of the employees at the Hopkins Airport work in the terminal area; the remainder cannot easily go to their jobs from the transit station. This problem increases with airport size.

Because of the survey techniques used, it appears that the Rapid airport service aided the casual visitors, but this conclusion is only weakly supported. Most business visitors will continue to use their cars (or trucks in the case of cargo) and avoid access problems such as congestion simply by travelling at off-peak hours.

It appears that the only group with real potential benefits from radically improved airport access are the passengers, and even they as a whole or as sub-groups may not be in a much improved situation. Certainly major changes in access will be discouraged by those business operations, access mode operators, and concessions affected. Airport authorities and airlines would probably favor more minor changes, particularly if they had to bear some of the capital costs of major improvements.

2.5 Conclusions

Access mode selection is a key factor in understanding and influencing airport access problems. Most of those passengers having private automobiles available will use them for their access trip unless they are not convenient or another mode is very convenient. This leaves many passengers, particularly in concentrated market areas (e.g. CBD), with a choice between other modes. Their choice seems to be influenced primarily by the relative convenience of the alternate modes, especially the proximity of the mode to their trip end and its price. Many passengers using rapid transit or a similar mode (e.g. Carey bus in New York) will walk to the station. This limits the size of the market area served by a station. In less dense areas or from greater distances, passengers may use a taxi or be driven in private automobiles to the primary access mode station. However, most passengers having to travel more than about two miles to the station will use modes other than rapid transit/bus to go to the airport unless the airport is considerably farther away (e.g. from Westchester County in New York).

Convenience also includes the number of transfers, the frequency of service, and the relative ease of handling baggage. These influence behavior in a less clear way.

Time seems to be less significant in modal choice than previously suspected. Time is assumed to be more critical for departing passengers. These passengers appear to judge the reliability and access time of their selected mode and begin their trip so as to arrive at the airport "on time", as they define it. There are exceptions, typically the departing businessmen travelling at peak hours. These are, perhaps, the people who perceive the greatest access problems and who complain the most. A change in their behavior might be easier to affect and more equitable, when considering the scope of urban transportation, than large capital investments to attempt to bring major improvement in airport access.

Price appears to be of more importance than time for public modes, especially given relatively similar convenience and accessibility characteristics. Price becomes even more important as the relative fare increases.

Major impedances to highway traffic, such as the CBD of Cleveland, boost the market share of public modes. It is doubtful that without this the Cleveland "Rapid" would carry so many air passengers. It is to be expected that many current Rapid airport passengers from the eastern suburbs will return to their private cars if and when the proposed interstate highways linking the eastern suburbs with the airport (I290 and I80) are completed.

Airport access "problems" are defined in terms of the air passenger. Other groups must be considered when planning for access improvements. Improvements for the passenger may aid employees and visitors somewhat, but may not be beneficial to operators of some of the existing modes, airport concession operators, airport operators, and airlines.

If there were an optimum mode, it would be ubiquitous, inexpensive, reliable, convenient, and fast. The "best" existing mode, the private automobile, is not available to all, and, by its numbers, exacerbates congestion and other access problems. Other modes are necessary and can provide acceptable service for certain passenger groups at certain locations. For example, the Cleveland Rapid Transit provides excellent access service for businessmen whose trips end in the CBD. However, this service is narrowly distributed to passengers near the rapid transit system, which is not extensive in Cleveland. Many passengers (perhaps 50% of those surveyed in the CHAAS) do not have the Rapid reasonably available. The air passenger using the Rapid must be subsidized. Generally fixed right-of-way access modes cannot be justified on the basis of airport traffic alone. Even though some valuable service might be provided, fixed route systems should be designed to serve large volume urban transportation markets, of which airport access represents only a minor component. If during the design of such a system the airport can also be served at a low marginal cost (for example the Washington METRO system serving National Airport) then it may well be justifiable.

If there are roles for the different modes, what are they and how can modal use be optimized? At present there appears to be little chance of rational optimization of modal use, even if it could be defined. In the U.S., where demand preferences tend to be indulged in planning more than in many countries, these preferences indicate the use of private automobiles. This is not necessarily modal optimization. The access trip crosses many jurisdictions in which the authorities, each with their own goals, interests, and constraints, rarely care specifically about airport access, or even transportation. There is no active coordinating agency for multi-modal planning, much less such planning for a single, limited purpose.

2.6 Policy Implication

In applying economic theory to airport access, one can consider the demand schedule fixed; therefore, manipulation of supply shifts the equilibrium point and equilibrium volumes. Transportation policy operates by altering supply characteristics to change modal volumes. Two general access system alternatives are often considered: construction of a line-haul system and improvement of the existing distributive systems.

The line haul system most often discussed for improving airport access is rail rapid transit, although new technology systems, e.g. TACV and VTOL, and exclusive-use bus-ways are also considered. These systems in general are cost-ineffective. Capital costs are very high, and operating costs generally are higher than most passengers are willing to pay. Subsidy of air passengers, while conceivably desirable to promote commerce in a particular area (or optimal use of services), is regressive. These systems would serve only those passengers close to stations in the denser market areas. These systems would not be able to serve the distributional needs of the air passengers unless made part of an extensive urban network, in which case other factors of passenger access demand would limit their use. The line-haul system would, in the

United States, be the choice of less than half of the local passenger market: those without automobiles conveniently available. To serve only the areas of concentrated airport access demand, primarily the CBD, would seriously under-utilize the line-haul modes' strongest point: ability to carry large numbers of passengers efficiently.

Airport dedicated fixed facility systems are not warranted given present or projected demand conditions. Stations such as Washington National that are an integral part of a fixed network, will probably not appreciably decrease highway congestion around the airport. More flexible systems (bus, limousine, or dial-a-ride) may be able to serve some distributional needs and operate on fare box revenues in certain locations. Demonstrations to evaluate this potential may well be justified.

Improvement of existing access systems is a more cost-effective approach and is recommended with qualifications. Limousine and airport bus operators generally serve the denser market areas but could provide a more distributive service to selected areas. Baggage and transfers are small problems with such service, particularly if a door-to-door mode of operation such as Dial-A-Ride is adopted. Dial-A-Ride may be particularly useful in the airport access context in view of the apparent passenger sensitivity to price rather than time. Price could be reduced considerably below current taxi fares through ride-sharing with small increases in travel times (7,13). Operation changes, new markets, and coordination with airlines and others may improve service and their financial position. Service could be offered to employees (subscription service to shift workers) as well as to passengers. Little is known about the institutional problems that would be encountered by aiding selected access mode operators. Demonstration projects would be useful to determine the service improvement and financial and institutional feasibility of these ideas.

Other minor capital and operational improvements could be undertaken to relieve congestion at and near the airports. Improvement of passenger and vehicle flow includes signing, remote parking with shuttle service, and relatively minor road construction projects at congestion points.

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Table 2.1 Local Origins of Air Passengers in Selected Cities. (1)

CITY / AIRPORT	Air Passengers Originating in the CBD (%)
Chicago / O'Hare	33
Cleveland / Hopkins	10
Denver / Stapleton	30
Kansas City / Municipal	40
Los Angeles / International	15
New York / JFK International	33
La Guardia	56
Newark	29
Phoenix / Sky Harbor	24
San Diego	10
Seattle-Tacoma / International	17
Washington,D.C. / National	23

Table 2.2 AVAILABILITY AND USE OF PRIVATE AUTOMOBILE FOR AIRPORT ACCESS, BY AREA (Cleveland, Phase 1)

Availability and Use	Passengers in Area (%)					
	CBD	CTS East	Shaker	Total East	West	Total
Available & Used	21	60	68	52	88	56
Available & Not Used	11	15	17	14	8	14
Not Available	68	25	15	34	7	30

Table 2.3 AVAILABILITY AND USE OF PRIVATE AUTOMOBILE FOR AIRPORT ACCESS, BY GROUP (Cleveland, Phase 1)

Availability and Use	Passengers in Group (%)				
	Resident Business	Resident Non-Business	Non-Resident Business	Non-Resident Non-Business	Total
Available & Used	71	75	35	62	60
Available & Not Used	20	14	9	9	13
Not Available	9	11	56	29	27

Table 2.4 EFFECT OF AUTOMOBILE AVAILABILITY ON THE SELECTION OF ACCESS MODES OTHER THAN PRIVATE AUTOMOBILE (Cleveland, Phase 1)

ZONES	Availability	Passengers Using a Mode, Stratified by Availability (%)						
		Rented Car	Taxi	Public Bus	Airport Limo	Airport Bus	Hotel/Motel Limo	Total
ALL	Available	27	33	35	36	30	14	33
	Not Available	73	67	65	64	70	86	67

Table 2.5 DISPOSITION OF PRIVATE CAR USED FOR AIRPORT ACCESS BY GROUP
(Cleveland, Primary Area, Departing Passengers Only)

Disposition of Car	Passengers in Group (%)					
	Phase 1 Total	Phase 2 Total	Resident Business	Resident Non-Business	Non-Resident Business	Non-Resident Non-Business
Parked at Airport	32	29	67	16	7	1
Passenger Dropped Off	44	49	22	31	67	38
Driven Away by Another	23	22	11	53	26	61

Table 2.6 AUTOMOBILE AVAILABILITY FOR LIMOUSINE RIDERS FROM SUBURBAN NEW YORK (Wilder 1) (6)

Group	Passengers with Auto Available as Defined (%)			Resident Passengers (%)
	Someone Could Drive	To Drive and Park (Residents)	Would Risk Parking at Airport (Residents)	
All	41	61	42	59
Outbound	40	65	46	72
Businessmen	34	64	48	30
Non-Resident Businessmen	29	0	0	0

Table 2.7 AUTOMOBILE AVAILABILITY FOR DEPARTING LIMOUSINE RIDERS FROM SUBURBAN NEW YORK (Wilder 2) (6)

Passengers	Percent of Residents			Non-Residents (%)
	All	With Auto-Park Available	Without Auto-Park Available	
With Auto Drop-Off Available	54	35	19	46
Without Auto Drop-Off Available	46	29	17	25
All		64	36	

Table 2.8 REASONS FOR NOT USING AUTOMOBILE AVAILABLE TO DRIVE AND PARK AT AIRPORT, NEW YORK (Wilder 3 and Carey 1) (18)

Reason	All Passengers to an Airport with Auto Available (%)			
	Survey - Wilder 3 Area-Westchester Co.		Survey - Carey 1 Area-Manhattan	
	JFK	LaGuardia	JFK	LaGuardia
Parking Too Costly	28	25	44	28
Parking Too Far From Terminal	5	11	8	14
Do Not Like to Drive	26	23	16	26
Concerned about Theft and Vandalism	28	26	20	21
Other	13	16	12	12

Table 2.9 REASONS FOR NOT BEING DRIVEN TO/FROM THE AIRPORT IN A PRIVATE CAR
(Wilder 3 and Carey 1) (18)

Reason	All Passengers to an Airport with Auto Available (%)			
	Survey - Wilder 3 Area-Westchester Co.		Survey - Carey 1 Area-Manhattan	
	JFK	LaGuardia	JFK	LaGuardia
Driver Unavailable or at Work	19	24	26	24
Driver Does Not Like to Drive to Airport	13	14	6	9
Did Not Wish to Inconvenience the Driver	19	38	26	15
Bus More Convenient	19	10	32	37
Other	31	14	10	15

Table 2.10 The Effect of Distance from Transit Stations on the Market Share of the Cleveland Rapid Transit and of Private Automobile (Phase 2)

Distance from the Rapid Transit Station	Market Shares by Areas of Cleveland (%)							
	WEST		CBD		CTS EAST		SHAKER	
	auto	rapid	auto	rapid	auto	rapid	auto	rapid
0-1/4 mile	51	21	12	47	27	58	49	28
1/4 - 1/2 mile	60	20	15	32	44	48	60	24

Table 2.11 Secondary Access Modes for the Cleveland and Shaker Heights Rapid Transit Systems, by Market Areas (Phase 2)

Mode	Market Share by Area of Cleveland (%)							
	0-1/4 mile from the station					1/4-2 miles		over 2 miles w/in mkt area
	CBD	CTS-EAST	SHAKER	TOTAL EAST	WEST	TOTAL EAST	WEST	EAST
Taxi	6	11	6	7	5	25	15	18
Driven by Another	8	30	42	24	44	35	43	61
Drive and Park	2	4	4	3	7	3	9	8
Walk	82	44	41	60	35	23	13	1
Bus	2	10	3	4	9	12	20	11
Other	1	1	5	2	0	1	1	2

Table 2.12 Market Share of All Airport Access Modes for Different Areas in Cleveland and Number of Rapid Transit and Limousine Stops in Each Area. (Phase 2)

Mode	Market Share (%) by Area around the Rapid Transit Stations							
	Within 1/2 mile					1/2-2 miles		Over 2 miles but within Rapid Market Area
	CBD	CTS-EAST	SHAKER	TOTAL EAST	WEST	EAST	WEST	EAST
Rented Car	6	3	5	5	8	6	10	8
Private Car	14	33	50	28	57	44	46	59
Taxi	17	6	11	13	13	11	16	4
Limousine	24	4	7	16	1	11	18	9
Rapid Transit	39	55	27	38	21	31	8	19
Other	1	0	1	1	0	0	0	1
NUMBER OF STOPS								
Limousine	6	4	3	9	0	9	1	N/A
Rapid Transit	1	1	24	32	9	32	9	0

Table 2.13 Secondary Access Modes for the Cleveland (Eastern Suburbs only) and Shaker Heights Rapid Transit Systems, by Stations Used. (Phase 2)

Mode	Market Share by Transit System (%)	
	Cleveland	Shaker Heights
Taxi	9	6
Driven by another	46	26
Drive and Park	4	4
Walk	30	55
Bus	13	2
Other	0	7

TABLE 2.14 Secondary Access Modes to Limousine and Bus Airport Access Service, All Passengers by Airport and Station Location, Wilder and Carey Surveys, New York (6,14,15,18).

<table>
<tr><th rowspan="4">MODE</th><th colspan="9">PASSENGERS BY MODE (%) BY SURVEY</th></tr>
<tr><th rowspan="3">Wilder (1970)</th><th colspan="4">By Wilder (1971) to</th><th colspan="4">By Carey (1971) to</th></tr>
<tr><th colspan="2">JFK</th><th colspan="2">LaGuardia</th><th colspan="2">JFK</th><th colspan="2">LaGuardia</th></tr>
<tr><th>West-chester</th><th>Connect-icut</th><th>West-chester</th><th>Connect-icut</th><th>East Side</th><th>Grand Central</th><th>East Side</th><th>Grand Central</th></tr>
<tr><td>Drove Car</td><td>8</td><td rowspan="2">70</td><td rowspan="2">84</td><td rowspan="2">48</td><td rowspan="2">74</td><td rowspan="2">1</td><td rowspan="2">2</td><td rowspan="2">2</td><td rowspan="2">0</td></tr>
<tr><td>Was Driven</td><td>46</td></tr>
<tr><td>Taxi</td><td>28</td><td>20</td><td>12</td><td>34</td><td>12</td><td>57</td><td>40</td><td>49</td><td>28</td></tr>
<tr><td>Subway</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>3</td><td>20</td><td>3</td><td>17</td></tr>
<tr><td>Bus</td><td>0</td><td>1</td><td>0</td><td>4</td><td>2</td><td>22</td><td>9</td><td>18</td><td>8</td></tr>
<tr><td>Walk/Other</td><td>18</td><td>9</td><td>4</td><td>14</td><td>12</td><td>17</td><td>29</td><td>28</td><td>47</td></tr>
</table>

TABLE 2.15. Comparison of Travel Times and Market Shares of the Airport Access Modes from Selected SCOTS Zones, CHAAS, Phase 1.

AREA	ZONE	Average Time and (Standard Deviation) in Minutes and Market Share (%) by Access Mode											
		RENTED CAR		PRIVATE CAR		TAXI		PUBLIC BUS		LIMOUSINE		AIRPORT BUS	
CBD	0016	34(9)	12%	39(17)	16%	33(10)	36%	-		44(15)	16%	35(9)	20%
CBD	0018	47(23)	6%	45(44)	12%	43(53)	28%	51(16)	1%	43(49)	35%	36(15)	15%
CTS EAST	8333	66(57)	18%	44(15)	38%	39(9)	18%	70(28)	4%	66(10)	9%	62(14)	10%
CTS EAST	8338	51(25)	21%	41(11)	24%	31(5)	21%	66(0)	3%	57(25)	12%	56(25)	15%
SHAKER HEIGHTS	7401	58(18)	7%	53(60)	69%	50(13)	13%	-		79(33)	8%	70(26)	3%
SHAKER HEIGHTS	7404	55(15)	17%	55(18)	32%	75(122)	22%	75(0)	1%	62(20)	25%	70(17)	2%
WEST	2420	-		16(14)	86%	13(4)	9%	8(0)	17%	-		-	

Table 2.16 Modal Choice of Departing Passengers by Area at Evening Rush Hour, Cleveland, Phase 2

Mode	Market Share (%) by Area		
	CBD	CTS-East	Shaker
Rented Car	8	7	3
Private Car	17	34	47
Taxi	14	5	12
Limousine	19	7	7
Rapid Transit	42	46	29
Other	0	1	2

Table 2.17 Change of Market Share for Highway Modes Between the CBD and the Airport, Cleveland, Phase 1 to Phase 2 (Quarter-mile Zones)

Mode		Market Share (%)		
Type	Price ($)	Phase 1	Phase 2	% Change
Taxi	7.00	31	16	- 48
Rented Car	1.00+	8	5	- 38
Limousine	1.60	31	20	- 36
Private Car	2.50	15	13	- 11

Table 2.18 Change of Market Shares for Highway Modes Between Selected Suburban Areas and the Airport, Cleveland, Phase 1 to Phase 2 (Quarter-mile Zones)

Mode	Market Share in an Area (%)								
	CTS - EAST			SHAKER HEIGHTS			WEST		
	Phase 1	Phase 2	% Change	Phase 1	Phase 2	% Change	Phase 1	Phase 2	% Change
Taxi	23	8	- 65	14	10	- 29	22	13	- 40
Rented Car	8	3	- 63	6	5	- 17	8	14	+ 75
Limousine	19	4	- 79	14	7	- 50	4	1	- 75
Private Car	35	27	- 23	60	50	- 17	62	51	- 18

Table 2.19 Market Share of Access Modes of Arriving Passengers and Percent of Arriving Passengers Preselecting Each Mode, Two-mile East Area, Cleveland, Phase 2.

	Airport Access Mode				
	Rented Car	Private Car	Taxi	Limousine	Rapid Transit
Market Share of All Arriving Passengers (%)	6	29	15	17	33
Percent of Arriving Passengers Pre-selecting Eash Mode	83	76	60	65	76

TABLE 2.20 The Effect of Transfers on Market Share, Phase 2, Cleveland

Number of Transfers	Percent of Transfers by Mode						
	Rented Car	Private Car	Taxi	Airport Limo	Hotel Limo	Rapid Transit	All Modes
0	94	94	90	70	81	36	74
1	5	5	9	28	15	62	25
2	1	1	1	23	4	2	1
Market Share (%)	7	37	13	9	2	30	

Table 2.21 Most Frequent Reasons Given for not Riding the Rapid to the Airpcrt, Cleveland, (PONYA Phase 3) (11)

Area	Order	Reasons	%	% Who Had Used Transit Before	Remarks
Two-mile East	1	Other Mode More Convenient	45	39	Of these, 67% used Private Car, 20% Limousine
	2	Luggage	18	54	0 bags: 4%; 1 bag:12%; 2:33%; 3+:51%
	3	No Knowledge	11	0	
	4	Other	5	50	
	5	Too Far to Station	3	56	
	6	Transfer	3	38	Few from Shaker Heights 0 bags: 19%; 1 bag: 38%; 2:24%; 3+:19%
Over Two Miles East, but in Rapid Market Area	1	Other Mode More Convenient	31	37	Of these, 78% used Private Car, 16% Limousine
	2	Not in Rapid Market Area	24	27	
	3	Luggage	11	65	0 bags:3 %; 1:9% ; 2:30%; 3+:58%
	4	Other	6	58	
	5	To Far to Station	5	65	
	6	Was Driven	5	64	
Two-mile West	1	Other Mode More Convenient	38	40	Of these, 79% used Private Car, 2% Taxi, 5% Limousine
	2	Used Courtesy Bus	17	21	All non-residents; 84% businessmen
	3	Luggage	8	24	2 bags:53%; 3+:47%
	4	Was Driven	6	50	
	5	Not In Rapid Area	6	29	
	6	Too Far to Station	5	42	

Table 2.22 Comparison Over Time of Modal Shares in Selected Areas, Cleveland, Phases 1, 2, 3

Mode	Modal Share (%) by Area and Phase						
	Two Mile Circle-East			Two Mile Circle-West		Outside Two Mile Circle East	
	1	2	3	2	3	2	3
Rented Car	7	5	5	11	4	8	6
Private Car	48	34	39	49	55	59	67
Taxi	18	12	9	15	9	4	3
Limousine	16	14	15	14	4	9	11
Transit or Bus	3	35	31	11	10	19	12
Other including Courtesy Bus	8		1		18	1	2

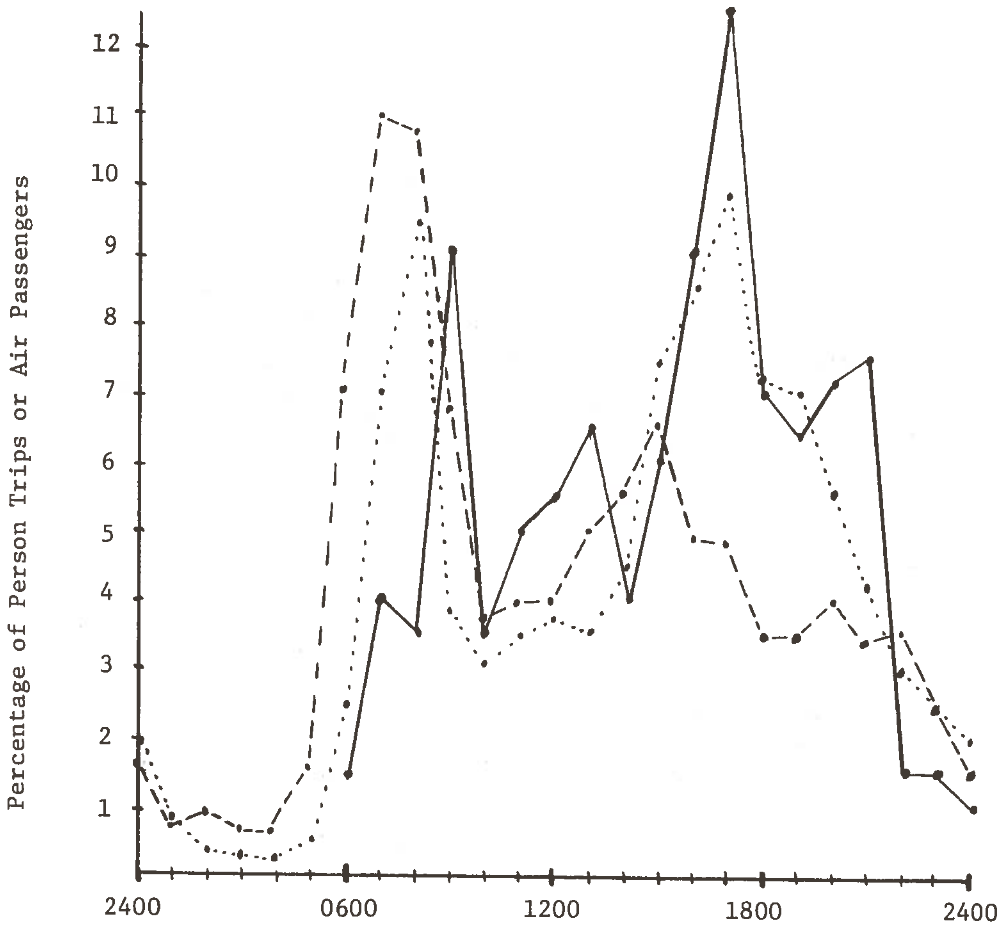

Figure 2.1 Peaking Characteristics of Urban Area Person Trips (....), Airport Access Person Trips (----), and Cleveland Air Passenger Airport Access Trips (________). (16,5,12)

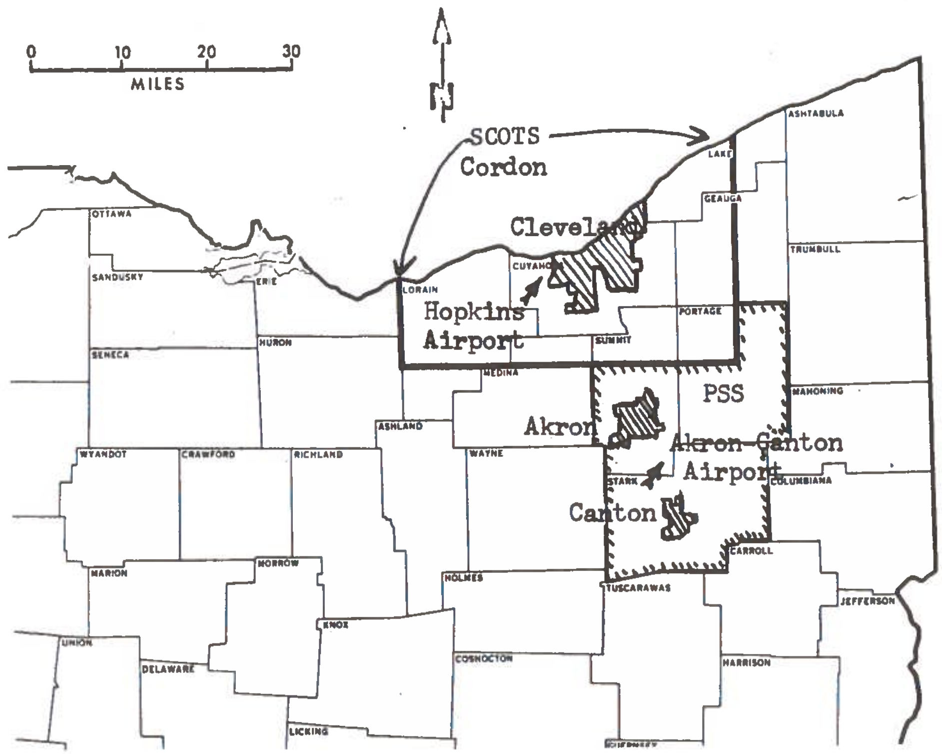

FIGURE 2.2 Northeast Ohio, Showing Counties and Cleveland Hopkins Airport Access Study / SCOTS Cordon Area, Cleveland, Akron, Canton, Hopkins Airport, Akron-Canton Airport, and the "PSS" area: Portage, Stark and Summit Counties outside the SCOTS Cordon. (12)

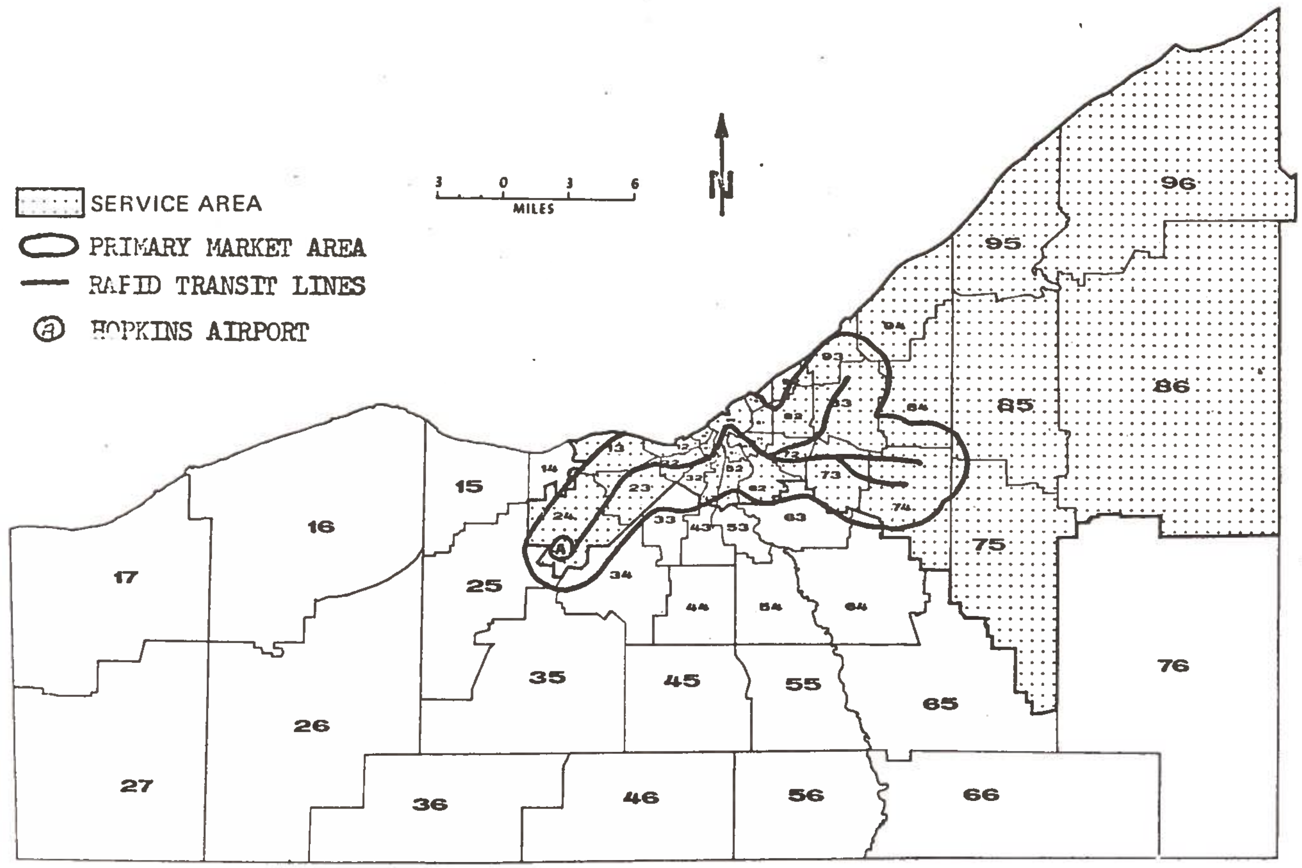

FIGURE 2.3 Cleveland-Hopkins Airport Rapid Transit Service Area and Primary Market Area by SCOTS Districts. (12)

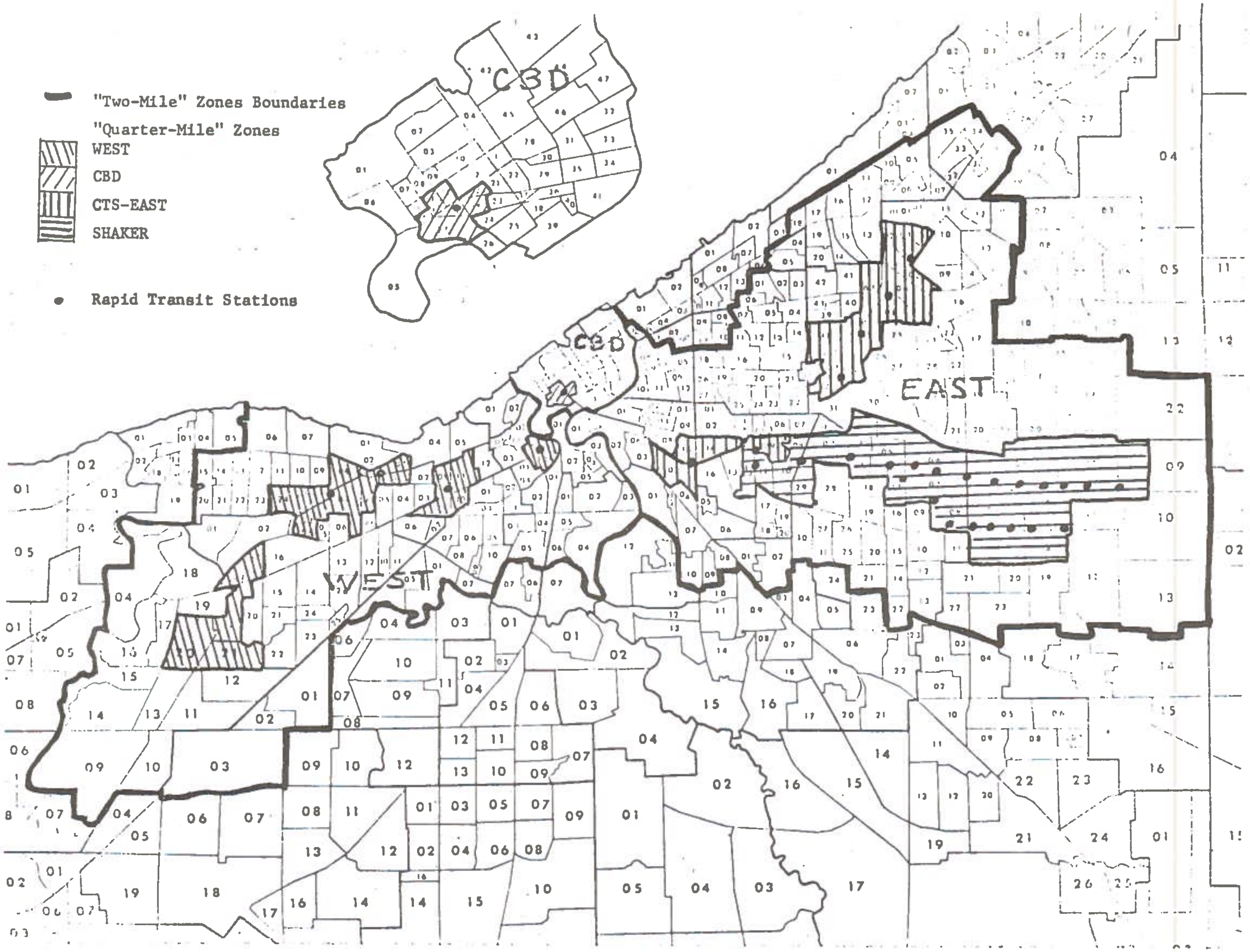

FIGURE 2.4 Cleveland and Vicinity, Showingthe Primary Market Area for the Rapid Transit Service to the Airport, and the zones used for this Study: Two-Mile East, CBD, Two-Mile West, and Quarter-Mile Zones: CTS-East, Shaker, CBD, and West.

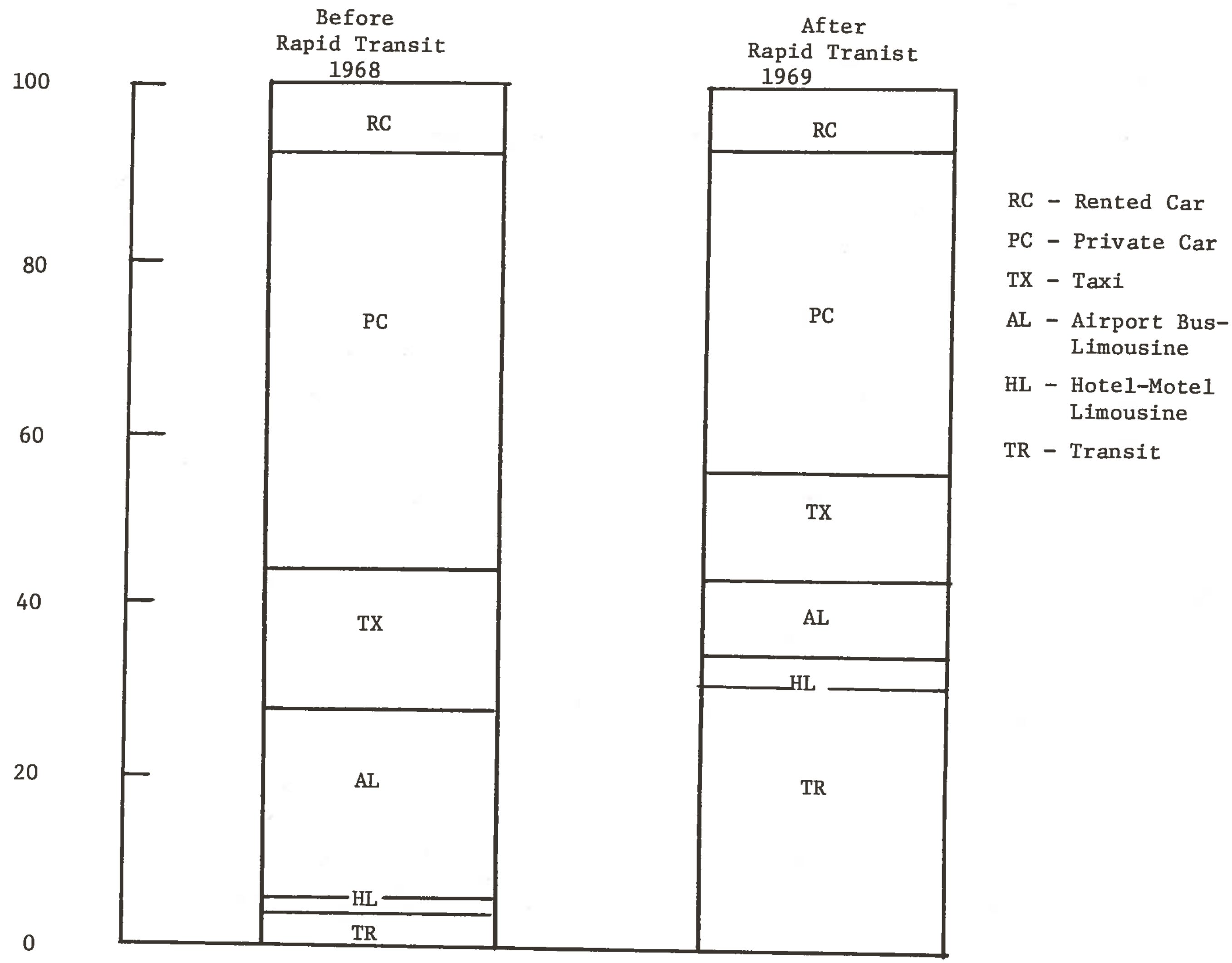

Figure 2.5 Change in Airline Passenger Airport Access Modal Choice after the Introduction of Rapid Transit Service, Primary Market Area for Rapid Transit, Cleveland, Phases 1 and 2.

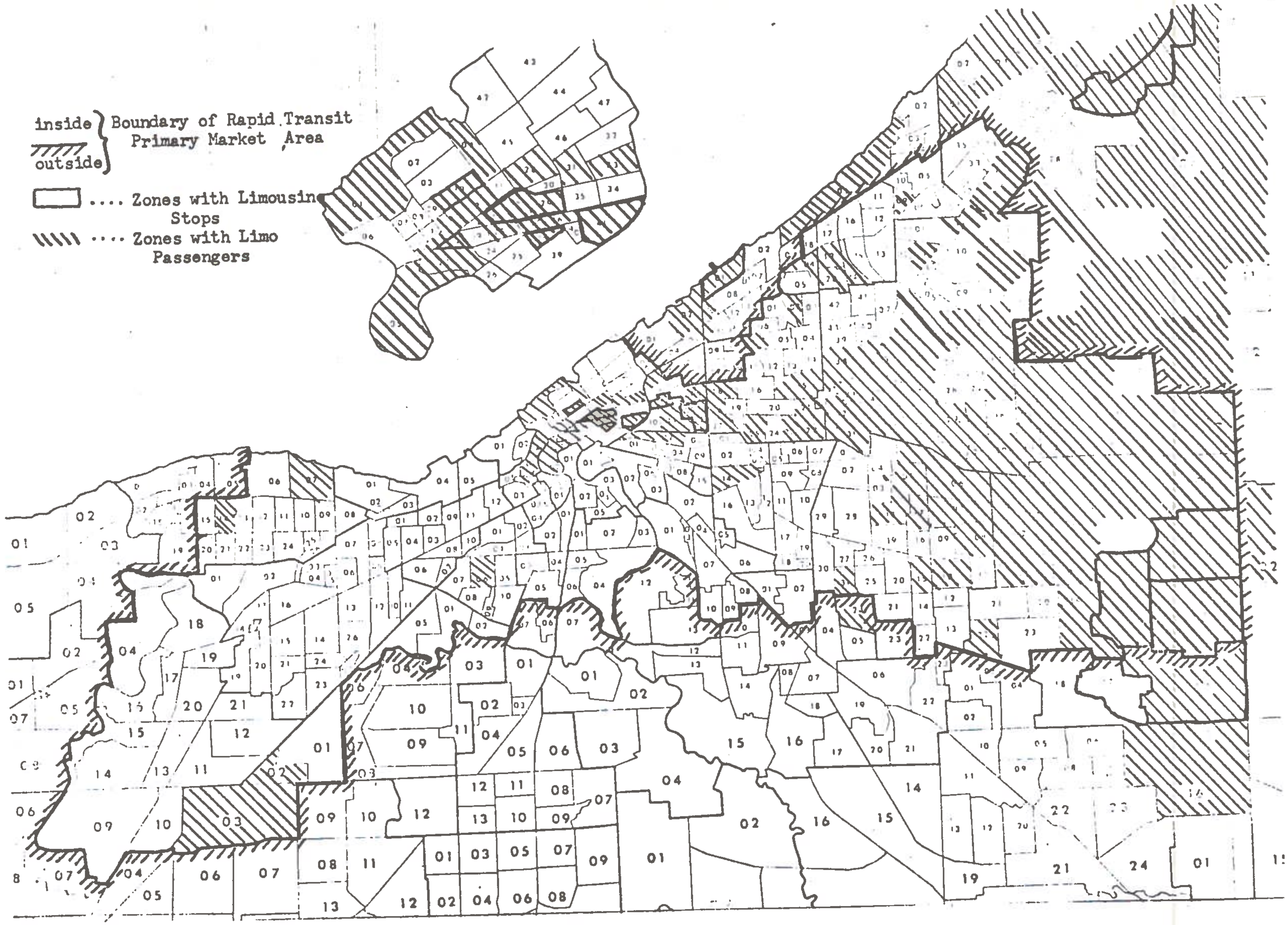

FIGURE 2.6 Cleveland and Vicinity, Showing Limousine Stops and Market Areas.

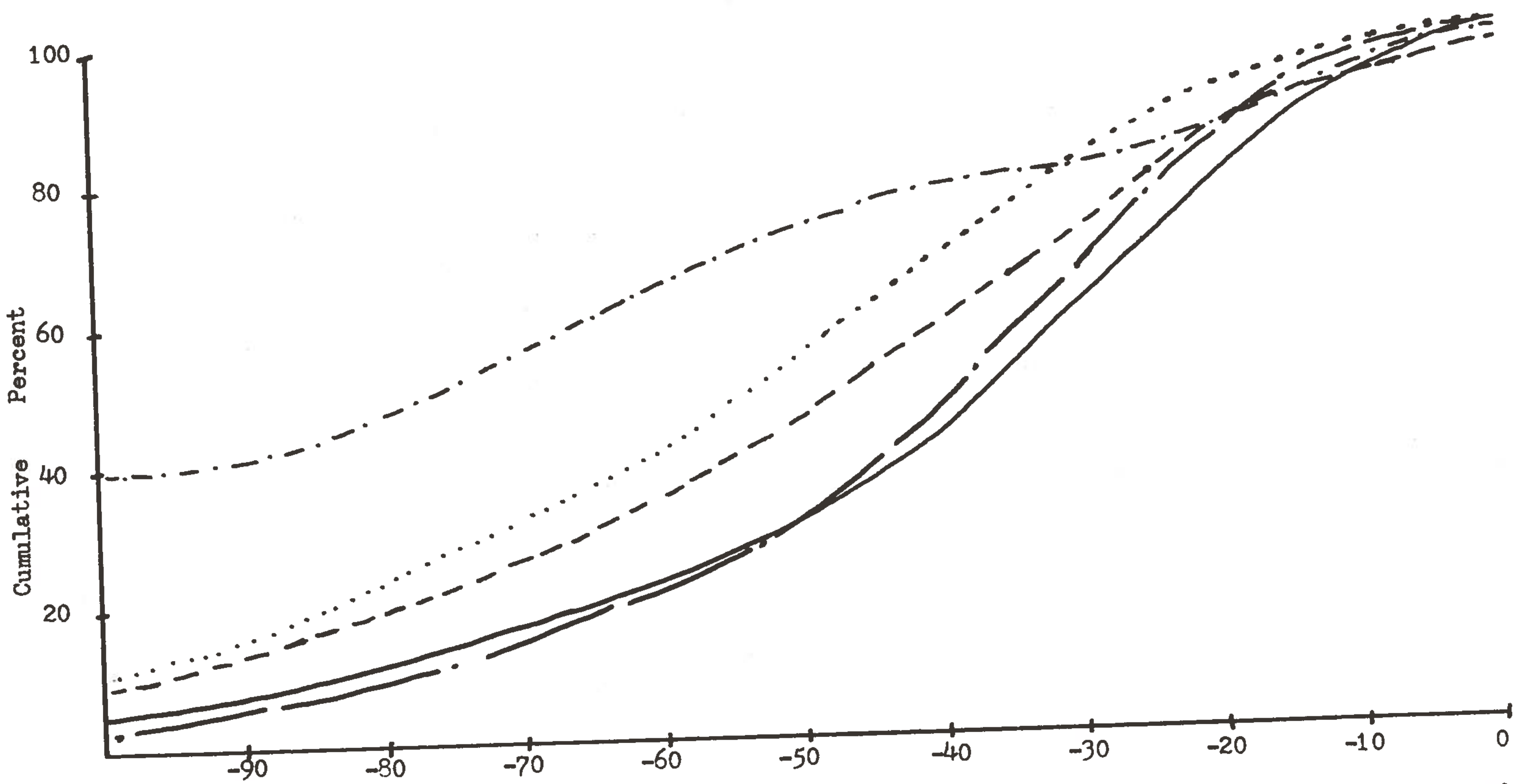

FIGURE 2.7 Arrival Distribution of All Departing Passengers, Studies, Areas, and Airports as Noted, (12,14,15)

Carey 1, JFK —·—
Carey 1, LaGuardia — — —
Wilder 1 ······
Cleveland, Phase 2 (Two-Mile East Area) ———
Portage, Stark, and Summit Counties, Phase 2 —·——

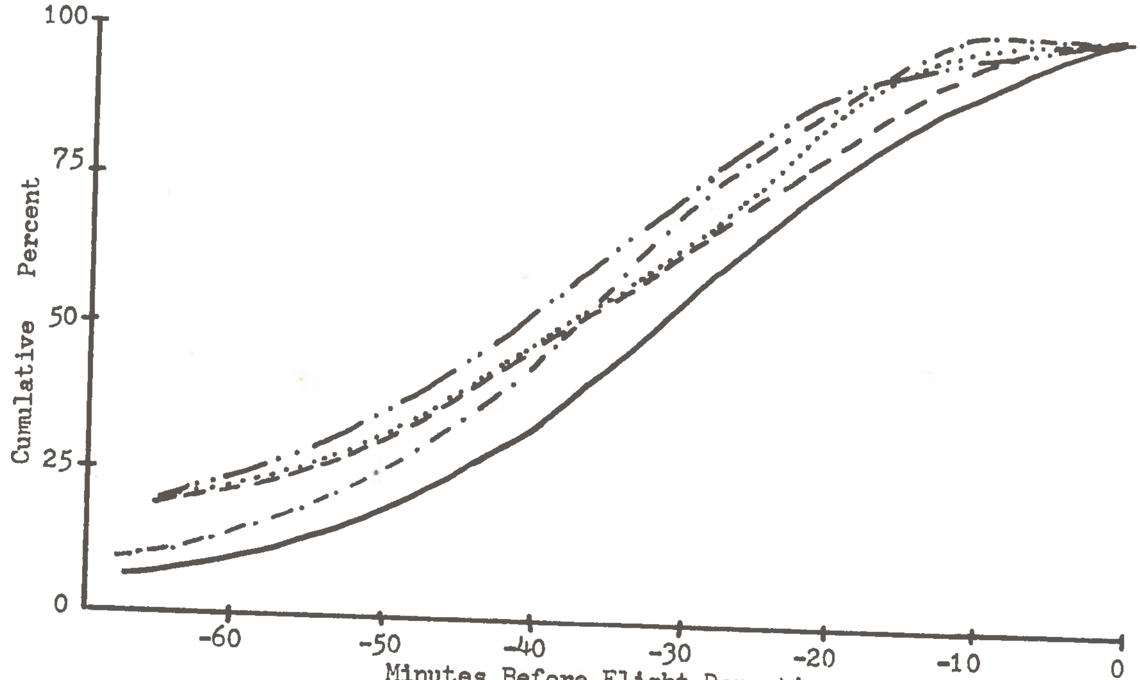

FIGURE 2.8 Arrival Distribution of All Departing Passengers from the CBD, Between 3 and 7 p.m., by Mode, Cleveland, Phase 2

Rapid Transit — — — Limousine ······· Rented Car —·—·
Private Car ——— Taxi —··—

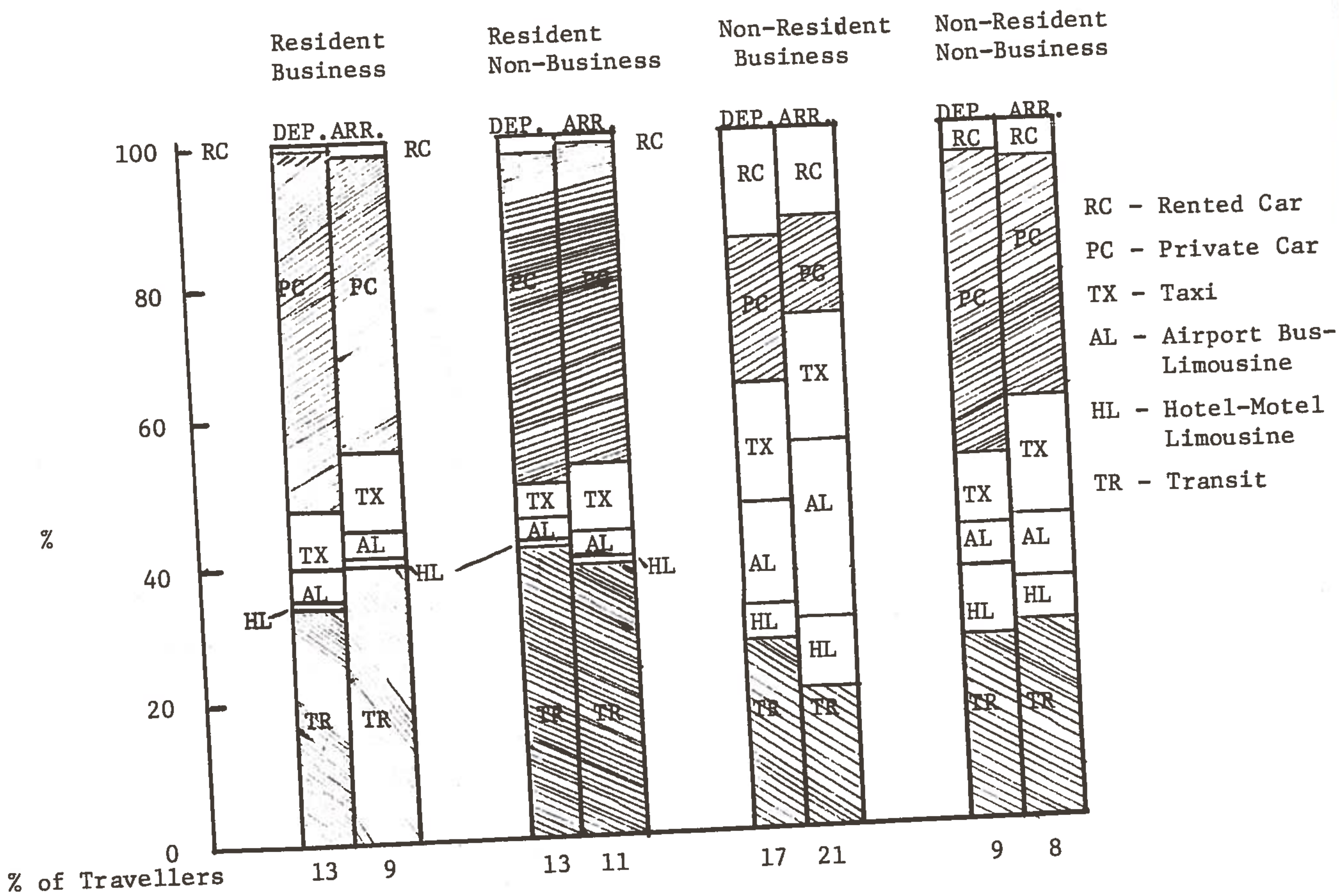

Figure 2.9 Asymmetry of Airport Access Modal Choice by Arriving and Departing Air Passengers, Cleveland, Phase 2.

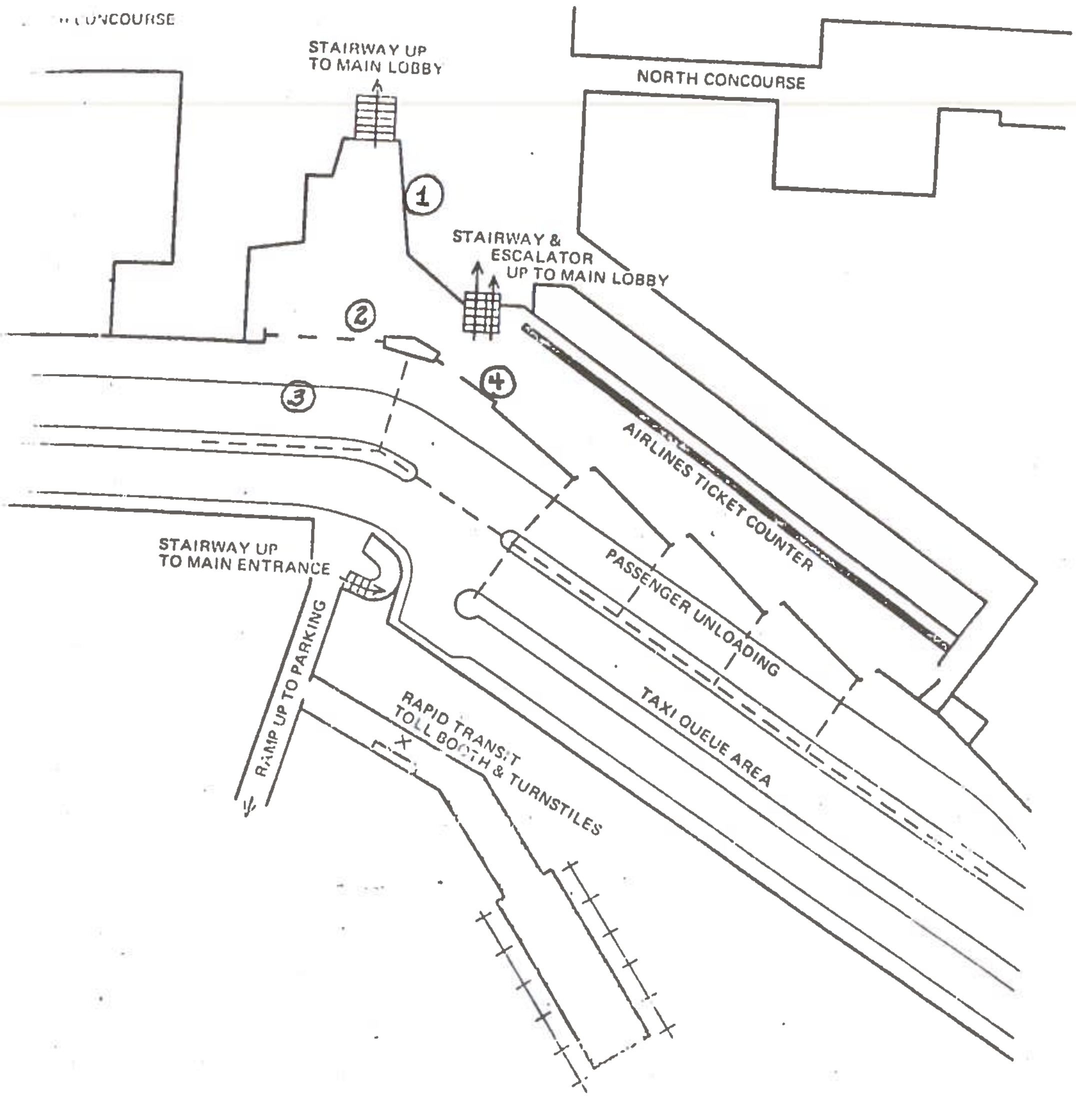

Figure 2.10 The Cleveland Hopkins Airport Terminal Building, Showing the Location of the Limousine Operators, Limousines, Taxis, and Rental Car Booths with respect to the Rapid Transit Station (12)

LEGEND:
(1) Baggage Claim
(2) Limousine Operators
(3) Parked Limousines
(4) Rental Car Booths

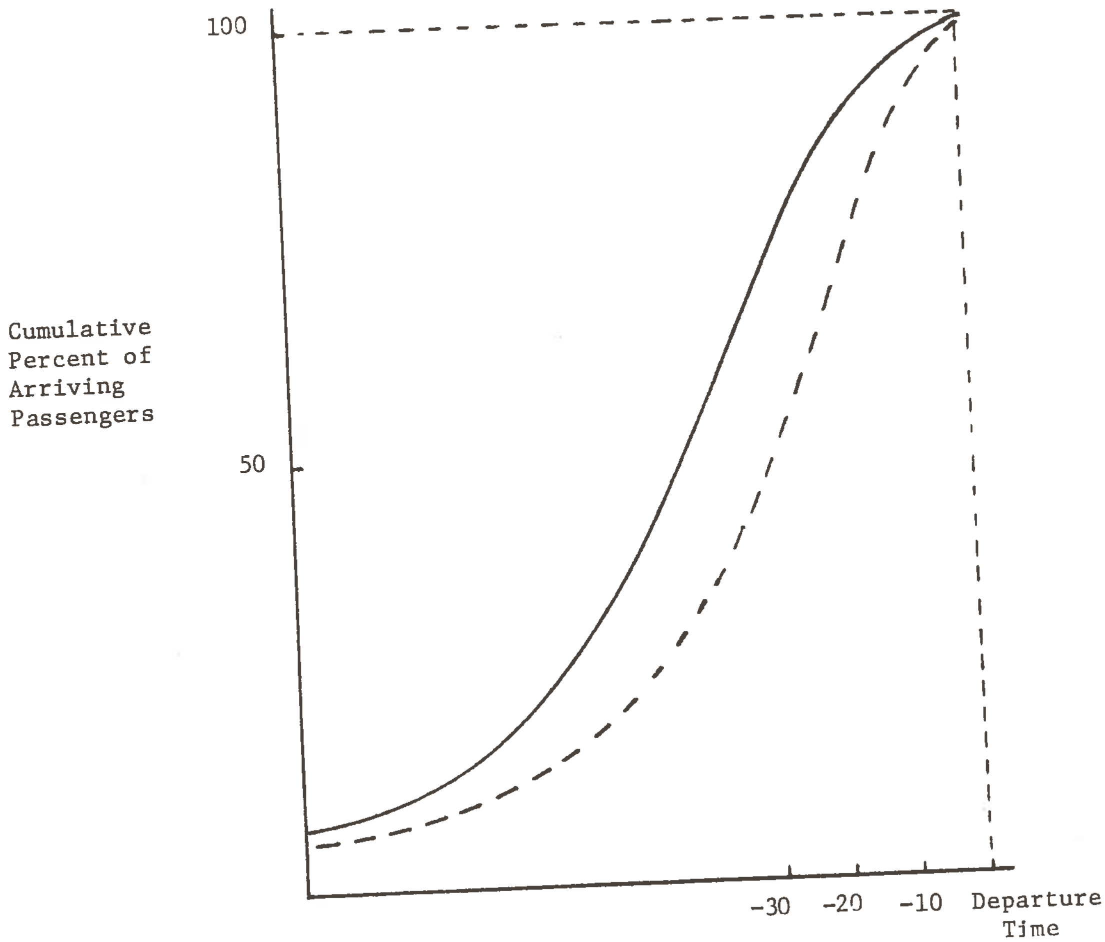

Figure 2.11 Distribution of Departing Flight Passengers Arriving at the Airport Before their Flight

——— present typical distribution

- - - - possible distribution if access reliability is significantly improved.

3 AIR SERVICE ACCESS: AIR NETWORK CONFIGURATION

3.1 Introduction

Air service access can be defined as a function of the level of service provided by the air transportation system as well as the ground transportation system that affects airport access. The previous chapter addressed the question of airport access alone, in this chapter attention is directed to the air transportation system itself. The level of air service in any particular city-pair market may be described as a set of attributes including such factors as cost, travel time, frequency, comfort, and convenience. The level of service is a function of the technology used, operating policies, and network structure.

Network configuration is an important factor in air service access, given the regulatory and technological framework of air transportation. A passenger from a small city ("O" in Fig. 3.1a) travelling to city "D_u" may have to use an infrequent and circuitous air feeder or "access" service to reach the air service he really wants but can find only at a nearby large city ("L"). The passenger from town "O" has poor air service access because he lives where he does, while the passenger from city "L" has good access to air service (excluding possible airport access problems) solely because he lives in a large city. A fully connected network (Fig. 3.1b) may give greater equity in air service access by providing direct air service between all cities in the network. The direct service provided by a highly connected network may not be such a clear improvement if a measure of effectiveness other than equity is used. The effects on the whole system must be considered, for example: highly connected networks are generally not economically viable because of lower volumes on all routes.

This type of issue can be analyzed using a simple fleet allocation model discussed in this section. A more detailed description of the model is found in Reference 4.

3.2 The Fleet Allocation Model

The purpose of the model is to provide reasonable and accurate insight into the behavior of the overall network and the effect on aggregate delay of making route changes. It is not designed to analyze the detailed scheduling, crew basing the similar aspects of this complex system. The essential problems addressed by this model are:

a. How to allocate a fleet to a network to minimize delay.

b. What fleet sizes should be used (a tradeoff between extra cost and extra convenience, solved by iteration for different fleet sizes).

c. What is the best network (a tradeoff between connectivity of networks, found by iterating the model on fleet sizes for different networks).

The model also aids in determining the tradeoffs between the distribution of service (the probability density function of delay) and the average delay.

The model uses average delay time for the system as a measure of aggregate effectiveness. One of the reasons a person flies rather than uses a ground or water mode is because of the savings in trip time. We have already seen that one of the basic problems in airport access is that people expect low door-to-door trip times because of the speed of the aircraft. The problem of time expectation is similar for air service access. Trip time (airtime plus schedule delay time) is a valid measure of the level of air service in the short run,assuming constant cost. Flight time is constrained by technology, so average delay time provides a reasonable measure of effectiveness.

Delay time includes congestion and schedule delay. Congestion delay is caused primarily by air traffic control problems or congestion on the airport ramps and runway. This sort of stochastic delay can also result from unexpected aircraft repairs. Schedule delay is generally more common and important. It occurs when the passenger's desired departure time does not coincide with a scheduled flight or when the flight is full and the passenger must wait for the next flight. The former is a function of the flight frequency; the latter, of the load factor.

Congestion delay is avoided by routing around the delay points, where, in the few cases that exist, it becomes significant. Schedule delay is generally expensive to reduce because it involves flying more aircraft. Reduction of schedule delay becomes especially costly as network connectivity increases and more flights have to be put on more links.

Traffic on the network and network delay are stochastic, but there is as yet no solution to the generalized network queuing problem. However, there are particular classes of communications networks in which the network problem can be recast so that closed-form solutions can be calculated, and thus optimal designs devised (5). Our problem falls in this class if delays are assumed to be independent and occur only at the nodes. This is not too removed from reality, particularly considering the importance of schedule delay to the passenger. Other assumptions have been made to simplify the model, without losing the essential insight. These assumptions include fixed fleet capacity, exogenous aircraft allocation, and perfect scheduling.

The model retains the two types of schedule delay. Increased frequency reduces delay due to scheduling; the average waiting time for a city-pair link is assumed to be inversely proportional to the frequency on that link. The other determinant of delay is the average load factor, ρ, for a given link, i, where ρ_i = demand$_i$/capacity$_i$. Increases in the load factor make it increasingly difficult to obtain a seat on that flight. As the load factor approaches one, the queue length of passengers waiting for service and the average delay would both tend to become indefinitely large. Setting delay proportional to $1/(1-\rho_i^{k})^{1/s}$ satisfies these properties, and a closed form solution is obtained for s = k = 1. Therefore, average delay will be set equal to $\alpha\,[N_i\,(1-\rho_i)]^{-1}$, where N_i is the number of flights on a route and α is an empirically derived proportionality constant, unique to the system.

The objective is to allocate capacity to maximize service by minimizing delay over the entire network, or

$$\text{minimize } D = \sum_i \frac{\alpha\, v_i}{N_i\,(1-\rho_i)} \qquad (3.1)$$

(where v_i is the number of passengers on link i), subject to a constraint on the total capacity available on any given iteration of the analysis:

$$\Sigma_i N_i c_i t_i = S + (B/\delta) = H \tag{3.2}$$

This constraint indicates that for a given fleet size providing a fixed number of seat-hours, S, whose expansion is restricted by a budget, B, the number of seat-hours available is the sum of the seat-hours in each link represented by the number of flights, N_i, times the size of the aircraft, c_i times the block time, t_i.

Optimizing using the LaGrange multiplier technique

$$N_i = \Psi \sqrt{v_i/c_i t_i} + v_i/c_i \tag{3.3}$$

where $\Psi = H - \Sigma_i v_i t_i / \Sigma_i \sqrt{v_i c_i t_i}$, a system constant.

$$D = \Sigma_i D_i = \frac{\alpha(\Sigma_i \sqrt{v_i + c_i})^2}{H - \Sigma_i v_i t_i} \tag{3.4}$$

In Eq. 3.3, each link is assigned the minimal number of aircraft necessary to meet the demand (v_i/c_i). The remainder of the fleet is allocated among the links according to a square root law.

$$N_i \sim \sqrt{v_i/c_i t_i} \tag{3.5}$$

or

$$N_i^2 \sim v_i/c_i t_i \tag{3.6}$$

and $\rho_i = v_i/c_i N_i \sim N_i t_i$ (3.7)

Therefore, the load factor, ρ_i, should increase as the block time, t_i, increases and as the passenger volume, v_i, increases or the flight frequency, N_i, increases. Thus the average load factor on long haul flights or in markets with high demand should be high. This conclusion is corroborated by Douglas (2,3).

3.3 Implications of the Fleet Allocation Model

This model can be used to analyze the optimality, from an aggregate delay standpoint, of a given network, to estimate the relative need for new services, or to determine the adequacy of existing services. It provides a means to estimate the effect on the system in terms of degradation of service as aircraft are directed to markets with less demand or in terms of extra costs as more aircraft are acquired to provide new service and maintain the overall level of service.

A key issue raised by this model is that of distribution of service. The distribution of air service access times or delay times for the feeder network may look something like the solid line in Fig. 3.2. The average time, $\overline{T}_1$ is low, probably because of the larger number of passengers in the large collecting city. However, some people, often those who live in the smaller cities with only feeder flights to the collecting city, have high access times. If we try to reduce the extreme access times by providing greater network connectivity, we will change the distribution to that with the dashed line and raise the average access/delay time to $\overline{T}_2$. The model can be used to show who will receive improved or reduced service with a change in connectivity by calculating link times for the before and after networks, the origin/destination patterns, and the delay probability distribution functions for the passengers at each node. The model cannot be used to show who should receive what service, but it assists the policy maker by clarifying the distributional tradeoffs of a revision of services provided by a changed network.

The model and its results have implications for regional development. Air transportation can play an important role in developing a region. If a policy determination is made to minimize average delay in a system, the optimal network configuration is a tree-like feeder system. Then the development strategy would be to establish a larger airport at a regional center for air service from outside the region. The smaller towns could have small airports and connecting feeder air service to the regional center (Fig. 3.3). However, more study of the air service access problem is required to determine, among other things, if the feeder service should be by air or by another mode or modes. Because of better transportation facilities and of transfer functions, one would expect the location picked as the "regional center" to experience more growth than the other towns. Perhaps the largest city in a region should be selected to be the "regional center". Obviously there are many political and economic implications that are beyond the scope of this paper.

This approach to optimal network configuration has implications for large metropolitan areas, also. The shape of the low average delay network seems to imply that a metropolitan area should have a large airport fed not only by ground transportation but also by air from satellite airports in the area. This has been advocated in several of the largest U.S. metropolitan areas, but so far has met with little success. Most "satellite" airports have been used for direct city-pair operations, not feeder service. One problem has been air traffic congestion, already experienced at the major airport, which precludes the addition of many feeder flights. Another is that most of the feeder operations were performed with VTOL aircraft that were too costly to operate.

The more highly connected network improves air service access for certain passengers. Batchelder has examined air service between small, inner-city airports for certain city pairs. (1) Passengers ending their trips in the CBD often are businessmen who are in a hurry and who experience some of the greater airport access problems because of their schedules and of the unavailability of many access modes. Thus, it would appear that this group's airport and air service access can be improved by downtown airports. Batchelder found, however, that very few city-pair markets had sufficient demand to support this type of service, and most downtown terminals would serve relatively few passengers and be cost-ineffective. Obviously, any policy attempting to improve air service access must be preceded by thorough study of the situation. Although greater connectivity in the cases examined by Batchelder improved average air service access times (as a separate fleet was added to the route) it was not financially viable except for close city-pairs with traffic comparable to Chicago; these are very rare.

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Figure 3.1a Feeder Service Network (low connectivity).

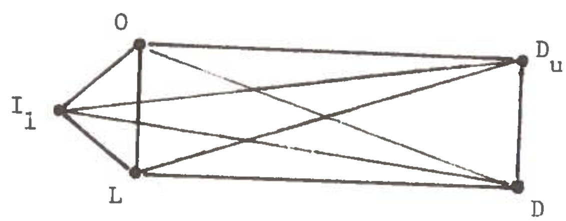

Figure 3.1b Direct Routing (fully connected network).

Figure 3.1 Routing of a Passenger from Town O to Town D_u

LEGEND
O - Passenger origin
I_1 - Intermediate Stop on Direct Feeder Service (---)
L, D - Large cities with trunk line service (——)
D_u - Ultimate destination

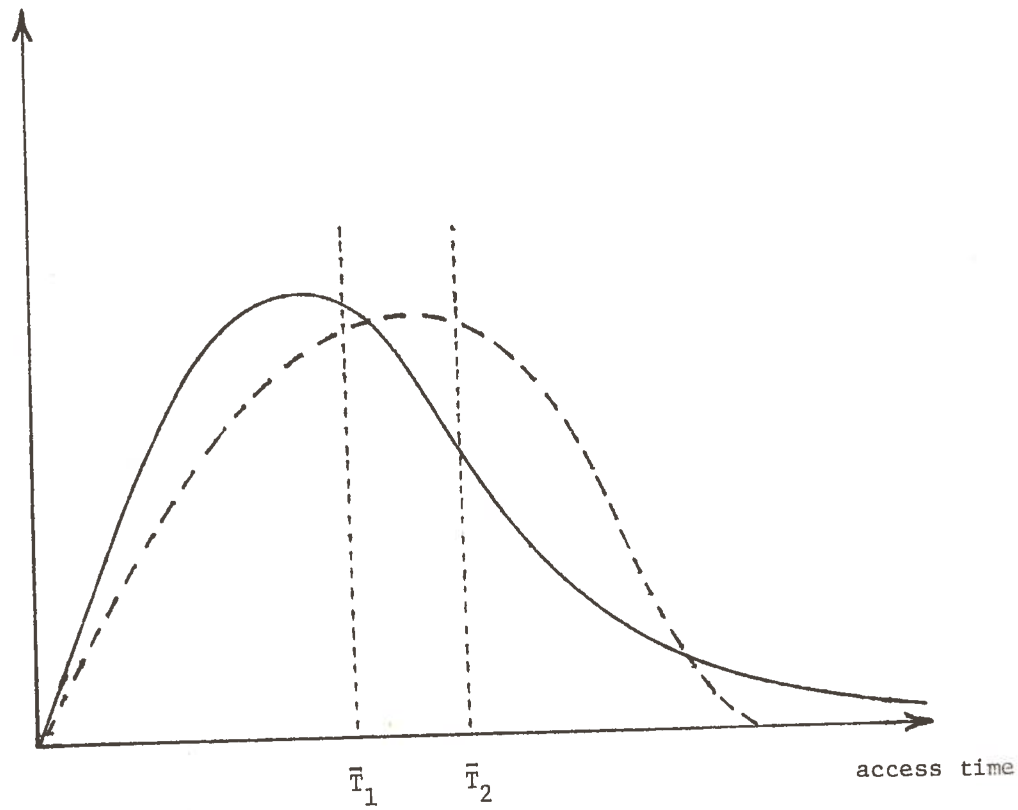

Figure 3.2 Average Delay and Distribution of Delay for Networks of Different Connectivity

(________) Delay probability distribution function for a network with low connectivity (feeder or tree-like network).having an average delay of $\bar{T}_1$

(--------) Delay probability distribution function for network with high connectivity, having an average delay of $\bar{T}_2$

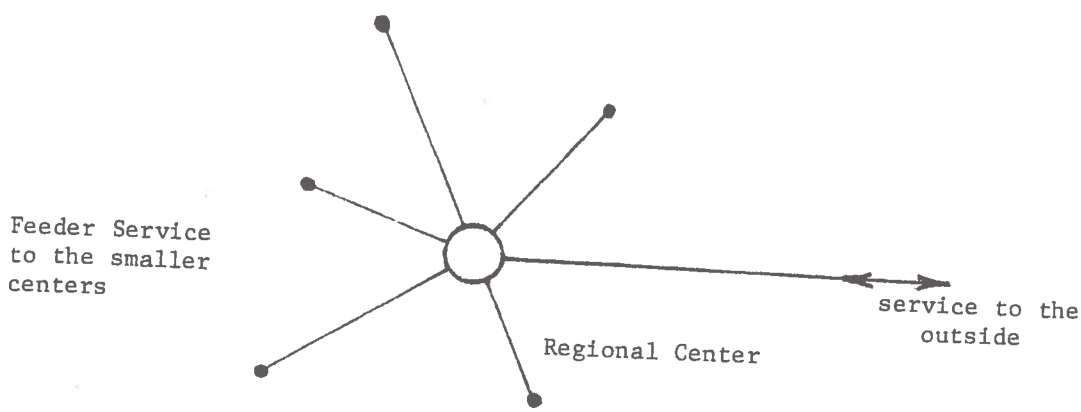

Figure 3.3 Developing Region Air Feeder Service

4. AIR SERVICE ACCESS: SATELLITE AIRPORTS

4.1 Introduction

The discussion of the network configuration model in the previous section suggests that satellite airports may be useful in the air transportation system of a large metropolitan area. The satellite airport is a solution often proposed to alleviate the problems of airport access. With more airports in the area, average airport access distance would be shorter, therefore access time and cost would be lower. This strategy may not, however, increase access to air services. Satellite airports may reduce or increase the average delay time and the air traffic congestion at the main airport depending on the network structure. An air feeder network would reduce average delay time but increase congestion by adding smaller aircraft to the larger line-haul aircraft currently operating. A more highly connected air network may have the opposite effect.

At present there is little air shuttle service between main and "satellite" airports, even at Los Angeles, which has perhaps the most highly developed satellite system. Each airport serves certain, usually overlapping, inter-regional markets. Often certain forms of coercion have been used to maintain service at the smaller (in terms of passenger volume) airports. Still, many passengers increase their airport access problem by driving a longer distance to the larger airport, presumably to decrease their air service access problem by increasing the number of flights to their destination.

4.2 Cleveland and Akron-Canton Case Study

This is the case in the Cleveland area, where about 13% of the air passengers using Hopkins Airport are from the Akron-Canton area (PSS: Portage, Stark, and Summit Counties outside the SCOTS cordon, see map, Figure 2.2) Over 60% of all air passengers from this area use Cleveland-Hopkins rather than the Akron-Canton Airport. The magnitude of the Akron-through Hopkins market may indicate that for many passengers the much higher level of air service at Cleveland is enough to induce

City population does not explain the difference in airport utilization. The ratio of SMSA population to demand for each major airport and city were nearly 1.0 while that for each smaller airport and city were generally less than 0.2. The ratios of volume to population did correlate fairly well with the ratio of flight frequency per inhabitant. This is not causal evidence, but it suggests the importance of flight frequency and the relative unimportance of population per se.

Analyses of air passenger response to airline service by Renard (5), Taneja (6), and TWA (7) indicate a relationship between frequency share and market share. Specifically, Renard shows this to be:

$$MS_i = \frac{FS_i^{\alpha}}{\Sigma_i FS_i^{\alpha}} \qquad (4.1)$$

where i is any airline and α is a value dependent on the number of competitors, usually $1 < \alpha < 2$. This model traces an S-shaped curve, implying that if there are two competitive airlines in a city-pair market and one has greater than 50% of the frequency share, it will have an even greater percent of the market. Conversely, if one has less than 50% of the frequency, it will have an even smaller market share. Assuming linear costs to the airlines and the non-linear response of passengers to "go with the winner", there are three points of equilibrium. (Fig. 4.2) Each airline will act to maximize its profits by matching flight frequency (and often flight times) with the other so that it keeps its proportional frequency and market share, 1/(number of competitors) or 50% for 2 airlines, unless it drops out or takes the whole market. This analysis shows the dynamics of the competition, under regulation, in which the airlines engage and prescribes the equilibrium points toward which they will move. Empirical evidence supports Renard's model. The S-shaped model of traveller response to relative frequency share appears, by tracing out its implications through the competitive game, to provide a good explanation of actual airline flight scheduling. This approach was used to explain how carriers schedule flights between principal and satellite airports.

In evidence gathered from eight sets of major and satellite airports, non- and one-stop flights fitted a curve very similar to the S-shaped curve in Renard's and Taneja's analyses for airlines. Assuming that passengers choose both their airport and their airline according to frequency of service, Renard's model can be used to find how each airline can maximize its market share given the reaction to the frequency share of the other airlines. Using Renard's model in a two-airport, two-airline competitive game example, a two dimensional payoff matrix was calculated. Analysis of this matrix using zero-sum, two-player game theory yielded equilibrium points where each airline concentrates its traffic at a single airport. In fact, since one airport will enjoy at least a slightly better location or market, both airlines will tend to locate all their flights there.

This conclusion applies, for similar reasons, to more than two airlines operating at two or more airports. In all cases, the market forces, which define the S-shaped consumer behavior, impel airlines to concentrate their flights at a single major airport.

To explore this question further, a simulation of detailed passenger behavior was conducted to examine how passengers would react to different schedules at airports located at a range of separations in different relationships to the metropolitan area. Because airports do enjoy a specific locational advantage, which does not apply to airlines at a given airport, any satellite airport will, inevitably, tend to have some traffic. Yet, as indicated by the preceding market share analysis, this traffic is but a small fraction (about 10%) of the total traffic at the principal airport. Akron-Canton passenger traffic is about 8% of that of Hopkins.

Because of the competitive forces motivating the airlines to congregate at one airport in a given metropolitan area, satellite airports cannot be competitive with existing airports unless measures are taken to alter the nature of the competition.

4.4 Other Supporting Evidence

The actions of airlines at multi-airport cities demonstrate the effects of this competition. Midway sees little traffic despite congestion at O'Hare and pressure by the airport authority. The San Francisco-Los Angeles market is served overwhelmingly by San Francisco International and Los Angeles International. Use of the satellite airports in these cities is by extra flights and "commuter" airlines competing for a different market. Long-haul flight restrictions at Washington National force these flights to Dulles, but the "free" short-haul market is concentrated at National despite the hourly quota and nighttime curfew. At New York, JFK serves the long and international flights, but La Guardia and Newark, competing for shorter flights, each dominate any given market.

Airlines often do serve both primary and satellite airports in an area. TWA explains that this is not at the cost of reducing service to the primary airport. (7) Due to some locational effects, history, CAB regulation, or other reasons, there are market demands at these secondary airports and the airlines serve this demand. However, the game is still played: flight frequencies and times are often closely matched.

The analysis does not explicitly consider the station costs to an airline to operate at an additional (satellite) airport. These can be appreciable and will work to discourage duplicating or overlapping service from a satellite airport. The analysis also does not consider transferring passengers, a potentially major problem for certain uses of satellite airports.

4.5 Satellite Terminals

Satellite terminals, strategically located in a city at points of high air passenger demand, have also been suggested as solutions primarily to airport access. Their situation appears to be parallel to that of satellite airports: they will serve some passengers, but many will go directly to the terminal with the highest level of service: the airport terminal, not a satellite terminal.

Proposals using satellite terminals usually include airline ticketing, baggage checking, a guaranteed seat on the aircraft, and a fast airport access mode. The value of these services is questionable; these types of services appear not to draw customers and many have been discontinued, as at the East-Side and West-Side Air Terminals in Manhattan. These two terminals draw on a geographically limited market, a warning for further use of satellite terminals.

Given the airport access characteristics brought out in Chapter 2 from the CHAAS data, an additional transfer point between the passenger and the air service he desires may not be widely accepted. A major satellite terminal, complete with all of the airport services may provide only another place to wait and be an added expense for which the passenger is unwilling and the airlines unable to pay. Small, functional limousine or airport bus stations, located throughout high demand density areas and offering frequent and reliable service at a nominal charge are recommended over large satellite terminals. These would serve the distribution of demand better, would handle baggage efficiently, and be much less expensive.

4.6 Conclusions and Policy Implications

The expansion in city size and the dispersal of passenger origins and destinations in these areas has resulted in increases in the distances and difficulty of airport and air service access for many air passengers. Satellite airports are often suggested as a way to improve airport and air service access and to relieve growing congestion and other pressures from the increasing demand for air services in major metropolitan areas. Characteristics of airline competition under current regulation and of the air service provided at an airport, not air passenger characteristics, determine the use of satellite and primary airports. Changes in the role of satellite airports depends, then, on airline regulation, competition, and service. Air feeder service between primary and satellite airports may reduce average delay time in the system and may be well used if frequent and inexpensive. However, such a service may pose serious air and runway congestion problems. Airlines and passengers will naturally gravitate to the major terminal, so they must be persuaded to use satellite airports if these are to have a significant impact on airport and air service access problems. The methods of persuasion may take advantage of present behavior or may change behavior by changing the regulatory environment. Possible policies include making route awards to serve only specific airports, putting quotas on major airports, and raising the landing fees at the major airports. Similar policies have been used at several U.S. airports (e.g. quotas at Washington National Airport), so information is available to test these and other policies before implementation.

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Table 4.1 Market Share of Airport Access Modes Used by the Different Passenger Groups from the Akron-Canton Area (PSS), Phase 2.

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	RES-BUS-DEP 1.00	RES-BUS-ARR 2.00	RES-NBUS-DEP 3.00	RES-NBUS-ARR 4.00	NRES-BUS-DEP 5.00	NRES-BUS-ARR 6.00	NRES-NON-BUS-DEP 7.00	NRES-NON-BUS-ARR 8.00	ROW TOTAL
RENTED CAR	1.00	68	64	13	15	552	626	30	58	1428
		4.8	4.5	0.9	1.1	38.7	43.9	2.1	4.1	15.3
		3.3	4.0	1.3	1.6	46.2	53.9	4.7	9.1	
		0.7	0.7	0.1	0.2	5.9	6.7	0.3	0.6	
PRIVATE CAR	2.00	1682	1315	926	832	408	302	549	505	6517
		25.8	20.2	14.2	12.8	6.3	4.6	8.4	7.7	69.9
		82.1	80.8	89.8	84.8	34.2	26.0	86.2	78.2	
		18.0	14.1	9.9	8.9	4.4	3.2	5.9	5.4	
TAXI	3.00	11	6	2	5	8	17	7	8	63
		16.9	8.8	3.2	7.6	12.3	26.7	11.6	12.1	0.7
		0.5	0.3	0.2	0.5	0.7	1.5	1.2	1.2	
		0.1	0.1	0.0	0.1	0.1	0.2	0.1	0.1	
AIRPORT BUS-LIMO	5.00	235	199	80	108	194	200	36	66	1118
		21.0	17.8	7.1	9.6	17.4	17.9	3.2	5.9	12.0
		11.5	12.2	7.7	11.0	16.3	17.2	5.6	10.2	
		2.5	2.1	0.9	1.2	2.1	2.1	0.4	0.7	
HOTEL-MOTEL LIMO	7.00	10	6	5	2	17	9	7	9	64
		15.9	9.1	8.1	2.6	26.4	14.3	10.3	13.4	0.7
		0.5	0.4	0.5	0.2	1.4	0.8	1.0	1.3	
		0.1	0.1	0.1	0.0	0.2	0.1	0.1	0.1	
TRANSIT	8.00	24	26	4	15	13	4	8	0	95
		25.4	27.9	4.4	15.5	13.5	4.7	8.6	0.0	1.0
		1.2	1.6	0.4	1.5	1.1	0.4	1.3	0.0	
		0.3	0.3	0.0	0.2	0.1	0.0	0.1	0.0	
OTHER	9.00	19	12	0	5	2	3	0	0	41
		47.3	29.6	0.0	11.5	4.9	6.8	0.0	0.0	0.4
		0.9	0.7	0.0	0.5	0.2	0.2	0.0	0.0	
		0.2	0.1	0.0	0.1	0.0	0.0	0.0	0.0	
COLUMN TOTAL		2049	1628	1031	981	1194	1161	636	645	9326
		22.0	17.5	11.1	10.5	12.8	12.5	6.8	6.9	100.0

Table 4.2 Comparison of Flight Frequency and Market Shares for Markets Common to Cleveland-Hopkins and Akron-Canton Airports.

Common City Markets (3)	Hopkins Weekly Frequency (3)	Akron-Canton Weekly Frequency (3)	Hopkins Frequency Share (%)	Weekly Number of PSS Passengers Using Hopkins (CHAAS)	Weekly Number of Passengers Using Hopkins (2)	Weekly Number of Passengers Using Akron-Canton (2)	Hopkins Market Share (%)	% of PSS Passengers Using Hopkins
Atlanta, Ga.	192	105	65	147	1153	92	93	62
Baltimore, Md.	122	35	78	6	992	76	93	7
Boston, Mass.	334	113	75	285	2844	38	99	88
Buffalo, N.Y.	71	13	85	124	737	3	99	98
Cedar Rapids, Iowa	14	7	67	3	68	21	76	12
Chicago, Ill.	392	101	80	454	7628	1286	86	26
Cincinnati, Ohio	149	26	85	98	1489	51	97	66
Columbus, Ohio	76	32	70	12	461	38	92	24
Dayton, Ohio	211	25	89	60	1220	6	100	91
Denver, Colo.	333	84	80	37	654	72	90	34
Detroit, Mich.	661	25	96	268	1888	201	90	57
Indianapolis, Ind.	112	12	90	225	1091	12	99	95
Los Angeles, Calif.	552	168	77	749	2553	139	95	84
Louisville, Ky.	97	25	80	161	665	38	95	81
Miami, Fla.	167	78	68	270	3499	372	90	42
Mpls/St. Paul, Minn.	173	95	65	157	1089	92	92	58
New York/Newark	406	281	59	1123	12710	1323	91	46
Omaha, Neb.	152	14	99	25	151	30	80	45
Philadelphia, Pa.	147	80	65	165	3396	268	93	38
Pittsburgh, Pa.	260	88	75	10	1069	155	87	6
San Francisco, Calif.	518	180	74	197	1139	85	93	70
Seattle/Tacoma	276	104	73	32	393	68	84	32
Tampa, Fla.	156	21	88	121	1160	135	90	47
Toledo, Ohio	49	35	58	0	167	58	74	0
Washington, D.C.	323	68	83	119	3318	131	96	48
Youngstown, Ohio	2	109	6	0	12	5	70	0
Subtotal	5895	1924	75	4848	53046	3905	93	55
Total	-	-	-	9328	69220	5280	93	64

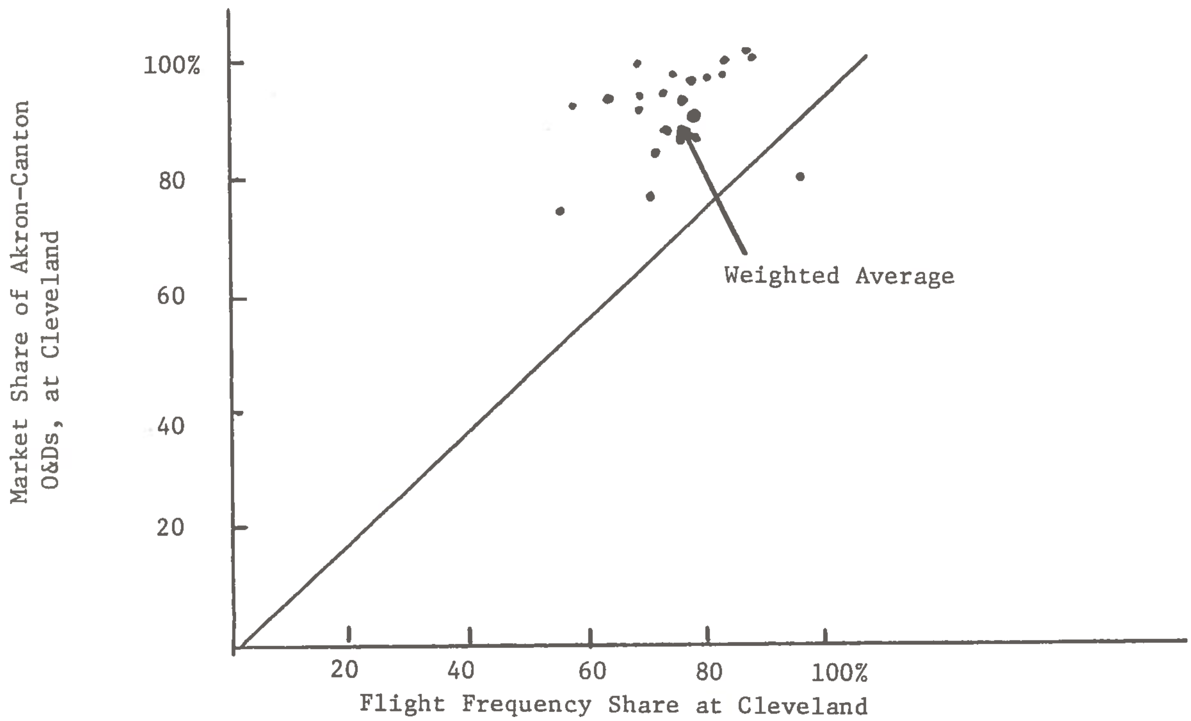

Figure 4.1 Market Share of Akron-Canton O&Ds at Cleveland Airport as a Function of Cleveland Flight Frequency Share for 26 Common Markets

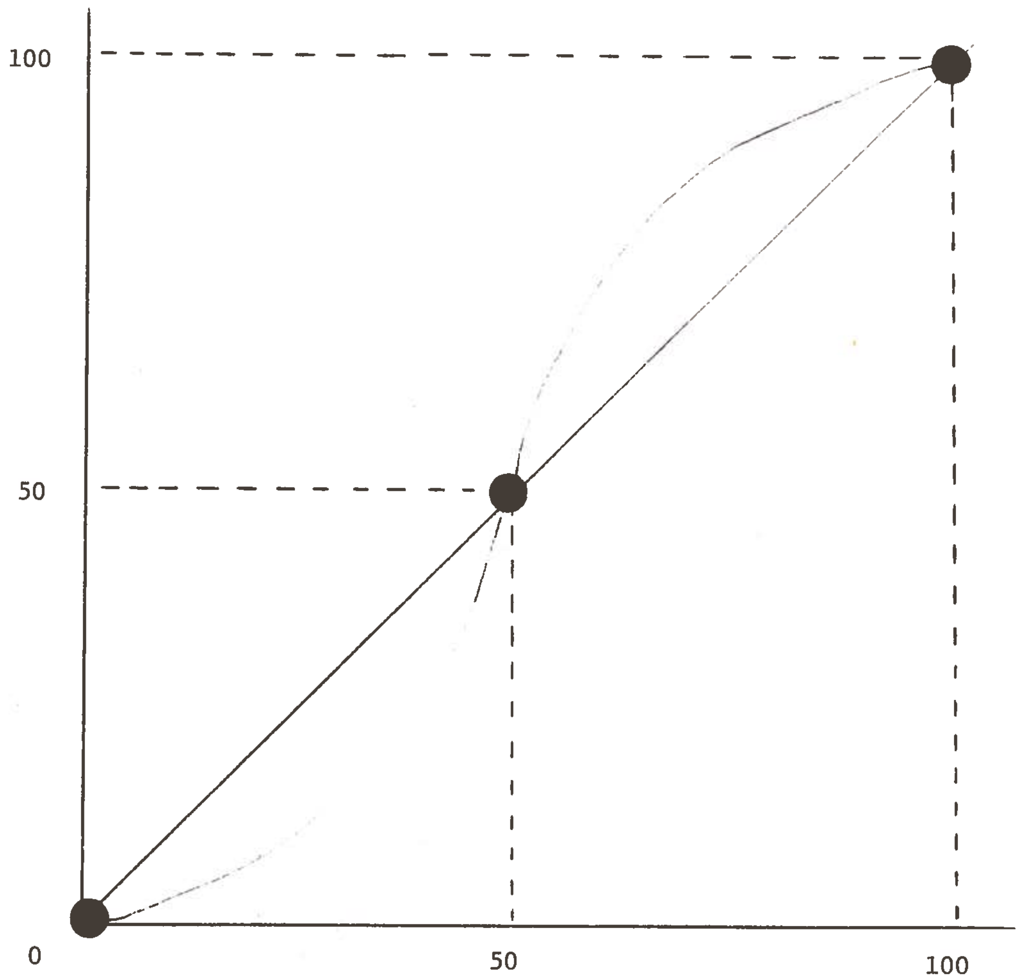

Figure 4.2 Non-Linear Passenger Response Versus Linear Airline Costs

● Equilibrium Points

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Appendix 2 PASSENGER CHARACTERISTICS AND THEIR EFFECT ON ACCESS MODAL CHOICE

This appendix is included for reference and comparison of areas of study and between phases of the survey. Section 1 compares the personal and trip characteristics of air passengers using Cleveland Hopkins Airport. Section 2 compares many of these characteristics with the access mode used at the airport.

In Section 1, there are five columns representing different areas of study phases:

CHAAS 1 & CHAAS 2: Phase 1 and Phase 2 weighted data respectively for the entire passenger sample, data from the Cleveland Hopkins Airport Access Survey Results.

PH 1 and PH 2: Phase 1 and Phase 2 unweighted data respectively for the primary area of interest of this report (see map, Fig. 3.3).

PSSW: Phase 2 weighted data for Portage, Stark, and Summit Counties outside the SCOTS cordon area (see map, Fig. 3.1). This area is thought to be the primary market area for the Akron-Canton Airport.

All numbers are rounded percentages; each column in each table sums approximately to 100%. The percent of "no response" to questions are omitted from the tables. Empty cells occur, usually under CHAAS 1 and CHAAS 2, when the information was unavailable in the particular level of aggregation used in the table.

Discussion of selected tables, denoted by a letter in parenthesis after the table title, follows the table sections. Footnotes for the tables follow the discussion section and are noted by superscripts.

A.2.1 Section 1 Tables AIR PASSENGER, AIR TRIP, AND ACCESS TRIP CHARACTERISTICS

Table A.2.1 Passenger Group(A)

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Resident[1], Business[2], Dep	-[3]	-[3]	14	13	22
Resident, Business, Arr	-	-	7	9	18
Resident, Non-Business, Dep	-	-	14	13	11
Resident, Non-Business, Arr	-	-	9	11	11
Non-Resident, Business, Dep	-	-	16	17	13
Non-Resident, Business, Arr	-	-	17	21	13
Non-Resident, Non-Business, Dep	-	-	12	9	7
Non-Resident, Non-Business, Arr	-	-	11	7	7

Table A.2.2 Passenger Age

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Under 12	} 10	} 9	0	0	0
13 - 16			1	1	1
17 - 20			11	8	9
21 - 45	56	57	54	56	57
46 - 64	29	30	29	30	29
Over 65	5	4	5	5	4

Table A.2.3 Passenger Sex

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Male	73	74	72	74	77
Female	27	26	28	26	23

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Table A.2.4 Passenger Annual Family Income					
Under $5,000	5	4	4	4	3
$5,000 - 9,999	15	12	14	12	10
$10,000 - 14,999	25	23	20	19	26
$15,000 - 19,999	21	22	18	20	25
Over $20,000	34	39	44	45	36
Table A.2.5 Passenger Trip Purpose					
School	6	4	9	5	4
Crew Member	-[4]	-[4]	1	2	0
Convention-Meeting	8	8	10	11	6
Business	47	50	45	48	55
Military	4	4	3	3	4
Vacation	17	16	14	14	15
Personal	16	16	16	15	15
Other	2	2	2	2	1
Table A.2.6 Residence of Passenger(B)					
Resident[1]	50	53	44	46	61
Non-Resident[1]	50	47	56	54	39

Table A.2.7 Number of Checked Bags(C)

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
None	25	28	28	31	26
1	40	42	39	41	42
2	26	24	24	22	26
3	6	4	6	4	4
4 or More	3	2	3	2	2

Table A.2.8 Number of Flights from Cleveland in the Previous Twelve Months

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
1 (present flight)	35	28	34	26	27
2 - 3	20	22	21	23	21
4 - 7	17	19	19	21	19
8 - 12	9	11	9	11	10
13 - 20	7	7	6	7	9
Over 21	12	13	11	12	14

Table A.2.9 Duration of Trip[5]

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Return Same Day	7	13	7	12	11
1 Night	13	18	13	20	17
2 Nights	14	15	14	17	15
3 Nights	12	11	12	11	12
4 Nights	9	8	8	8	8
5 - 7 Nights	15	11	15	10	11
8 - 14 Nights	13	9	13	8	10
15 - 28 Nights	7	5	8	5	5
Over 29 Nights	10	10	10	9	11

Table A.2.10 Air Trip Distance(D)

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Under 100 miles	–[4]	–[4]	3	4	5
101 - 200	–	–	16	19	20
201 - 300	–	–	8	8	7
301 - 400	–	–	19	22	19
401 - 500	–	–	37	40	39
501 - 600	–	–	17	7	10
600 - 1000	–	–	1	–	–
1000 - 1500	–	–	4	–	–
over 1500	–	–	7	–	–

Table A.2.11 Day of Flight

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Sunday	15	15	13	15	16
Monday	14	15	15	16	14
Tuesday	14	14	17	15	12
Wednesday	15	15	17	17	16
Thursday	16	15	15	14	16
Friday	15	16	16	14	15
Saturday	11	10	7	9	11

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Table A.2.12 Flight Arrival or Departure Time					
Midnight - 7	2	2	2	1	1
7 - 8	4	4	4	4	4
8 - 9	4	3	4	4	4
9 - 10	8	9	10	9	9
10 - 11	4	3	4	3	3
11 - Noon	4	5	4	5	5
Noon - 1	6	5	7	6	6
1 - 2	6	6	7	7	7
2 - 3	4	4	6	4	4
3 - 4	4	6	4	7	7
4 - 5	12	9	11	8	8
5 - 6	10	13	8	12	12
6 - 7	9	7	8	7	7
7 - 8	7	6	5	6	6
8 - 9	7	7	6	8	7
9 - 10	5	7	5	7	7
10 - 11	2	1	3	2	1
11 - Midnight	1	2	1	2	2
Table A.2.13 Direction of Flight(E)					
Departing	50	51	56	52	53
Arriving	50	49	44	48	47

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Table A.2.14 Primary Airport Mode(F)					
Rented Car	9	10	7	7	15
Private Car	62	57	48	38	70
Taxi	12	9	18	13	1
Limousine	13	7	16	14	13
Transit[6]	2	15	3	30	1
Other	3	3	8[7]	0	0

Table A.2.15 Number of Persons Accompanying Passenger on Flight

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
None	68	74	66	73	72
1	19	17	19	17	19
2	7	4	8	5	4
3 or More	6	5	7	5	5

Table A.2.16 Number of Wellwishers/Greeters Using Same Access Mode as Passengers

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
None	37	46	42	53	42
1	27	26	27	25	26
2	16	13	15	11	14
3	9	7	7	5	9
4	5	4	4	3	4
5 or More	6	4	5	3	5

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW

Table A.2.17 Land Use at Origin or Destination(G)

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Residence	61	62	49	46	67
Hotel/Motel	20	19	26	30	13
School	3	1	5	2	1
Normal Workplace	5	6	7	9	7
Other Workplace	9	11	10	11	11
Other	2	1	3	2	1

Table A.2.18 Disposition of Private Automobile[8] (H)

	CHAAS 1	CHAAS 2	PH 1	PH 2	PSSW
Car Parked at Airport During Trip	3	3	32	29	37
Passenger Driven or Picked Up	-	-	44	49	42
Car Parked at Airport, Driven Away by Another	-	-	23	22	21
Other	-	-	1	0	0

A.2.2 Section 1 DISCUSSION

A. Generally, non-resident businessmen form the largest passenger group; however, those of the passengers from the Akron-Canton area (PSSW) using Hopkins Airport, resident businessmen are the largest group. Businessmen form the largest group there probably because of the six major corporations headquartered in Akron and Canton and because businessmen more than persons not on business would increase their airport access trip to obtain better air service. It is postulated that the presence of the headquarters results in more resident businessmen from those headquarters flying to other offices of those corporations than usual and than non-residents flying to the local businesses. Also, residents have easier access by their private automobiles to a distant airport; although non-resident businessmen can use rented cars, it is more expensive than flying to Akron-Canton, so perhaps fewer do (see Tables A.2.14 and A.2.19). Similar data for Akron-Canton airport is unavailable, so a positive comparison cannot be made.

B. The PH 1 and PH 2 bias toward non-residents is due to the relatively large number of non-resident businessmen having trip ends in the CBD. The larger percentage of residents is because of the resident businessmen and is discussed in A.

C. Nearly all passengers check two bags or less, possibly, showing the constraining effect of the "two bag free" rule, but more likely being the number of bags a passenger can handle conveniently.

D. There is an error in the coding of this variable for Phase 2 so that the categories "601-1000", "1001-1500", and "greater than 1500 miles" are missing. However, all passengers surveyed appear in the six codes shown in PH 2 and PSSW, so the categories are incorrect.

E. No reason has been found for the differences of PH 1, PH 2, and PSSW from the expected 50-50 split.

F. The effect of limiting the area of consideration to the primary market area for the "Rapid" is clearly shown by its high market share in PH 2. As reported in the Survey Results and shown by the CHAAS 1 and CHAAS 2 columns, both limousine and taxi lost an appreciable amount of their market share (46 and 33% respectively), while private car lost less than ten percent of its share. However, comparing PH 1 and PH 2, taxi lost 28% and private car lost 22% (assuming sample sizes to be approximately equal). Obviously the "Rapid" can have a significant effect in limited areas on private automobile use, despite inconveniences (e.g., baggage and transfers). "Limousine's" loss is probably about 40%, but cannot be calculated exactly (see footnote 6).

Private car is the major access mode even with Rapid transit available within two miles. For areas with no such competing mode, e.g., PSSW, automobile is used by the vast majority of passengers. Rented car has a high modal share for PSSW because of the high concentration of businessmen (60%), particularly the non-resident businessmen (26%) (see Table A.2.1 and A.2.19).

G. Most residents begin or end their trips at home, although some depart (rarely arrive) from their normal place of business. Non-resident businessmen begin or end their trips at hotels/motels or "other workplace", while non-resident non-business passengers usually come from or go to residences.

H. Most passengers using private cars are driven to the airport rather than pay to park for the duration of their trip or risk leaving their cars at the airport. Most of the people who park and leave their cars are resident businessmen.

A.2.3 Section 1 FOOTNOTES

1. Residents are passengers living within the SCOTS cordon area or passengers whose local origin/destination address is the same as his residence address, non-residents are all other.
2. Business includes crew members, convention, business and military trip purpose categories.
3. Information not disaggregated in this form in the CHAAS *Survey Results*.
4. Not included, probably in "other"; there are very few crew members in the survey and they make no impact except in the CBD.
5. Question was not to be answered by passengers not returning to Cleveland or expecting to return to Cleveland in the next few weeks.
6. Transit is public bus in Phase 1 and rail rapid transit in Phase 2.
7. Includes airport bus that normally is aggregated with limousine.
8. Asked only of those passengers who used private automobile as their primary access mode.

A.2.4 Section 2 Tables: AIRPORT ACCESS MODES BY AIR PASSENGER, AIR TRIP, AND ACCESS TRIP CHARACTERISTICS.

TABLE A.2.19 a. Airport Access Modal Share by Passenger Group, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	RES-BUS-DEP 1.00	RES-BUS-ARR 2.00	RES-NBUS-DEP 3.00	RES-NBUS-ARR 4.00	NRES-BUS-DEP 5.00	NRES-BUS-ARR 6.00	NRES-NON-BUS-DEP 7.00	NRES-NON-BUS-ARR 8.00	ROW TOTAL
1.00 RENTED CAR		11	4	8	6	235	205	74	55	598
		1.8	0.7	1.3	1.0	39.3	34.3	12.4	9.2	7.1
		1.0	0.6	0.7	0.8	17.0	14.5	7.4	6.2	
		0.1	0.0	0.1	0.1	2.8	2.4	0.9	0.7	
2.00 PRIVATE CAR		793	419	834	478	386	236	552	336	4034
		19.7	10.4	20.7	11.8	9.6	5.9	13.7	8.3	48.0
		69.0	65.8	70.9	63.4	27.9	16.7	55.0	37.9	
		9.4	5.0	9.9	5.7	4.6	2.8	6.6	4.0	
3.00 TAXI		164	83	95	85	340	366	133	210	1476
		11.1	5.6	6.4	5.8	23.0	24.8	9.0	14.2	17.6
		14.3	13.0	8.1	11.3	24.5	25.9	13.2	23.7	
		2.0	1.0	1.1	1.0	4.0	4.4	1.6	2.5	
4.00 PUBLIC BUS		13	13	80	29	13	15	67	48	278
		4.7	4.7	28.8	10.4	4.7	5.4	24.1	17.3	3.3
		1.1	2.0	6.8	3.8	0.9	1.1	6.7	5.4	
		0.2	0.2	1.0	0.3	0.2	0.2	0.8	0.6	
5.00 AIRPORT -LIMO		99	82	90	125	253	401	93	180	1323
		7.5	6.2	6.8	9.4	19.1	30.3	7.0	13.6	15.7
		8.6	12.9	7.6	16.6	18.3	28.4	9.3	20.3	
		1.2	1.0	1.1	1.5	3.0	4.8	1.1	2.1	
6.00 AIRPORT BUS		58	29	55	30	136	137	54	50	549
		10.6	5.3	10.0	5.5	24.8	25.0	9.8	9.1	6.5
		5.0	4.6	4.7	4.0	9.8	9.7	5.4	5.6	
		0.7	0.3	0.7	0.4	1.6	1.6	0.6	0.6	
7.00 HOTEL-MOTEL LIMO		1	1	1	0	7	22	4	4	40
		2.5	2.5	2.5	0.0	17.5	55.0	10.0	10.0	0.5
		0.1	0.2	0.1	0.0	0.5	1.6	0.4	0.5	
		0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	
9.00 OTHER		11	6	14	1	15	31	27	4	109
		10.1	5.5	12.8	0.9	13.8	28.4	24.8	3.7	1.3
		1.0	0.9	1.2	0.1	1.1	2.2	2.7	0.5	
		0.1	0.1	0.2	0.0	0.2	0.4	0.3	0.0	
COLUMN TOTAL		1150	637	1177	754	1385	1413	1004	887	8407
		13.7	7.6	14.0	9.0	16.5	16.8	11.9	10.6	100.0

TABLE A.2.19 b. Airport Access Modal Share by Passenger Group, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	RES-BUS-DEP 1.00	RES-BUS-ARR 2.00	RES-NBUS-DEP 3.00	RES-NBUS-ARR 4.00	NRES-BUS-DEP 5.00	NRES-BUS-ARR 6.00	NRES-NON-BUS-DEP 7.00	NRES-NON-BUS-ARR 8.00	ROW TOTAL
1.00 RENTED CAR	COUNT	9	9	8	2	259	284	34	34	639
	ROW PCT	1.4	1.4	1.3	0.3	40.5	44.4	5.3	5.3	6.7
	COL PCT	0.7	1.1	0.7	0.2	16.4	14.0	3.9	4.7	
	TOT PCT	0.1	0.1	0.1	0.0	2.7	3.0	0.4	0.4	
2.00 PRIVATE CAR	COUNT	663	374	678	543	339	281	400	268	3546
	ROW PCT	18.7	10.5	19.1	15.3	9.6	7.9	11.3	7.6	37.2
	COL PCT	53.0	44.1	56.4	52.8	21.5	13.9	45.8	37.0	
	TOT PCT	7.0	3.9	7.1	5.7	3.6	2.9	4.2	2.8	
3.00 TAXI	COUNT	108	94	74	119	228	409	80	120	1232
	ROW PCT	8.8	7.6	6.0	9.7	18.5	33.2	6.5	9.7	12.9
	COL PCT	8.6	11.1	6.2	11.6	14.4	20.2	9.2	16.6	
	TOT PCT	1.1	1.0	0.8	1.2	2.4	4.3	0.8	1.3	
5.00 AIRPORT BUS-LIMO	COUNT	45	35	40	44	187	436	57	61	905
	ROW PCT	5.0	3.9	4.4	4.9	20.7	48.2	6.3	6.7	9.5
	COL PCT	3.6	4.1	3.3	4.3	11.9	21.6	6.5	8.4	
	TOT PCT	0.5	0.4	0.4	0.5	2.0	4.6	0.6	0.6	
7.00 HOTEL-MOTEL LIMO	COUNT	2	1	6	2	76	123	71	42	323
	ROW PCT	0.6	0.3	1.9	0.6	23.5	38.1	22.0	13.0	3.4
	COL PCT	0.2	0.1	0.5	0.2	4.8	6.1	8.1	5.8	
	TOT PCT	0.0	0.0	0.1	0.0	0.8	1.3	0.7	0.4	
8.00 TRANSIT	COUNT	418	334	392	316	478	485	231	196	2850
	ROW PCT	14.7	11.7	13.8	11.1	16.8	17.0	8.1	6.9	29.9
	COL PCT	33.4	39.3	32.6	30.7	30.3	24.0	26.4	27.0	
	TOT PCT	4.4	3.5	4.1	3.3	5.0	5.1	2.4	2.1	
9.00 OTHER	COUNT	6	2	4	3	11	5	1	4	36
	ROW PCT	16.7	5.6	11.1	8.3	30.6	13.9	2.8	11.1	0.4
	COL PCT	0.5	0.2	0.3	0.3	0.7	0.2	0.1	0.6	
	TOT PCT	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	
COLUMN TOTAL		1251	849	1202	1029	1578	2023	874	725	9531
		13.1	8.9	12.6	10.8	16.6	21.2	9.2	7.6	100.0

TABLE A.2.20 a. Airport Access Modal Share by Passenger Age, Phase 1, Phase 2

AGE → COUNT / ROW PCT / COL PCT / TOT PCT		DNC RESPONSE 0.00	UNDER 12 1.00	13-16 YEARS 2.00	17-20 YEARS 3.00	21-45 YEARS 4.00	46-64 YEARS 5.00	OVER 65 YEARS 6.00	ROW TOTAL
AETMODE									
RENTED CAR	1.00	2	0	2	24	379	185	9	601
		0.3	0.0	0.3	4.0	63.1	30.8	1.5	7.0
		3.4	0.0	4.1	2.5	8.2	7.6	2.1	
		0.0	0.0	0.0	0.3	4.4	2.2	C.1	
PRIVATE CAR	2.00	36	11	34	507	2158	1156	233	4135
		0.9	0.3	0.8	12.3	52.2	28.0	5.6	48.3
		62.1	78.6	69.4	53.2	46.5	47.5	55.1	
		0.4	0.1	0.4	5.9	25.2	13.5	2.7	
TAXI	3.00	7	2	6	101	843	448	92	1499
		0.5	0.1	0.4	6.7	56.2	29.9	6.1	17.5
		12.1	14.3	12.2	10.6	18.2	18.4	21.7	
		0.1	0.0	C.1	1.2	9.8	5.2	1.1	
PUBLIC BUS	4.00	1	0	0	121	113	33	11	279
		0.4	0.0	C.0	43.4	40.5	11.8	3.9	3.3
		1.7	0.C	C.0	12.7	2.4	1.4	2.6	
		0.0	0.0	C.0	1.4	1.3	0.4	C.1	
AIRPORT -LIMO	5.00	7	0	4	133	799	362	45	1350
		0.5	0.0	0.3	9.9	59.2	26.8	3.3	15.8
		12.1	0.0	8.2	14.0	17.2	14.9	1C.6	
		0.1	0.0	C.0	1.6	9.3	4.2	0.5	
AIRPORT BUS	6.00	2	0	0	54	267	203	28	554
		0.4	0.0	C.0	9.7	48.2	36.6	5.1	6.5
		3.4	0.0	0.0	5.7	5.8	8.3	6.6	
		0.C	C.0	C.0	0.6	3.1	2.4	0.3	
HOTEL-MOTEL LIMO	7.00	1	0	0	1	20	16	2	40
		2.5	0.0	C.0	2.5	50.C	40.0	5.0	0.5
		1.7	0.0	C.0	0.1	0.4	0.7	C.5	
		0.C	C.0	C.0	0.0	0.2	0.2	0.0	
OTHER	9.00	2	1	3	12	60	30	3	111
		1.8	C.9	2.7	10.8	54.1	27.C	2.7	1.3
		3.4	7.1	6.1	1.3	1.3	1.2	C.7	
		0.0	C.0	C.0	0.1	0.7	0.4	0.0	
COLUMN TOTAL		58	14	49	953	4639	2433	423	8569
		0.7	0.2	C.6	11.1	54.1	28.4	4.9	100.0

TABLE A.2.20 b. Airport Access Modal Share by Passenger Age, Phase 1 Phase 2.

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	UNDER 12 1.00	13-16 YEARS 2.00	17-20 YEARS 3.00	21-45 YEARS 4.00	46-64 YEARS 5.00	OVER 65 YEARS 6.00	ROW TOTAL
RENTED CAR	1.00	0	1	4	452	180	7	644
		0.0	0.2	0.6	70.2	28.0	1.1	6.7
		0.0	2.1	0.5	8.3	6.1	1.6	
		0.0	0.0	0.0	4.7	1.9	0.1	
PRIVATE CAR	2.00	9	31	388	1979	1061	160	3628
		0.2	0.9	10.7	54.5	29.2	4.4	37.5
		100.0	64.6	48.3	36.3	36.2	37.6	
		0.1	0.3	4.0	20.5	11.0	1.7	
TAXI	3.00	0	2	36	691	448	76	1253
		0.0	0.2	2.9	55.1	35.8	6.1	12.9
		0.0	4.2	4.5	12.7	15.3	17.8	
		0.0	0.0	0.4	7.1	4.6	0.8	
AIRPORT BUS-LIMO	5.00	0	1	22	456	367	64	910
		0.0	0.1	2.4	50.1	40.3	7.0	9.4
		0.0	2.1	2.7	8.4	12.5	15.0	
		0.0	0.0	0.2	4.7	3.8	0.7	
HOTEL-MOTEL LIMO	7.00	0	0	8	244	69	5	326
		0.0	0.0	2.5	74.8	21.2	1.5	3.4
		0.0	0.0	1.0	4.5	2.4	1.2	
		0.0	0.0	0.1	2.5	0.7	0.1	
TRANSIT	8.00	0	13	342	1614	795	113	2877
		0.0	0.5	11.9	56.1	27.6	3.9	29.7
		0.0	27.1	42.5	29.6	27.1	26.5	
		0.0	0.1	3.5	16.7	8.2	1.2	
OTHER	9.00	0	0	4	20	13	1	38
		0.0	0.0	10.5	52.6	34.2	2.6	0.4
		0.0	0.0	0.5	0.4	0.4	0.2	
		0.0	0.0	0.0	0.2	0.1	0.0	
COLUMN TOTAL		9	48	804	5456	2933	426	9676
		0.1	0.5	8.3	56.4	30.3	4.4	100.0

TABLE A.2.21 a. Airport Access Modal Share by Passenger Sex, Phase 1, Phase 2

AFTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	SEX: INC RESPONSE 0.0	MALE 1.00	FEMALE 2.00	ROW TOTAL
RENTED CAR	1.00	13	505	83	601
		2.2	84.0	13.8	7.0
		5.0	8.4	3.6	
		0.2	5.9	1.0	
PRIVATE CAR	2.00	145	2587	1403	4135
		3.5	62.6	33.9	48.3
		56.2	43.1	60.9	
		1.7	30.2	16.4	
TAXI	3.00	43	1099	357	1499
		2.9	73.3	23.8	17.5
		16.7	18.3	15.5	
		0.5	12.8	4.2	
PUBLIC BUS	4.00	6	235	38	279
		2.2	84.2	13.6	3.3
		2.3	3.9	1.7	
		0.1	2.7	0.4	
AIRPORT -LIMO	5.00	33	1015	302	1350
		2.4	75.2	22.4	15.8
		12.8	16.9	13.1	
		0.4	11.8	3.5	
AIRPORT BUS	6.00	15	442	97	554
		2.7	79.8	17.5	6.5
		5.8	7.4	4.2	
		0.2	5.2	1.1	
HOTEL-MOTEL LIMO	7.00	1	33	6	40
		2.5	82.5	15.0	0.5
		0.4	0.5	0.3	
		0.0	0.4	0.1	
OTHER	9.00	2	92	17	111
		1.8	82.9	15.3	1.3
		0.8	1.5	0.7	
		0.0	1.1	0.2	
COLUMN TOTAL		258	6008	2303	8569
		3.0	70.1	26.9	100.0

TABLE A.2.21 b. Airport Access Modal Share by Passenger Sex, Phase 1, Phase 2

APTMODE		SEX: MALE 1.00	FEMALE 2.00	ROW TOTAL
	COUNT / ROW PCT / COL PCT / TOT PCT			
RENTED CAR	1.00	554	48	602
		92.0	8.0	6.7
		8.3	2.0	
		6.2	0.5	
PRIVATE CAR	2.00	2153	1221	3374
		63.8	36.2	37.5
		32.4	52.0	
		23.9	13.6	
TAXI	3.00	854	293	1147
		74.5	25.5	12.7
		12.8	12.5	
		9.5	3.3	
AIRPORT BUS-LIMO	5.00	647	195	842
		76.8	23.2	9.4
		9.7	8.3	
		7.2	2.2	
HOTEL-MOTEL LIMO	7.00	223	84	307
		72.6	27.4	3.4
		3.4	3.6	
		2.5	0.9	
TRANSIT	8.00	2189	498	2687
		81.5	18.5	29.9
		32.9	21.2	
		24.3	5.5	
OTHER	9.00	29	9	38
		76.3	23.7	0.4
		0.4	0.4	
		0.3	0.1	
COLUMN TOTAL		6649	2348	8997
		73.9	26.1	100.0

TABLE A.2.22 a. Airport Access Modal Share by Passenger's Annual Family Income, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	INCOME: NO RESPONSE 0.0	UNDER 5000 1.00	5000-9999 2.00	10000 - 14999 3.00	15000 - 19999 4.00	OVER 20000 5.00	ROW TOTAL
1.00 RENTED CAR	COUNT	36	7	25	113	126	294	601
	ROW PCT	6.0	1.2	4.2	18.8	21.0	48.9	7.0
	COL PCT	5.6	2.2	2.3	7.0	8.9	8.4	
	TOT PCT	0.4	0.1	0.3	1.3	1.5	3.4	
2.00 PRIVATE CAR	COUNT	354	187	593	718	586	1697	4135
	ROW PCT	8.6	4.5	14.3	17.4	14.2	41.0	48.3
	COL PCT	54.8	59.4	54.5	44.5	41.6	48.5	
	TOT PCT	4.1	2.2	6.9	8.4	6.8	19.8	
3.00 TAXI	COUNT	102	32	145	238	242	740	1499
	ROW PCT	6.8	2.1	9.7	15.9	16.1	49.4	17.5
	COL PCT	15.8	10.2	13.3	14.8	17.2	21.2	
	TOT PCT	1.2	0.4	1.7	2.8	2.8	8.6	
4.00 PUBLIC BUS	COUNT	20	20	79	81	38	41	279
	ROW PCT	7.2	7.2	28.3	29.0	13.6	14.7	3.3
	COL PCT	3.1	6.3	7.3	5.0	2.7	1.2	
	TOT PCT	0.2	0.2	0.9	0.9	0.4	0.5	
5.00 AIRPORT -LIMO	COUNT	88	45	162	294	286	475	1350
	ROW PCT	6.5	3.3	12.0	21.8	21.2	35.2	15.8
	COL PCT	13.6	14.3	14.9	18.2	20.3	13.6	
	TOT PCT	1.0	0.5	1.9	3.4	3.3	5.5	
6.00 AIRPORT BUS	COUNT	27	20	61	131	109	206	554
	ROW PCT	4.9	3.6	11.0	23.6	19.7	37.2	6.5
	COL PCT	4.2	6.3	5.6	8.1	7.7	5.9	
	TOT PCT	0.3	0.2	0.7	1.5	1.3	2.4	
7.00 HOTEL-MOTEL LIMO	COUNT	4	0	5	11	8	12	40
	ROW PCT	10.0	0.0	12.5	27.5	20.0	30.0	0.5
	COL PCT	0.6	0.0	0.5	0.7	0.6	0.3	
	TOT PCT	0.0	0.0	0.1	0.1	0.1	0.1	
9.00 OTHER	COUNT	15	4	18	26	15	33	111
	ROW PCT	13.5	3.6	16.2	23.4	13.5	29.7	1.3
	COL PCT	2.3	1.3	1.7	1.6	1.1	0.9	
	TOT PCT	0.2	0.0	0.2	0.3	0.2	0.4	
COLUMN TOTAL		646	315	1088	1612	1410	3498	8569
		7.5	3.7	12.7	18.8	16.5	40.8	100.0

TABLE A.2.22 b. Airport Access Modal Share by Passenger's Annual Family Income, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	INCOME: UNDER 5000 (1.00)	5000-9999 (2.00)	10000 - 14999 (3.00)	15000 - 19999 (4.00)	OVER 20000 (5.00)	ROW TOTAL
RENTED CAR	1.00	5	21	128	161	302	617
		0.8	3.4	20.7	26.1	48.9	6.8
		1.5	2.0	7.2	8.8	7.5	
		0.1	0.2	1.4	1.8	3.3	
PRIVATE CAR	2.00	162	461	664	565	1505	3357
		4.8	13.7	19.8	16.8	44.8	37.0
		47.6	42.9	37.1	31.0	37.2	
		1.8	5.1	7.3	6.2	16.6	
TAXI	3.00	23	128	185	230	611	1177
		2.0	10.9	15.7	19.5	51.9	13.0
		6.8	11.9	10.3	12.6	15.1	
		0.3	1.4	2.0	2.5	6.7	
AIRPORT BUS-LIMO	5.00	21	86	185	213	339	844
		2.5	10.2	21.9	25.2	40.2	9.3
		6.2	8.0	10.3	11.7	8.4	
		0.2	0.9	2.0	2.3	3.7	
HOTEL-MOTEL LIMO	7.00	21	43	58	75	108	305
		6.9	14.1	19.0	24.6	35.4	3.4
		6.2	4.0	3.2	4.1	2.7	
		0.2	0.5	0.6	0.8	1.2	
TRANSIT	8.00	107	333	564	569	1166	2739
		3.9	12.2	20.6	20.8	42.6	30.2
		31.5	31.0	31.5	31.2	28.8	
		1.2	3.7	6.2	6.3	12.8	
OTHER	9.00	1	2	6	11	15	35
		2.9	5.7	17.1	31.4	42.9	0.4
		0.3	0.2	0.3	0.6	0.4	
		0.0	0.0	0.1	0.1	0.2	
	COLUMN TOTAL	340	1074	1790	1824	4046	9074
		3.7	11.8	19.7	20.1	44.6	100.0

TABLE A.2.23 a. Airport Access Modal Share by Passenger Trip Purpose, Phase 1, Phase 2

AIRMODE	COUNT / ROW PCT / COL PCT / TOT PCT	SCHOOL 1.00	CREW MEMBER 2.00	CONVENTION-MEET 3.00	BUSINESS 4.00	MILITARY 5.00	VACATION 6.00	PERSONAL 7.00	OTHER 8.00	ROW TOTAL
1.00 RENTED CAR	COUNT	39	1	20	436	0	20	78	6	600
	ROW PCT	6.5	0.2	3.3	72.7	0.0	3.3	13.0	1.0	7.1
	COL PCT	5.2	1.1	2.4	11.5	0.0	1.6	5.6	3.9	
	TOT PCT	0.5	0.0	0.2	5.1	0.0	0.2	0.9	0.1	
2.00 PRIVATE CAR	COUNT	381	7	276	1569	94	823	848	77	4075
	ROW PCT	9.3	0.2	6.8	38.5	2.3	20.2	20.8	1.9	48.0
	COL PCT	50.8	7.9	33.6	41.5	34.7	67.6	60.7	50.3	
	TOT PCT	4.5	0.1	3.3	18.5	1.1	9.7	10.0	0.9	
3.00 TAXI	COUNT	126	71	179	775	8	119	183	26	1487
	ROW PCT	8.5	4.8	12.0	52.1	0.5	9.0	12.3	1.7	17.5
	COL PCT	16.8	79.8	21.8	20.5	3.0	9.8	13.1	17.0	
	TOT PCT	1.5	0.8	2.1	9.1	0.1	1.4	2.2	0.3	
4.00 PUBLIC BUS	COUNT	39	0	7	47	114	35	29	8	279
	ROW PCT	14.0	0.0	2.5	16.8	40.9	12.5	10.4	2.9	3.3
	COL PCT	5.2	0.0	0.9	1.2	42.1	2.9	2.1	5.2	
	TOT PCT	0.5	0.0	0.1	0.6	1.3	0.4	0.3	0.1	
5.00 AIRPORT-LIMO	COUNT	121	7	234	605	19	154	179	20	1339
	ROW PCT	9.0	0.5	17.5	45.2	1.4	11.5	13.4	1.5	15.8
	COL PCT	16.1	7.9	28.5	16.0	7.0	12.7	12.8	13.1	
	TOT PCT	1.4	0.1	2.8	7.1	0.2	1.8	2.1	0.2	
6.00 AIRPORT BUS	COUNT	37	0	83	277	23	50	72	9	551
	ROW PCT	6.7	0.0	15.1	50.3	4.2	9.1	13.1	1.6	6.5
	COL PCT	4.9	0.0	10.1	7.3	8.5	4.1	5.2	5.9	
	TOT PCT	0.4	0.0	1.0	3.3	0.3	0.6	0.8	0.1	
7.00 HOTEL-MOTEL LIMO	COUNT	0	3	3	28	0	5	1	0	40
	ROW PCT	0.0	7.5	7.5	70.0	0.0	12.5	2.5	0.0	0.5
	COL PCT	0.0	3.4	0.4	0.7	0.0	0.4	0.1	0.0	
	TOT PCT	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.0	
9.00 OTHER	COUNT	7	0	19	45	13	11	8	7	110
	ROW PCT	6.4	0.0	17.3	40.9	11.8	10.0	7.3	6.4	1.3
	COL PCT	0.9	0.0	2.3	1.2	4.8	0.9	0.6	4.6	
	TOT PCT	0.1	0.0	0.2	0.5	0.2	0.1	0.1	0.1	
COLUMN TOTAL		750	89	821	3782	271	1217	1398	153	8481
		8.8	1.0	9.7	44.6	3.2	14.3	16.5	1.8	100.0

TABLE A.2.23 b. Airport Access Modal Share by Passenger Trip Purpose, Phase 1, Phase 2

APTMODE	TRIPPUR: COUNT / ROW PCT / COL PCT / TOT PCT	SCHOOL 1.00	CREW MEMBER 2.00	CONVENTION-MEET 3.00	BUSINESS 4.00	MILITARY 5.00	VACATION 6.00	PERSONAL 7.00	OTHER 8.00	ROW TOTAL
1.00 RENTED CAR	COUNT	2	0	33	531	4	21	47	5	643
	ROW PCT	0.3	0.0	5.1	82.6	0.6	3.3	7.3	0.8	6.7
	COL PCT	0.4	0.0	3.1	11.3	1.4	1.6	3.2	3.5	
	TOT PCT	0.0	0.0	0.3	5.5	0.0	0.2	0.5	0.1	
2.00 PRIVATE CAR	COUNT	258	4	225	1455	98	771	729	76	3616
	ROW PCT	7.1	0.1	6.2	40.2	2.7	21.3	20.2	2.1	37.4
	COL PCT	52.3	2.0	21.1	31.1	34.9	57.4	49.9	53.9	
	TOT PCT	2.7	0.0	2.3	15.0	1.0	8.0	7.5	0.8	
3.00 TAXI	COUNT	32	63	192	653	10	152	135	14	1253
	ROW PCT	2.6	5.0	15.3	52.1	0.8	12.1	10.8	1.3	13.0
	COL PCT	6.5	30.9	18.0	14.0	3.6	11.3	9.2	11.3	
	TOT PCT	0.3	0.7	2.0	6.8	0.1	1.6	1.4	0.2	
5.00 AIRPORT BUS-LIMO	COUNT	13	24	257	448	2	81	79	9	913
	ROW PCT	1.4	2.6	28.1	49.1	0.2	8.9	8.7	1.0	9.4
	COL PCT	2.6	11.3	24.1	9.6	0.7	6.0	5.4	6.4	
	TOT PCT	0.1	0.2	2.7	4.6	0.0	0.8	0.8	0.1	
7.00 HOTEL-MOTEL LIMO	COUNT	3	96	46	159	2	13	4	5	328
	ROW PCT	0.9	29.3	14.0	48.5	0.6	4.0	1.2	1.5	3.4
	COL PCT	0.6	47.1	4.3	3.4	0.7	1.0	0.3	3.5	
	TOT PCT	0.0	1.0	0.5	1.6	0.0	0.1	0.0	0.1	
8.00 TRANSIT	COUNT	185	14	305	1416	162	303	462	30	2877
	ROW PCT	6.4	0.5	10.6	49.2	5.6	10.5	16.1	1.0	29.8
	COL PCT	37.5	6.9	28.6	30.2	57.7	22.6	31.6	21.3	
	TOT PCT	1.9	0.1	3.2	14.6	1.7	3.1	4.8	0.3	
9.00 OTHER	COUNT	0	3	7	19	3	2	4	0	38
	ROW PCT	0.0	7.9	18.4	50.0	7.9	5.3	10.5	0.0	0.4
	COL PCT	0.0	1.5	0.7	0.4	1.1	0.1	0.3	0.0	
	TOT PCT	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	
COLUMN TOTAL		493	204	1065	4681	281	1343	1460	141	9669
		5.1	2.1	11.0	48.4	2.9	13.9	15.1	1.5	100.0

TABLE A.2.24 a. Airport Access Modal Share by Residence of Passenger, Phase 1, Phase 2

APTMODE		COUNT / ROW PCT / COL PCT / TOT PCT	RESIDENT: INC RESPONSE 0.0	RESIDENT 1.00	NON-RESIDENT 2.00	ROW TOTAL
RENTED CAR	1.00	COUNT	2	29	570	601
		ROW PCT	0.3	4.8	94.8	7.0
		COL PCT	2.6	0.8	12.1	
		TOT PCT	0.0	0.3	6.7	
PRIVATE CAR	2.00	COUNT	44	2558	1533	4135
		ROW PCT	1.1	61.9	37.1	48.3
		COL PCT	57.1	67.9	32.4	
		TOT PCT	0.5	29.9	17.9	
TAXI	3.00	COUNT	11	434	1054	1499
		ROW PCT	0.7	29.0	70.3	17.5
		COL PCT	14.3	11.5	22.3	
		TOT PCT	0.1	5.1	12.3	
PUPLIC BUS	4.00	COUNT	1	135	143	279
		ROW PCT	0.4	48.4	51.3	3.3
		COL PCT	1.3	3.6	3.0	
		TOT PCT	0.0	1.6	1.7	
AIRFCRT -LIMO	5.00	COUNT	16	401	933	1350
		ROW PCT	1.2	29.7	69.1	15.8
		COL PCT	20.8	10.6	19.7	
		TOT PCT	0.2	4.7	10.9	
AIRPORT BUS	6.00	COUNT	2	174	378	554
		ROW PCT	0.4	31.4	68.2	6.5
		COL PCT	2.6	4.6	8.0	
		TOT PCT	0.0	2.0	4.4	
HOTEL-MOTEL LIMO	7.00	COUNT	0	3	37	40
		ROW PCT	0.0	7.5	92.5	0.5
		COL PCT	0.0	0.1	0.8	
		TOT PCT	0.0	0.0	0.4	
OTHER	9.00	COUNT	1	33	77	111
		ROW PCT	0.9	29.7	69.4	1.3
		COL PCT	1.3	0.9	1.6	
		TOT PCT	0.0	0.4	0.9	
COLUMN TOTAL			77	3767	4725	8569
			0.9	44.0	55.1	100.0

TABLE A.2.24 b. Airport Access Modal Share by Residence of Passenger, Phase 1, Phase 2

APTMODE		COUNT / ROW PCT / COL PCT / TOT PCT	RESIDENT 1.00	NON-RESIDENT 2.00	ROW TOTAL
RENTED CAR	1.00	COUNT	28	612	640
		ROW PCT	4.4	95.6	6.7
		COL PCT	0.6	11.7	
		TOT PCT	0.3	6.4	
PRIVATE CAR	2.00	COUNT	2281	1297	3578
		ROW PCT	63.8	36.2	37.3
		COL PCT	52.3	24.8	
		TOT PCT	23.8	13.5	
TAXI	3.00	COUNT	400	845	1245
		ROW PCT	32.1	67.9	13.0
		COL PCT	9.2	16.2	
		TOT PCT	4.2	8.8	
AIRPORT BUS-LIMO	5.00	COUNT	164	742	906
		ROW PCT	18.1	81.9	9.5
		COL PCT	3.8	14.2	
		TOT PCT	1.7	7.7	
HOTEL-MOTEL LIMO	7.00	COUNT	11	312	323
		ROW PCT	3.4	96.6	3.4
		COL PCT	0.3	6.0	
		TOT PCT	0.1	3.3	
TRANSIT	8.00	COUNT	1465	1393	2858
		ROW PCT	51.3	48.7	29.8
		COL PCT	33.6	26.7	
		TOT PCT	15.3	14.5	
OTHER	9.00	COUNT	15	21	36
		ROW PCT	41.7	58.3	0.4
		COL PCT	0.3	0.4	
		TOT PCT	0.2	0.2	
COLUMN TOTAL			4364	5222	9586
			45.5	54.5	100.0

TABLE A.2.25 a. Airport Access Modal Share by the Number of Checked Bags of a Passenger, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	NUMBAGS: NONE 0.0	ONE 1.00	TWO 2.00	THREE 3.00	FOUR 4.00	FIVE OR MORE 5.00	NO RESPONSE 9.00	ROW TOTAL
1.00 RENTED CAR	COUNT	149	238	158	27	5	9	15	601
	ROW PCT	24.8	39.6	26.3	4.5	0.8	1.5	2.5	7.0
	COL PCT	6.4	7.4	7.7	5.9	3.5	9.7	5.6	
	TOT PCT	1.7	2.8	1.8	0.3	0.1	0.1	0.2	
2.00 PRIVATE CAR	COUNT	955	1467	1123	289	82	58	141	4135
	ROW PCT	23.1	36.0	27.2	7.0	2.0	1.4	3.4	48.3
	COL PCT	41.0	46.1	54.8	62.7	57.3	62.4	52.6	
	TOT PCT	11.1	17.4	13.1	3.4	1.0	0.7	1.6	
3.00 TAXI	COUNT	498	551	284	72	37	13	44	1499
	ROW PCT	33.2	36.8	18.9	4.8	2.5	0.9	2.9	17.5
	COL PCT	21.4	17.1	13.8	15.6	25.9	14.0	16.4	
	TOT PCT	5.8	6.4	3.3	0.8	0.4	0.2	0.5	
4.00 PUBLIC BUS	COUNT	152	72	39	5	0	0	11	279
	ROW PCT	54.5	25.8	14.0	1.8	0.0	0.0	3.9	3.3
	COL PCT	6.5	2.2	1.9	1.1	0.0	0.0	4.1	
	TOT PCT	1.8	0.8	0.5	0.1	0.0	0.0	0.1	
5.00 AIRPORT -LIMO	COUNT	344	585	308	48	14	8	43	1350
	ROW PCT	25.5	43.3	22.8	3.6	1.0	0.6	3.2	15.8
	COL PCT	14.8	18.1	15.0	10.4	9.8	8.6	16.0	
	TOT PCT	4.0	6.8	3.6	0.6	0.2	0.1	0.5	
6.00 AIRPORT BUS	COUNT	173	237	113	19	2	1	9	554
	ROW PCT	31.2	42.8	20.4	3.4	0.4	0.2	1.6	6.5
	COL PCT	7.4	7.3	5.5	4.1	1.4	1.1	3.4	
	TOT PCT	2.0	2.8	1.3	0.2	0.0	0.0	0.1	
7.00 HOTEL-MOTEL LIMO	COUNT	11	15	12	1	0	0	1	40
	ROW PCT	27.5	37.5	30.0	2.5	0.0	0.0	2.5	0.5
	COL PCT	0.5	0.5	0.6	0.2	0.0	0.0	0.4	
	TOT PCT	0.1	0.2	0.1	0.0	0.0	0.0	0.0	
9.00 OTHER	COUNT	46	40	14	0	3	4	4	111
	ROW PCT	41.4	36.0	12.6	0.0	2.7	3.6	3.6	1.3
	COL PCT	2.0	1.2	0.7	0.0	2.1	4.3	1.5	
	TOT PCT	0.5	0.5	0.2	0.0	0.0	0.0	0.0	
COLUMN TOTAL		2328	3225	2051	461	143	93	268	8569
		27.2	37.6	23.9	5.4	1.7	1.1	3.1	100.0

TABLE A.2.25 b. Airport Access Modal Share bv the Number of Checked Bags of a Passenger, Phase 1, Phase 2

APTMODE	NUMBAGS: COUNT / ROW PCT / COL PCT / TOT PCT	NONE 0.0	ONE 1.00	TWO 2.00	THREE 3.00	FOUR 4.00	FIVE OR MORE 5.00	NO RESPONSE 9.00	ROW TOTAL
1.00 RENTED CAR	COUNT	209	253	136	20	6	3	17	644
	ROW PCT	32.5	39.3	21.1	3.1	0.9	0.5	2.6	6.6
	COL PCT	7.2	6.5	6.7	5.6	5.5	5.7	4.3	
	TOT PCT	2.1	2.6	1.4	0.2	0.1	0.0	0.2	
2.00 PRIVATE CAR	COUNT	902	1369	953	182	62	38	147	3653
	ROW PCT	24.7	37.5	26.1	5.0	1.7	1.0	4.0	37.5
	COL PCT	31.0	35.3	47.0	51.0	56.4	71.7	37.4	
	TOT PCT	9.3	14.1	9.8	1.9	0.6	0.4	1.5	
3.00 TAXI	COUNT	384	474	250	64	25	7	62	1266
	ROW PCT	30.3	37.4	19.7	5.1	2.0	0.6	4.9	13.0
	COL PCT	13.2	12.2	12.3	17.9	22.7	13.2	15.8	
	TOT PCT	3.9	4.9	2.6	0.7	0.3	0.1	0.6	
5.00 AIRPORT BUS-LIMO	COUNT	165	442	224	42	7	1	35	916
	ROW PCT	18.0	48.3	24.5	4.6	0.8	0.1	3.8	9.4
	COL PCT	5.7	11.4	11.0	11.8	6.4	1.9	8.9	
	TOT PCT	1.7	4.5	2.3	0.4	0.1	0.0	0.4	
7.00 HOTEL-MOTEL LIMO	COUNT	135	114	45	4	1	2	27	328
	ROW PCT	41.2	34.8	13.7	1.2	0.3	0.6	8.2	3.4
	COL PCT	4.6	2.9	2.2	1.1	0.9	3.8	6.9	
	TOT PCT	1.4	1.2	0.5	0.0	0.0	0.0	0.3	
8.00 TRANSIT	COUNT	1106	1205	417	45	9	1	104	2887
	ROW PCT	38.3	41.7	14.4	1.6	0.3	0.0	3.6	29.7
	COL PCT	38.0	31.1	20.6	12.6	8.2	1.9	26.5	
	TOT PCT	11.4	12.4	4.3	0.5	0.1	0.0	1.1	
9.00 OTHER	COUNT	13	20	3	0	0	1	1	38
	ROW PCT	34.2	52.6	7.9	0.0	0.0	2.6	2.6	0.4
	COL PCT	0.4	0.5	0.1	0.0	0.0	1.9	0.3	
	TOT PCT	0.1	0.2	0.0	0.0	0.0	0.0	0.0	
COLUMN TOTAL		2914	3877	2028	357	110	53	393	5732
		29.9	39.8	20.8	3.7	1.1	0.5	4.0	100.0

TABLE A.2.26 a. Airport Access Modal Share by the Number of Flights Through Cleveland Made by the Passenger in the Previous Twelve Months, Phase 1, Phase 2

APRMODE	COUNT / ROW PCT / COL PCT / TOT PCT	FLTINYR: NO RESPONSE 0.0	ONE FLIGHT 1.00	2 TO 3 FLIGHTS 2.00	4-7 FLIGHTS 3.00	8-12 FLIGHTS 4.00	13-20 FLIGHTS 5.00	OVER 21 FLIGHTS 6.00	ROW TOTAL
1.00 RENTED CAR	COUNT	0	161	125	139	75	49	52	601
	ROW PCT	0.0	26.8	20.8	23.1	12.5	8.2	8.7	7.0
	COL PCT	0.0	5.6	6.8	8.8	9.4	9.1	5.5	
	TOT PCT	0.0	1.9	1.5	1.6	0.9	0.6	0.6	
2.00 PRIVATE CAR	COUNT	17	1229	898	756	383	272	570	4135
	ROW PCT	0.4	30.0	21.7	18.3	9.3	6.6	13.8	48.3
	COL PCT	43.6	43.4	49.2	47.8	48.2	50.5	60.8	
	TOT PCT	0.2	14.5	10.5	8.8	4.5	3.2	6.7	
3.00 TAXI	COUNT	8	523	303	260	146	99	160	1499
	ROW PCT	0.5	34.9	20.2	17.3	9.7	6.6	10.7	17.5
	COL PCT	20.5	18.3	16.6	16.4	18.4	18.4	17.1	
	TOT PCT	0.1	6.1	3.5	3.0	1.7	1.2	1.9	
4.00 PUBLIC BUS	COUNT	5	137	53	51	15	4	14	279
	ROW PCT	1.8	49.1	19.0	18.3	5.4	1.4	5.0	3.3
	COL PCT	12.8	4.8	2.9	3.2	1.9	0.7	1.5	
	TOT PCT	0.1	1.6	0.6	0.6	0.2	0.0	0.2	
5.00 AIRPORT -LIMO	COUNT	5	522	311	246	105	72	89	1350
	ROW PCT	0.4	38.7	23.0	18.2	7.8	5.3	6.6	15.8
	COL PCT	12.8	18.3	17.0	15.6	13.2	13.4	9.5	
	TOT PCT	0.1	6.1	3.6	2.9	1.2	0.8	1.0	
6.00 AIRPORT BUS	COUNT	1	197	100	107	66	40	43	554
	ROW PCT	0.2	35.6	18.1	19.3	11.9	7.2	7.8	6.5
	COL PCT	2.6	6.9	5.5	6.8	8.3	7.4	4.6	
	TOT PCT	0.0	2.3	1.2	1.2	0.8	0.5	0.5	
7.00 HOTEL-MOTEL LIMO	COUNT	0	21	9	5	3	0	2	40
	ROW PCT	0.0	52.5	22.5	12.5	7.5	0.0	5.0	0.5
	COL PCT	0.0	0.7	0.5	0.3	0.4	0.0	0.2	
	TOT PCT	0.0	0.2	0.1	0.1	0.0	0.0	0.0	
9.00 OTHER	COUNT	3	53	26	17	1	3	8	111
	ROW PCT	2.7	47.7	23.4	15.3	0.9	2.7	7.2	1.3
	COL PCT	7.7	1.9	1.4	1.1	0.1	0.6	0.9	
	TOT PCT	0.0	0.6	0.3	0.2	0.0	0.0	0.1	
COLUMN TOTAL		39	2853	1825	1581	794	539	938	8569
		0.5	33.3	21.3	18.5	9.3	6.3	10.9	100.0

TABLE A.2.26 b. Airport Access Modal Share by the Number of Flights Through Cleveland Made by the Passenger in the Previous Twelve Months, Phase 1, Phase 2

APTMODE	FLTINYR: COUNT / ROW PCT / COL PCT / TOT PCT	ONE FLIGHT 1.00	2 TO 3 FLIGHTS 2.00	4-7 FLIGHTS 3.00	8-12 FLIGHTS 4.00	13-20 FLIGHTS 5.00	OVER 21 FLIGHTS 6.00	ROW TOTAL
RENTED CAR	1.00	136	156	152	86	49	48	627
		21.7	24.9	24.2	13.7	7.8	7.7	6.8
		5.7	7.5	7.7	8.5	7.6	4.2	
		1.5	1.7	1.6	0.9	0.5	0.5	
PRIVATE CAR	2.00	824	818	690	370	258	495	3455
		23.8	23.7	20.0	10.7	7.5	14.3	37.5
		34.6	39.3	35.1	36.6	40.1	43.7	
		8.9	3.9	7.5	4.0	2.8	5.4	
TAXI	3.00	328	247	236	133	88	139	1171
		28.0	21.1	20.2	11.4	7.5	11.9	12.7
		13.8	11.9	12.0	13.2	13.7	12.3	
		3.6	2.7	2.6	1.4	1.0	1.5	
AIRPORT BUS-LIMO	5.00	334	207	158	63	25	54	841
		39.7	24.6	18.8	7.5	3.0	6.4	9.1
		14.0	9.9	8.0	6.2	3.9	4.8	
		3.6	2.2	1.7	0.7	0.3	0.6	
HOTEL-MOTEL LIMO	7.00	76	65	58	28	18	66	311
		24.4	20.9	13.6	9.0	5.8	21.2	3.4
		3.2	3.1	3.0	2.8	2.8	5.8	
		0.8	0.7	0.6	0.3	0.2	0.7	
TRANSIT	8.00	671	585	667	328	205	324	2780
		24.1	21.0	24.0	11.8	7.4	11.7	30.1
		28.1	28.1	33.9	32.5	31.8	28.6	
		7.3	6.3	7.2	3.6	2.2	3.5	
OTHER	9.00	15	6	5	2	1	8	37
		40.5	16.2	13.5	5.4	2.7	21.6	0.4
		0.6	0.3	0.3	0.2	0.2	0.7	
		0.2	0.1	0.1	0.0	0.0	0.1	
COLUMN TOTAL		2384	2084	1966	1010	644	1134	9222
		25.9	22.6	21.3	11.0	7.0	12.3	100.0

TABLE A.2.27 a. Airport Access Modal Share by Trip Duration, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	TRIPSTAY: RETURN SAME DAY 0.0	ONE NIGHT 1.00	TWO NIGHTS 2.00	THREE NIGHTS 3.00	FOUR NIGHTS 4.00	5-7 NIGHTS 5.00	8-14 NIGHTS 6.00	15-28 NIGHTS 7.00	OVER 29 NIGHTS 8.00	ROW TOTAL
1.00 RENTED CAR	COUNT	9	14	21	19	8	29	47	31	33	211
	ROW PCT	4.3	6.6	10.0	9.0	3.8	13.7	22.3	14.7	15.6	4.6
	COL PCT	2.9	2.3	3.3	3.6	2.1	4.3	7.9	8.8	7.1	
	TOT PCT	0.2	0.3	0.5	0.4	0.2	0.6	1.0	0.7	0.7	
2.00 PRIVATE CAR	COUNT	217	417	432	307	215	367	309	176	177	2617
	ROW PCT	8.3	15.9	16.5	11.7	8.2	14.0	11.8	6.7	6.8	57.4
	COL PCT	68.9	68.8	67.1	57.8	55.4	54.9	52.2	49.7	38.1	
	TOT PCT	4.8	9.1	9.5	6.7	4.7	8.0	6.8	3.9	3.9	
3.00 TAXI	COUNT	38	74	74	84	63	114	92	59	80	678
	ROW PCT	5.6	10.9	10.9	12.4	9.3	16.8	13.6	8.7	11.8	14.9
	COL PCT	12.1	12.2	11.5	15.8	16.2	17.1	15.5	16.7	17.2	
	TOT PCT	0.8	1.6	1.6	1.8	1.4	2.5	2.0	1.3	1.8	
4.00 PUBLIC BUS	COUNT	6	12	12	15	14	17	9	16	50	151
	ROW PCT	4.0	7.9	7.9	9.9	9.3	11.3	6.0	10.6	33.1	3.3
	COL PCT	1.9	2.0	1.9	2.8	3.6	2.5	1.5	4.5	10.8	
	TOT PCT	0.1	0.3	0.3	0.3	0.3	0.4	0.2	0.4	1.1	
5.00 AIRPORT -LIMO	COUNT	23	50	70	76	50	91	96	46	79	581
	ROW PCT	4.0	8.6	12.0	13.1	8.6	15.7	16.5	7.9	13.6	12.7
	COL PCT	7.3	8.3	10.9	14.3	12.9	13.6	16.2	13.0	17.0	
	TOT PCT	0.5	1.1	1.5	1.7	1.1	2.0	2.1	1.0	1.7	
6.00 AIRPORT BUS	COUNT	21	29	29	27	31	44	31	26	32	270
	ROW PCT	7.8	10.7	10.7	10.0	11.5	16.3	11.5	9.6	11.9	5.9
	COL PCT	6.7	4.8	4.5	5.1	8.0	6.6	5.2	7.3	6.9	
	TOT PCT	0.5	0.6	0.6	0.6	0.7	1.0	0.7	0.6	0.7	
7.00 HOTEL-MOTEL LIMO	COUNT	0	0	2	0	4	2	1	0	2	11
	ROW PCT	0.0	0.0	18.2	0.0	36.4	18.2	9.1	0.0	18.2	0.2
	COL PCT	0.0	0.0	0.3	0.0	1.0	0.3	0.2	0.0	0.4	
	TOT PCT	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	
9.00 OTHER	COUNT	1	10	4	3	3	4	7	0	11	43
	ROW PCT	2.3	23.3	9.3	7.0	7.0	9.3	16.3	0.0	25.6	0.9
	COL PCT	0.3	1.7	0.6	0.6	0.8	0.6	1.2	0.0	2.4	
	TOT PCT	0.0	0.2	0.1	0.1	0.1	0.1	0.2	0.0	0.2	
COLUMN TOTAL		315	606	644	531	388	668	592	354	464	4562
		6.9	13.3	14.1	11.6	8.5	14.6	13.0	7.8	10.2	100.0

TABLE A.2.27 b. Airport Access Modal Share by Trip Duration, Phase 1, Phase 2

APTMODE (TRIPSTAY: COUNT / ROW PCT / COL PCT / TOT PCT)	RETURN SAME DAY 0.0	ONE NIGHT 1.00	TWO NIGHTS 2.00	THREE NIGHTS 3.00	FOUR NIGHTS 4.00	5-7 NIGHTS 5.00	8-14 NIGHTS 6.00	15-28 NIGHTS 7.00	OVER 29 NIGHTS 8.00	ROW TOTAL
1.00 RENTED CAR	80	127	143	73	65	44	24	9	10	575
	13.9	22.1	24.9	12.7	11.3	7.7	4.2	1.6	1.7	6.4
	7.6	7.1	9.5	7.3	9.5	4.7	3.2	2.1	1.2	
	0.9	1.4	1.6	0.8	0.7	0.5	0.3	0.1	0.1	
2.00 PRIVATE CAR	392	538	519	347	235	325	358	208	433	3355
	11.7	16.0	15.5	10.3	7.0	9.7	10.7	6.2	12.9	37.3
	37.3	30.1	34.5	34.7	34.5	34.7	47.7	48.3	51.0	
	4.4	6.0	5.8	3.9	2.6	3.6	4.0	2.3	4.8	
3.00 TAXI	150	273	175	118	71	149	97	62	66	1161
	12.9	23.5	15.1	10.2	6.1	12.8	8.4	5.3	5.7	12.9
	14.3	15.3	11.6	11.8	10.4	15.9	12.9	14.4	7.3	
	1.7	3.0	1.9	1.3	0.8	1.7	1.1	0.7	0.7	
5.00 AIRPORT BUS-LIMO	39	177	142	103	78	135	80	32	36	822
	4.7	21.5	17.3	12.5	9.5	16.4	9.7	3.9	4.4	9.1
	3.7	9.9	9.4	10.3	11.5	14.4	10.7	7.4	4.2	
	0.4	2.0	1.6	1.1	0.9	1.5	0.9	0.4	0.4	
7.00 HOTEL-MOTEL LIMO	34	121	41	34	15	35	15	6	8	309
	11.0	39.2	13.3	11.0	4.9	11.3	4.9	1.9	2.6	3.4
	3.2	6.8	2.7	3.4	2.2	3.7	2.0	1.4	0.9	
	0.4	1.3	0.5	0.4	0.2	0.4	0.2	0.1	0.1	
8.00 TRANSIT	353	548	472	318	217	245	175	113	293	2734
	12.9	20.0	17.3	11.6	7.9	9.0	6.4	4.1	10.7	30.4
	33.6	30.6	31.4	31.8	31.9	26.1	23.3	26.2	34.5	
	3.9	6.1	5.2	3.5	2.4	2.7	1.9	1.3	3.3	
9.00 OTHER	4	6	11	7	0	4	1	1	3	37
	10.8	16.2	29.7	18.9	0.0	10.8	2.7	2.7	8.1	0.4
	0.4	0.3	0.7	0.7	0.0	0.4	0.1	0.2	0.4	
	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	
COLUMN TOTAL	1052	1790	1503	1000	681	937	750	431	849	8993
	11.7	19.9	16.7	11.1	7.6	10.4	8.3	4.8	9.4	100.0

TABLE A.2.28 a. Airport Access Modal Share by Distance of the Air Trip, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	AIRMILES: LESS THAN 100 MI 1.00	101-200 MILES 2.00	201-300 MILES 3.00	301-400 MILES 4.00	401-500 MILES 5.00	501-600 MILES 6.00	601-1000 MILES 7.00	1001-1500 MILES 8.00	OVER 1500 MILES 9.00	ROW TOTAL
RENTED CAR	1.00	37	86	43	147	213	36	2	8	29	601
		6.2	14.3	7.2	24.5	35.4	6.0	0.3	1.3	4.8	7.0
		13.6	6.4	6.5	9.2	6.8	6.6	5.6	2.2	4.8	
		0.4	1.0	0.5	1.7	2.5	0.4	0.0	0.1	0.3	
PRIVATE CAR	2.00	97	570	254	815	1544	280	22	204	349	4135
		2.3	13.8	6.1	19.7	37.3	6.8	0.5	4.9	8.4	48.3
		35.5	42.2	38.4	50.9	49.3	51.7	61.1	55.4	58.0	
		1.1	6.7	3.0	9.5	18.0	3.3	0.3	2.4	4.1	
TAXI	3.00	40	277	104	230	613	92	6	44	93	1499
		2.7	18.5	6.9	15.3	40.9	6.1	0.4	2.9	6.2	17.5
		14.7	20.5	15.7	14.4	19.6	17.0	16.7	12.0	15.4	
		0.5	3.2	1.2	2.7	7.2	1.1	0.1	0.5	1.1	
PUBLIC BUS	4.00	10	27	78	29	70	11	0	40	14	279
		3.6	9.7	28.0	10.4	25.1	3.9	0.0	14.3	5.0	3.3
		3.7	2.0	11.8	1.8	2.2	2.0	0.0	10.9	2.3	
		0.1	0.3	0.9	0.3	0.8	0.1	0.0	0.5	0.2	
AIRPORT -LIMO	5.00	52	256	116	257	467	79	5	39	79	1350
		3.9	19.0	8.6	19.0	34.6	5.9	0.4	2.9	5.9	15.8
		19.0	19.0	17.5	16.0	14.9	14.6	13.9	10.6	13.1	
		0.6	3.0	1.4	3.0	5.4	0.9	0.1	0.5	0.9	
AIRPORT BUS	6.00	32	107	50	108	172	22	0	29	34	554
		5.8	19.3	9.0	19.5	31.0	4.0	0.0	5.2	6.1	6.5
		11.7	7.9	7.6	6.7	5.5	4.1	0.0	7.9	5.6	
		0.4	1.2	0.6	1.3	2.0	0.3	0.0	0.3	0.4	
HOTEL-MOTEL LIMO	7.00	2	6	4	10	14	1	0	2	1	40
		5.0	15.0	10.0	25.0	35.0	2.5	0.0	5.0	2.5	0.5
		0.7	0.4	0.6	0.6	0.4	0.2	0.0	0.5	0.2	
		0.0	0.1	0.0	0.1	0.2	0.0	0.0	0.0	0.0	
OTHER	9.00	3	21	13	6	41	21	1	2	3	111
		2.7	18.9	11.7	5.4	36.9	18.9	0.9	1.8	2.7	1.3
		1.1	1.6	2.0	0.4	1.3	3.9	2.8	0.5	0.5	
		0.0	0.2	0.2	0.1	0.5	0.2	0.0	0.0	0.0	
COLUMN TOTAL		273	1350	662	1602	3134	542	36	368	602	8569
		3.2	15.8	7.7	18.7	36.6	6.3	0.4	4.3	7.0	100.0

TABLE A.2.28 b. Airport Access Modal Share by Distance of the Air Trip, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	AIRMILES: LESS THAN 100 MI 1.00	101-200 MILES 2.00	201-300 MILES 3.00	301-400 MILES 4.00	401-500 MILES 5.00	501-600 MILES 6.00	ROW TOTAL
1.00 RENTED CAR	COUNT	57	116	41	183	210	37	644
	ROW PCT	8.9	18.0	6.4	28.4	32.6	5.7	6.6
	COL PCT	13.1	6.3	5.2	8.6	5.5	5.6	
	TOT PCT	0.6	1.2	0.4	1.9	2.2	0.4	
2.00 PRIVATE CAR	COUNT	139	671	236	802	1503	302	3653
	ROW PCT	3.8	18.4	6.5	22.0	41.1	8.3	37.5
	COL PCT	32.0	36.2	29.7	37.6	39.0	45.7	
	TOT PCT	1.4	6.9	2.4	8.2	15.4	3.1	
3.00 TAXI	COUNT	53	270	98	234	525	86	1266
	ROW PCT	4.2	21.3	7.7	18.5	41.5	6.8	13.0
	COL PCT	12.2	14.6	12.3	11.0	13.6	13.0	
	TOT PCT	0.5	2.8	1.0	2.4	5.4	0.9	
5.00 AIRPORT BUS-LIMO	COUNT	47	194	96	186	336	57	916
	ROW PCT	5.1	21.2	10.5	20.3	36.7	6.2	9.4
	COL PCT	10.8	10.5	12.1	8.7	8.7	8.6	
	TOT PCT	0.5	2.0	1.0	1.9	3.5	0.6	
7.00 HOTEL-MOTEL LIMO	COUNT	21	64	28	72	122	21	328
	ROW PCT	6.4	19.5	8.5	22.0	37.2	6.4	3.4
	COL PCT	4.8	3.5	3.5	3.4	3.2	3.2	
	TOT PCT	0.2	0.7	0.3	0.7	1.3	0.2	
8.00 TRANSIT	COUNT	117	536	289	644	1147	154	2887
	ROW PCT	4.1	18.6	10.0	22.3	39.7	5.3	29.7
	COL PCT	27.0	28.9	36.4	30.2	29.8	23.3	
	TOT PCT	1.2	5.5	3.0	6.6	11.8	1.6	
9.00 OTHER	COUNT	0	3	7	14	10	4	38
	ROW PCT	0.0	7.9	18.4	36.8	26.3	10.5	0.4
	COL PCT	0.0	0.2	0.9	0.7	0.3	0.6	
	TOT PCT	0.0	0.0	0.1	0.1	0.1	0.0	
COLUMN TOTAL		434	1854	795	2135	3853	661	9732
		4.5	19.1	8.2	21.9	39.6	6.8	100.0

TABLE A.2.29 a. Airport Access Modal Share by Day of the Week, Phase 1, Phase 2

APIMODE	COUNT / ROW PCT / COL PCT / TOT PCT	SUNDAY 1.00	MONDAY 2.00	TUESDAY 3.00	WEDNESDAY 4.00	THURSDAY 5.00	FRIDAY 6.00	SATURDAY 7.00	ROW TOTAL
RENTED CAR 1.00	COUNT	68	92	98	122	105	99	17	601
	ROW PCT	11.3	15.3	16.3	20.3	17.5	16.5	2.8	7.0
	COL PCT	6.0	7.0	6.7	8.4	8.1	7.3	3.1	
	TOT PCT	0.8	1.1	1.1	1.4	1.2	1.2	C.2	
PRIVATE CAR 2.00	COUNT	743	643	653	581	544	602	369	4135
	ROW PCT	18.0	15.6	15.8	14.1	13.2	14.6	8.9	48.3
	COL PCT	65.5	48.6	44.9	40.2	41.8	44.4	66.2	
	TOT PCT	8.7	7.5	7.6	6.8	6.3	7.0	4.3	
TAXI 3.00	COUNT	115	230	273	313	279	226	63	1499
	ROW PCT	7.7	15.3	18.2	20.9	18.6	15.1	4.2	17.5
	COL PCT	10.1	17.4	18.8	21.7	21.5	16.7	11.3	
	TOT PCT	1.3	2.7	3.2	3.7	3.3	2.6	C.7	
PUBLIC BUS 4.00	COUNT	21	47	25	53	54	66	13	279
	ROW PCT	7.5	16.8	9.0	19.0	19.4	23.7	4.7	3.3
	COL PCT	1.9	3.6	1.7	3.7	4.2	4.9	2.3	
	TOT PCT	0.2	0.5	C.3	0.6	0.6	0.8	C.2	
AIRPORT-LIMO 5.00	COUNT	129	216	264	254	201	221	65	1350
	ROW PCT	9.6	16.0	19.6	18.8	14.9	16.4	4.8	15.8
	COL PCT	11.4	16.3	18.2	17.6	15.5	16.3	11.7	
	TOT PCT	1.5	2.5	3.1	3.0	2.3	2.6	C.8	
AIRPORT BUS 6.00	COUNT	35	83	96	96	96	126	22	554
	ROW PCT	6.3	15.0	17.3	17.3	17.3	22.7	4.0	6.5
	COL PCT	3.1	6.3	6.6	6.6	7.4	9.3	3.9	
	TOT PCT	0.4	1.0	1.1	1.1	1.1	1.5	0.3	
HOTEL-MOTEL LIMO 7.00	COUNT	5	6	6	13	3	4	3	40
	ROW PCT	12.5	15.0	15.0	32.5	7.5	10.0	7.5	0.5
	COL PCT	0.4	0.5	0.4	0.9	0.2	0.3	C.5	
	TOT PCT	0.1	0.1	C.1	0.2	0.0	0.0	C.0	
OTHER 9.00	COUNT	19	6	38	13	18	12	5	111
	ROW PCT	17.1	5.4	34.2	11.7	16.2	10.8	4.5	1.3
	COL PCT	1.7	0.5	2.6	0.9	1.4	0.9	C.9	
	TOT PCT	0.2	0.1	C.4	0.2	0.2	0.1	0.1	
COLUMN TOTAL		1135	1323	1453	1445	1300	1356	557	8569
		13.2	15.4	17.0	16.9	15.2	15.8	6.5	1CC.0

TABLE A.2.29 b. Airport Access Modal Share by Day of the Week, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	SUNDAY 1.00	MONDAY 2.00	TUESDAY 3.00	WEDNESDAY 4.00	THURSDAY 5.00	FRIDAY 6.00	SATURDAY 7.00	ROW TOTAL
1.00 RENTED CAR	COUNT	48	104	102	146	115	99	30	644
	ROW PCT	7.5	16.1	15.8	22.7	17.9	15.4	4.7	6.6
	COL PCT	3.3	6.5	6.8	9.0	8.5	7.3	3.5	
	TOT PCT	0.5	1.1	1.0	1.5	1.2	1.0	0.3	
2.00 PRIVATE CAR	COUNT	645	562	530	582	500	460	374	3653
	ROW PCT	17.7	15.4	14.5	15.9	13.7	12.6	10.2	37.5
	COL PCT	44.6	35.1	35.4	35.8	37.1	33.8	43.7	
	TOT PCT	6.6	5.8	5.4	6.0	5.1	4.7	3.8	
3.00 TAXI	COUNT	181	133	194	226	178	175	129	1266
	ROW PCT	14.3	14.5	15.3	17.9	14.1	13.8	10.2	13.0
	COL PCT	12.5	11.4	13.0	13.9	13.2	12.9	15.1	
	TOT PCT	1.9	1.9	2.0	2.3	1.8	1.8	1.3	
5.00 AIRPORT BUS-LIMO	COUNT	168	153	151	125	97	135	87	916
	ROW PCT	18.3	16.7	16.5	13.6	10.6	14.7	9.5	9.4
	COL PCT	11.6	9.6	10.1	7.7	7.2	9.9	10.2	
	TOT PCT	1.7	1.6	1.6	1.3	1.0	1.4	0.9	
7.00 HOTEL-MOTEL LIMO	COUNT	50	55	41	60	34	54	34	328
	ROW PCT	15.2	16.8	12.5	18.3	10.4	16.5	10.4	3.4
	COL PCT	3.5	3.4	2.7	3.7	2.5	4.0	4.0	
	TOT PCT	0.5	0.6	0.4	0.6	0.3	0.6	0.3	
8.00 TRANSIT	COUNT	351	539	474	483	416	424	200	2887
	ROW PCT	12.2	18.7	16.4	16.7	14.4	14.7	6.9	29.7
	COL PCT	24.3	33.7	31.7	29.7	30.9	31.2	23.4	
	TOT PCT	3.6	5.5	4.9	5.0	4.3	4.4	2.1	
9.00 OTHER	COUNT	4	3	5	4	6	14	2	38
	ROW PCT	10.5	7.9	13.2	10.5	15.8	36.8	5.3	0.4
	COL PCT	0.3	0.2	0.3	0.2	0.4	1.0	0.2	
	TOT PCT	0.0	0.0	0.1	0.0	0.1	0.1	0.0	
COLUMN TOTAL		1447	1599	1497	1626	1346	1361	856	9732
		14.9	16.4	15.4	16.7	13.8	14.0	8.8	100.0

TABLE A.2.30 a. Airport Access Modal Share by Time of Flight Arrival or Departure, Phase 1, Phase 2

AFTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	ACEPTIME 1.00	2.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	ROW TOTAL
RENTED CAR	1.00	0	0	3	11	32	61	35	42	43	29	601
		0.C	0.0	C.5	1.8	5.3	10.1	5.8	7.0	7.2	4.8	7.0
		0.0	0.0	5.0	3.5	8.4	6.9	9.4	11.2	6.9	5.1	
		0.C	0.0	C.0	0.1	0.4	0.7	0.4	0.5	0.5	0.3	
PRIVATE CAR	2.00	3	0	25	225	205	426	174	162	339	246	4135
		0.1	0.0	0.6	5.4	5.0	10.3	4.2	3.9	8.2	5.9	48.3
		100.0	0.0	41.7	71.7	54.1	48.1	46.5	43.3	54.3	43.2	
		0.0	0.0	0.3	2.6	2.4	5.0	2.0	1.9	4.0	2.9	
TAXI	3.00	0	0	11	35	55	166	63	61	96	138	1499
		0.0	0.0	C.7	2.3	3.7	11.1	4.2	4.1	6.4	9.2	17.5
		0.0	0.0	18.3	11.1	14.5	18.8	16.8	16.3	15.4	24.2	
		0.C	0.0	0.1	0.4	0.6	1.9	C.7	C.7	1.1	1.6	
PUBLIC BUS	4.00	0	0	1	5	9	23	4	13	14	14	279
		0.0	0.0	0.4	1.8	3.2	8.2	1.4	4.7	5.0	5.0	3.3
		0.0	0.0	1.7	1.6	2.4	2.6	1.1	3.5	2.2	2.5	
		0.0	0.0	C.0	0.1	0.1	0.3	C.0	C.2	0.2	0.2	
AIRPORT -LIMO	5.00	0	1	14	16	45	102	68	67	86	105	1350
		0.0	0.1	1.0	1.2	3.3	7.6	5.0	5.0	6.4	7.8	15.8
		0.0	100.0	23.3	5.1	11.9	11.5	18.2	17.9	13.8	18.4	
		0.0	0.0	0.2	0.2	0.5	1.2	C.8	0.8	1.0	1.2	
AIRPORT BUS	6.00	C	0	6	18	24	69	26	24	42	32	554
		0.0	0.0	1.1	3.2	4.3	12.5	4.7	4.3	7.6	5.8	6.5
		0.0	0.0	10.0	5.7	6.3	7.8	7.0	6.4	6.7	5.6	
		0.0	0.0	0.1	0.2	0.3	0.8	C.3	0.3	0.5	0.4	
HOTEL-MOTEL LIMO	7.00	C	0	0	2	1	2	0	1	1	3	40
		0.0	0.0	0.0	5.0	2.5	5.C	C.0	2.5	2.5	7.5	0.5
		0.C	0.0	C.0	0.6	0.3	0.2	C.0	0.3	0.2	0.5	
		0.0	0.0	C.0	0.0	0.C	0.0	C.0	0.0	0.0	0.0	
OTHER	9.00	0	0	0	2	8	36	4	4	3	3	111
		0.C	0.0	C.0	1.8	7.2	32.4	3.6	3.6	2.7	2.7	1.3
		0.0	0.0	C.0	0.6	2.1	4.1	1.1	1.1	0.5	0.5	
		0.C	0.0	C.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	
	COLUMN TOTAL	3	1	60	314	379	885	274	374	624	570	8569
		0.C	0.0	C.7	3.7	4.4	10.3	4.4	4.4	7.3	6.7	100.0

Table A.2.30 a. (continued

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	ACEPTIME 14.00	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	ROW TOTAL
1.00 RENTED CAR	COUNT	60	16	78	46	51	18	35	31	9	0	1	601
	ROW PCT	10.0	2.7	13.0	7.7	8.5	3.0	5.8	5.2	1.5	0.0	0.2	7.0
	COL PCT	11.7	4.7	8.3	6.4	7.7	3.9	6.6	6.7	4.2	0.0	1.0	
	TOT PCT	0.7	0.2	0.9	0.5	0.6	0.2	0.4	0.4	0.1	0.0	0.0	
2.00 PRIVATE CAR	COUNT	212	188	433	294	307	246	219	235	110	22	64	4135
	ROW PCT	5.1	4.5	10.5	7.1	7.4	5.9	5.3	5.7	2.7	0.5	1.5	48.3
	COL PCT	41.2	54.8	46.3	40.9	46.6	52.7	41.5	50.4	50.9	53.7	66.0	
	TOT PCT	2.5	2.2	5.1	3.4	3.6	2.9	2.6	2.7	1.3	0.3	0.7	
3.00 TAXI	COUNT	94	45	214	139	113	80	61	65	38	8	17	1499
	ROW PCT	6.3	3.0	14.3	9.3	7.5	5.3	4.1	4.3	2.5	0.5	1.1	17.5
	COL PCT	18.3	13.1	22.9	19.4	17.1	17.1	11.6	13.9	17.6	19.5	17.5	
	TOT PCT	1.1	0.5	2.5	1.6	1.3	0.9	0.7	0.8	0.4	0.1	0.2	
4.00 PUBLIC BUS	COUNT	6	7	15	51	18	22	67	4	4	1	1	279
	ROW PCT	2.2	2.5	5.4	18.3	6.5	7.9	24.0	1.4	1.4	0.4	0.4	3.3
	COL PCT	1.2	2.0	1.6	7.1	2.7	4.7	12.7	0.9	1.9	2.4	1.0	
	TOT PCT	0.1	0.1	0.2	0.6	0.2	0.3	0.8	0.0	0.0	0.0	0.0	
5.00 AIRPORT -LIMO	COUNT	97	61	131	119	103	72	102	100	39	9	13	1350
	ROW PCT	7.2	4.5	9.7	8.8	7.6	5.3	7.6	7.4	2.9	0.7	1.0	15.8
	COL PCT	18.8	17.8	14.0	16.6	15.6	15.4	19.3	21.5	18.1	22.0	13.4	
	TOT PCT	1.1	0.7	1.5	1.4	1.2	0.8	1.2	1.2	0.5	0.1	0.2	
6.00 AIRPORT BUS	COUNT	29	25	54	60	52	24	29	25	13	1	1	554
	ROW PCT	5.2	4.5	9.7	10.8	9.4	4.3	5.2	4.5	2.3	0.2	0.2	6.5
	COL PCT	5.6	7.3	5.8	8.4	7.9	5.1	5.5	5.4	6.0	2.4	1.0	
	TOT PCT	0.3	0.3	0.6	0.7	0.6	0.3	0.3	0.3	0.2	0.0	0.0	
7.00 HOTEL-MOTEL LIMO	COUNT	2	0	6	3	7	2	3	5	2	0	0	40
	ROW PCT	5.0	0.0	15.0	7.5	17.5	5.0	7.5	12.5	5.0	0.0	0.0	0.5
	COL PCT	0.4	0.0	0.6	0.4	1.1	0.	0.5	1.1	0.9	0.0	0.0	
	TOT PCT	0.0	0.0	0.1	0.0	0.1	0.0	0 0	0.1	0.0	0.0	0.0	
9.00 OTHER	COUNT	15	1	4	6	6	3	12	1	1	0	0	111
	ROW PCT	13.5	0.9	3.6	5.4	7.2	2.7	10.8	0.9	0.9	0.0	0.0	1.3
	COL PCT	2.9	0.3	0.4	0.8	1.2	0.6	2.3	0.2	0.5	0.0	0.0	
	TOT PCT	0.2	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	
COLUMN TOTAL		515	343	935	718	659	467	529	466	215	41	97	8569
		6.0	4.0	10.9	8.4	7.7	5.4	6.2	5.4	2.5	0.5	1.1	100.0

TABLE A.2.30 b. Airport Access Modal Share by Time of Flight Arrival or Departure, Phase 1, Phase 2

APTMODE	ADEPTIME: COUNT / ROW PCT / COL PCT / TOT PCT	1.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	ROW TOTAL
1.00 RENTED CAR	COUNT	0	0	12	32	65	20	39	42	37	32	644
	ROW PCT	0.0	0.0	1.9	5.0	10.1	3.1	6.1	6.5	5.7	5.0	6.6
	COL PCT	0.0	0.0	3.1	9.1	7.6	6.2	8.2	7.2	5.6	8.4	
	TOT PCT	0.0	0.0	0.1	0.3	0.7	0.2	0.4	0.4	0.4	0.3	
2.00 PRIVATE CAR	COUNT	3	13	181	112	339	125	159	253	238	152	3653
	ROW PCT	0.1	0.4	5.0	3.1	9.3	3.4	4.4	6.9	6.5	4.2	37.5
	COL PCT	75.0	39.4	47.1	31.9	39.9	38.7	33.3	43.2	36.2	39.9	
	TOT PCT	0.0	0.1	1.9	1.2	3.5	1.3	1.6	2.6	2.4	1.6	
3.00 TAXI	COUNT	1	6	39	62	89	49	63	63	88	44	1266
	ROW PCT	0.1	0.5	3.1	4.9	7.0	3.9	5.0	5.0	7.0	3.5	13.0
	COL PCT	25.0	18.2	10.2	17.7	10.5	15.2	13.2	10.8	13.4	11.5	
	TOT PCT	0.0	0.1	0.4	0.6	0.9	0.5	0.6	0.6	0.9	0.5	
5.00 AIRPORT BUS-LIMO	COUNT	0	0	16	23	63	24	60	61	74	32	916
	ROW PCT	0.0	0.0	1.7	2.5	6.9	2.6	6.6	6.7	8.1	3.5	9.4
	COL PCT	0.0	0.0	4.2	6.6	7.4	7.4	12.6	10.4	11.2	3.4	
	TOT PCT	0.0	0.0	0.2	0.2	0.6	0.2	0.6	0.6	0.8	0.3	
7.00 HOTEL-MOTEL LIMO	COUNT	0	0	38	7	34	16	15	7	31	11	328
	ROW PCT	0.0	0.0	11.6	2.1	10.4	4.9	4.6	2.1	9.5	3.4	3.4
	COL PCT	0.0	0.0	9.9	2.0	4.0	5.0	3.1	1.2	4.7	2.9	
	TOT PCT	0.0	0.0	0.4	0.1	0.3	0.2	0.2	0.1	0.3	0.1	
8.00 TRANSIT	COUNT	0	14	97	114	259	88	139	156	189	109	2887
	ROW PCT	0.0	0.5	3.4	3.9	9.0	3.0	4.8	5.4	6.5	3.8	29.7
	COL PCT	0.0	42.4	25.3	32.5	30.5	27.2	29.1	26.7	28.7	28.6	
	TOT PCT	0.0	0.1	1.0	1.2	2.7	0.9	1.4	1.6	1.9	1.1	
9.00 OTHER	COUNT	0	0	1	1	1	1	2	3	1	1	38
	ROW PCT	0.0	0.0	2.6	2.6	2.6	2.6	5.3	7.9	2.6	2.6	0.4
	COL PCT	0.0	0.0	0.3	0.3	0.1	0.3	0.4	0.5	0.2	0.3	
	TOT PCT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
COLUMN TOTAL		4	33	384	351	850	323	477	585	653	331	9732
		0.0	0.3	3.9	3.6	8.7	3.3	4.9	6.0	6.8	3.9	100.0

(CONTINUED)

TABLE A.2.30 b. (continued)

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	15.00	16.00	17.00	18.00	19.00	20.00	21.00	22.00	23.00	24.00	ROW TOTAL
1.00 RENTED CAR	COUNT	49	63	77	41	27	48	46	6	5	3	644
	ROW PCT	7.6	9.8	12.0	6.4	4.2	7.5	7.1	0.9	0.8	0.5	6.6
	COL PCT	7.6	8.2	6.6	5.8	4.6	6.6	6.8	4.2	3.1	3.0	
	TOT PCT	0.5	0.6	0.8	0.4	0.3	0.5	0.5	0.1	0.1	0.0	
2.00 PRIVATE CAR	COUNT	225	269	411	259	246	275	231	63	50	49	3653
	ROW PCT	6.2	7.4	11.3	7.1	6.7	7.5	6.3	1.7	1.4	1.3	37.5
	COL PCT	35.0	35.1	35.3	36.5	41.6	37.8	34.0	44.1	30.9	49.5	
	TOT PCT	2.3	2.8	4.2	2.7	2.5	2.8	2.4	0.6	0.5	0.5	
3.00 TAXI	COUNT	78	120	165	78	79	82	94	16	29	21	1266
	ROW PCT	6.2	9.5	13.0	6.2	6.2	6.5	7.4	1.3	2.3	1.7	13.0
	COL PCT	12.1	15.7	14.2	11.0	13.3	11.3	13.8	11.2	17.9	21.2	
	TOT PCT	0.8	1.2	1.7	0.8	0.8	0.8	1.0	0.2	0.3	0.2	
5.00 AIRPORT BUS-LIMO	COUNT	63	90	109	63	58	65	76	8	23	8	916
	ROW PCT	6.9	9.8	11.9	6.9	6.3	7.1	8.3	0.9	2.5	0.9	9.4
	COL PCT	9.8	11.7	9.4	8.9	9.8	8.9	11.2	5.6	14.2	8.1	
	TOT PCT	0.6	0.9	1.1	0.6	0.6	0.7	0.8	0.1	0.2	0.1	
7.00 HOTEL-MOTEL LIMO	COUNT	14	19	32	17	14	23	27	9	14	0	328
	ROW PCT	4.3	5.8	9.8	5.2	4.3	7.0	8.2	2.7	4.3	0.0	3.4
	COL PCT	2.2	2.5	2.7	2.4	2.4	3.2	4.0	6.3	8.6	0.0	
	TOT PCT	0.1	0.2	0.3	0.2	0.1	0.2	0.3	0.1	0.1	0.0	
8.00 TRANSIT	COUNT	210	203	366	247	166	230	204	41	37	18	2887
	ROW PCT	7.3	7.0	12.7	8.6	5.7	8.0	7.1	1.4	1.3	0.6	29.7
	COL PCT	32.7	26.5	31.4	34.8	28.0	31.6	30.0	28.7	22.9	18.2	
	TOT PCT	2.2	2.1	3.8	2.5	1.7	2.4	2.1	0.4	0.4	0.2	
9.00 OTHER	COUNT	3	2	4	5	2	5	2	0	4	0	38
	ROW PCT	7.9	5.3	10.5	13.2	5.3	13.2	5.3	0.0	10.5	0.0	0.4
	COL PCT	0.5	0.3	0.3	0.7	0.3	0.7	0.3	0.0	2.5	0.0	
	TOT PCT	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	
COLUMN TOTAL		642	766	1164	710	592	728	680	143	162	99	9732
		6.6	7.9	12.0	7.3	6.1	7.5	7.0	1.5	1.7	1.0	100.0

TABLE A.2.31 a. Airport Access Modal Share by Flight Direction, Phase 1, Phase 2

APTMODE		COUNT / ROW PCT / COL PCT / TOT PCT	FLTDIR OUTBOUND 1.00	INBOUND 2.00	ROW TOTAL
RENTED CAR	1.00	COUNT	331	270	601
		ROW PCT	55.1	44.9	7.0
		COL PCT	6.9	7.2	
		TOT PCT	3.9	3.2	
PRIVATE CAR	2.00	COUNT	2631	1504	4135
		ROW PCT	63.6	36.4	48.3
		COL PCT	54.6	40.1	
		TOT PCT	30.7	17.6	
TAXI	3.00	COUNT	744	755	1499
		ROW PCT	49.6	50.4	17.5
		COL PCT	15.5	20.1	
		TOT PCT	8.7	8.8	
PUBLIC BUS	4.00	COUNT	173	106	279
		ROW PCT	62.0	38.0	3.3
		COL PCT	3.6	2.8	
		TOT PCT	2.0	1.2	
AIRPORT -LIMO	5.00	COUNT	548	802	1350
		ROW PCT	40.6	59.4	15.8
		COL PCT	11.4	21.4	
		TOT PCT	6.4	9.4	
AIRPORT BUS	6.00	COUNT	307	247	554
		ROW PCT	55.4	44.6	6.5
		COL PCT	6.4	6.6	
		TOT PCT	3.6	2.9	
HOTEL-MOTEL LIMO	7.00	COUNT	13	27	40
		ROW PCT	32.5	67.5	0.5
		COL PCT	0.3	0.7	
		TOT PCT	0.2	0.3	
OTHER	9.00	COUNT	68	43	111
		ROW PCT	61.3	38.7	1.3
		COL PCT	1.4	1.1	
		TOT PCT	0.8	0.5	
COLUMN TOTAL			4815	3754	8569
			56.2	43.8	100.0

TABLE A.2.31 b. Airport Access Modal Share by Flight Direction, Phase 1, Phase 2

APTMODE		COUNT / ROW PCT / COL PCT / TOT PCT	FLTDIR OUTBOUND 1.00	INBOUND 2.00	ROW TOTAL
RENTED CAR	1.00	COUNT	313	331	644
		ROW PCT	48.6	51.4	6.6
		COL PCT	6.2	7.0	
		TOT PCT	3.2	3.4	
PRIVATE CAR	2.00	COUNT	2153	1500	3653
		ROW PCT	58.9	41.1	37.5
		COL PCT	42.9	31.8	
		TOT PCT	22.1	15.4	
TAXI	3.00	COUNT	507	759	1266
		ROW PCT	40.0	60.0	13.0
		COL PCT	10.1	16.1	
		TOT PCT	5.2	7.8	
AIRPORT BUS-LIMO	5.00	COUNT	334	582	916
		ROW PCT	36.5	63.5	9.4
		COL PCT	6.7	12.4	
		TOT PCT	3.4	6.0	
HOTEL-MOTEL LIMO	7.00	COUNT	159	169	328
		ROW PCT	48.5	51.5	3.4
		COL PCT	3.2	3.6	
		TOT PCT	1.6	1.7	
TRANSIT	8.00	COUNT	1533	1354	2887
		ROW PCT	53.1	46.9	29.7
		COL PCT	30.5	28.7	
		TOT PCT	15.8	13.9	
OTHER	9.00	COUNT	23	15	38
		ROW PCT	60.5	39.5	0.4
		COL PCT	0.5	0.3	
		TOT PCT	0.2	0.2	
COLUMN TOTAL			5022	4710	9732
			51.6	48.4	100.0

TABLE A.2.32 a. Airport Access Modal Share by Number of Persons Accompanying the Passenger on the Flight, Phase 1, Phase 2

APTMODE	ACOMPFLT: COUNT / ROW PCT / COL PCT / TOT PCT	NONE 0.0	ONE 1.00	TWO 2.00	THREE 3.00	FOUR 4.00	FIVE 5.00	SIX 6.00	SEVEN 7.00	EIGHT OR MORE 8.00	ROW TOTAL
1.00 RENTED CAR	COUNT	310	55	65	21	8	5	5	0	4	513
	ROW PCT	60.4	18.5	12.7	4.1	1.6	1.0	1.0	0.0	0.8	6.8
	COL PCT	6.2	6.5	11.6	9.2	8.5	13.2	16.7	0.0	3.1	
	TOT PCT	4.1	1.3	0.9	0.3	0.1	0.1	0.1	0.0	0.1	
2.00 PRIVATE CAR	COUNT	2453	787	301	105	58	12	16	0	16	3748
	ROW PCT	65.4	21.0	8.0	2.8	1.5	0.3	0.4	0.0	0.4	49.8
	COL PCT	49.3	53.9	53.6	46.1	61.7	31.6	53.3	0.0	12.5	
	TOT PCT	32.6	10.5	4.0	1.4	0.8	0.2	0.2	0.0	0.2	
3.00 TAXI	COUNT	720	307	142	68	17	9	7	4	9	1283
	ROW PCT	56.1	23.9	11.1	5.3	1.3	0.7	0.5	0.3	0.7	17.0
	COL PCT	14.5	21.0	25.3	29.8	18.1	23.7	23.3	50.0	7.0	
	TOT PCT	9.6	4.1	1.9	0.9	0.2	0.1	0.1	0.1	0.1	
4.00 PUBLIC BUS	COUNT	181	19	3	0	0	0	0	0	48	251
	ROW PCT	72.1	7.6	1.2	0.0	0.0	0.0	0.0	0.0	19.1	3.3
	COL PCT	3.6	1.3	0.5	0.0	0.0	0.0	0.0	0.0	37.5	
	TOT PCT	2.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	
5.00 AIRPORT-LIMO	COUNT	875	176	35	28	10	11	2	3	9	1149
	ROW PCT	76.2	15.3	3.0	2.4	0.9	1.0	0.2	0.3	0.8	15.3
	COL PCT	17.6	12.1	6.2	12.3	10.6	28.9	6.7	37.5	7.0	
	TOT PCT	11.6	2.3	0.5	0.4	0.1	0.1	0.0	0.0	0.1	
6.00 AIRPORT BUS	COUNT	365	55	12	3	1	1	0	1	12	450
	ROW PCT	81.1	12.2	2.7	0.7	0.2	0.2	0.0	0.2	2.7	6.0
	COL PCT	7.3	3.8	2.1	1.3	1.1	2.6	0.0	12.5	9.4	
	TOT PCT	4.9	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.2	
7.00 HOTEL-MOTEL LIMO	COUNT	22	8	2	2	0	0	0	0	0	34
	ROW PCT	64.7	23.5	5.9	5.9	0.0	0.0	0.0	0.0	0.0	0.5
	COL PCT	0.4	0.5	0.4	0.9	0.0	0.0	0.0	0.0	0.0	
	TOT PCT	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9.00 OTHER	COUNT	51	13	2	1	0	0	0	0	30	97
	ROW PCT	52.6	13.4	2.1	1.0	0.0	0.0	0.0	0.0	30.9	1.3
	COL PCT	1.0	0.9	0.4	0.4	0.0	0.0	0.0	0.0	23.4	
	TOT PCT	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.4	
COLUMN TOTAL		4977	1460	562	228	94	38	30	8	128	7525
		66.1	19.4	7.5	3.0	1.2	0.5	0.4	0.1	1.7	100.0

TABLE A.2.32 b. Airport Access Modal Share by Number of Persons Accompanying the Passenger on the Flight, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	NONE 0.0	ONE 1.00	TWO 2.00	THREE 3.00	FOUR 4.00	FIVE 5.00	SIX 6.00	SEVEN 7.00	EIGHT OR MORE 8.00	ROW TOTAL
1.00 RENTED CAR	COUNT	418	134	26	8	10	2	3	2	1	604
	ROW PCT	69.2	22.2	4.3	1.3	1.7	0.3	0.5	0.3	0.2	6.5
	COL PCT	6.1	8.3	5.8	4.0	11.5	3.6	12.0	10.5	1.8	
	TOT PCT	4.5	1.4	0.3	0.1	0.1	0.0	0.0	0.0	0.0	
2.00 PRIVATE CAR	COUNT	2445	693	202	92	47	22	8	11	9	3529
	ROW PCT	69.3	19.6	5.7	2.6	1.3	0.6	0.2	0.3	0.3	37.7
	COL PCT	35.6	43.2	44.9	46.5	54.0	39.3	32.0	57.9	16.4	
	TOT PCT	26.1	7.4	2.2	1.0	0.5	0.2	0.1	0.1	0.1	
3.00 TAXI	COUNT	790	241	80	46	13	6	6	0	5	1187
	ROW PCT	66.6	20.3	6.7	3.9	1.1	0.5	0.5	0.0	0.4	12.7
	COL PCT	11.5	15.0	17.8	23.2	14.9	10.7	24.0	0.0	9.1	
	TOT PCT	8.4	2.6	0.9	0.5	0.1	0.1	0.1	0.0	0.1	
5.00 AIRPORT BUS-LIMO	COUNT	694	106	18	8	1	2	2	1	18	850
	ROW PCT	81.6	12.5	2.1	0.9	0.1	0.2	0.2	0.1	2.1	9.1
	COL PCT	10.1	6.6	4.0	4.0	1.1	3.6	8.0	5.3	32.7	
	TOT PCT	7.4	1.1	0.2	0.1	0.0	0.0	0.0	0.0	0.2	
7.00 HOTEL-MOTEL LIMO	COUNT	198	33	23	16	11	20	1	2	3	307
	ROW PCT	64.5	10.7	7.5	5.2	3.6	6.5	0.3	0.7	1.0	3.3
	COL PCT	2.9	2.1	5.1	8.1	12.6	35.7	4.0	10.5	5.5	
	TOT PCT	2.1	0.4	0.2	0.2	0.1	0.2	0.0	0.0	0.0	
8.00 TRANSIT	COUNT	2301	392	101	27	5	4	3	1	14	2848
	ROW PCT	80.8	13.8	3.5	0.9	0.2	0.1	0.1	0.0	0.5	30.4
	COL PCT	33.5	24.4	22.4	13.6	5.7	7.1	12.0	5.3	25.5	
	TOT PCT	24.6	4.2	1.1	0.3	0.1	0.0	0.0	0.0	0.1	
9.00 OTHER	COUNT	20	6	0	1	0	0	2	2	5	36
	ROW PCT	55.6	16.7	0.0	2.8	0.0	0.0	5.6	5.6	13.9	0.4
	COL PCT	0.3	0.4	0.0	0.5	0.0	0.0	8.0	10.5	9.1	
	TOT PCT	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	
COLUMN TOTAL		6866	1605	450	198	87	56	25	19	55	9361
		73.3	17.1	4.8	2.1	0.9	0.6	0.3	0.2	0.6	100.0

TABLE A.2.33 a. Airport Access Modal Share by the Number of Well-wishers Using the Same Access Mode, Phase 1, Phase 2

APTMODE	GREETERS: COUNT / ROW PCT / COL PCT / TOT PCT	NONE 0.0	ONE 1.00	TWO 2.00	THREE 3.00	FOUR 4.00	FIVE 5.00	SIX 6.00	SEVEN 7.00	EIGHT OR MORE 8.00	ROW TOTAL
RENTED_CAR	1.00	285	1C4	71	25	9	5	5	0	5	513
		56.3	20.3	13.8	4.9	1.8	1.C	1.0	0.0	1.0	6.8
		9.1	5.2	6.3	4.7	3.4	3.8	6.0	0.0	2.7	
		3.8	1.4	C.9	0.3	0.1	0.1	0.1	0.0	0.1	
PRIVATE CAR	2.00	818	1253	822	396	223	99	65	19	53	3748
		21.8	33.4	21.9	10.6	5.9	2.6	1.7	0.5	1.4	49.8
		25.8	62.6	73.1	74.3	83.2	76.2	78.3	67.9	28.6	
		10.9	16.7	1C.9	5.3	3.0	1.3	0.9	0.3	0.7	
TAXI	3.00	671	330	154	74	22	8	9	4	11	1283
		52.3	25.7	12.0	5.8	1.7	0.6	0.7	0.3	0.9	17.0
		21.2	16.5	13.7	13.9	8.2	6.2	1C.8	14.3	5.9	
		8.9	4.4	2.0	1.0	0.3	0.1	C.1	C.1	0.1	
PUBLIC BUS	4.00	154	27	8	1	C	4	1	1	55	251
		61.4	10.8	3.2	0.4	0.0	1.6	0.4	0.4	21.9	3.3
		4.9	1.3	C.7	0.2	0.C	3.1	1.2	3.6	29.7	
		2.C	0.4	0.1	0.0	0.C	0.1	0.0	0.0	0.7	
AIRPORT -LIMO	5.00	837	201	44	28	11	1C	2	3	13	1149
		72.8	17.5	3.8	2.4	1.0	0.9	C.2	0.3	1.1	15.3
		26.4	10.0	3.9	5.3	4.1	7.7	2.4	10.7	7.0	
		11.1	2.7	0.6	0.4	0.1	0.1	C.0	C.0	0.2	
AIRPORT BUS	6.00	342	63	19	5	2	3	1	1	14	450
		76.C	14.0	4.2	1.1	0.4	0.7	0.2	0.2	3.1	6.0
		10.8	3.1	1.7	0.9	0.7	2.3	1.2	3.6	7.6	
		4.5	0.8	0.3	0.1	0.0	0.0	C.0	0.0	0.2	
HOTEL-MOTEL LIMO	7.00	22	8	2	2	C	C	0	0	0	34
		64.7	23.5	5.9	5.9	0.0	0.0	C.0	C.0	0.0	0.5
		0.7	0.4	C.2	0.4	0.0	0.0	0.0	0.0	0.0	
		0.3	0.1	0.0	0.0	0.C	0.C	C.0	0.0	0.0	
OTHER	9.0C	37	17	5	2	1	1	0	0	34	97
		38.1	17.5	5.2	2.1	1.C	1.0	0.0	0.0	35.1	1.3
		1.2	0.8	0.4	0.4	0.4	0.8	C.0	C.0	18.4	
		0.5	0.2	C.1	0.0	0.0	0.0	C.0	0.0	0.5	
	COLUMN TOTAL	3170	2003	1125	533	268	130	83	28	185	7525
		42.1	26.6	15.0	7.1	3.6	1.7	1.1	0.4	2.5	100.0

TABLE A.2.33 b. Airport Access Modal Share by the Number of Well-wishers using the Same Access Mode, Phase 1, Phase 2

APTMODE	COUNT / ROW PCT / COL PCT / TOT PCT	GREETERS NONE 0.0	ONE 1.00	TWO 2.00	THREE 3.00	FOUR 4.00	FIVE 5.00	SIX 6.00	SEVEN 7.00	EIGHT OR MORE 8.00	ROW TOTAL
RENTED CAR	1.00	372	155	38	17	10	4	3	0	5	604
		61.6	25.7	6.3	2.8	1.7	0.7	0.5	0.0	0.8	6.5
		7.5	6.6	3.8	3.6	3.8	3.1	4.5	0.0	4.3	
		4.0	1.7	0.4	0.2	0.1	0.0	0.0	0.0	0.1	
PRIVATE CAR	2.00	872	1235	680	334	205	84	43	20	56	3529
		24.7	35.0	19.3	9.5	5.8	2.4	1.2	0.6	1.6	37.7
		17.7	52.7	67.9	70.5	77.1	64.6	64.2	66.7	48.7	
		9.3	13.2	7.3	3.6	2.2	0.9	0.5	0.2	0.6	
TAXI	3.00	736	272	90	46	21	8	7	1	6	1187
		62.0	22.9	7.6	3.9	1.8	0.7	0.6	0.1	0.5	12.7
		14.9	11.6	9.0	9.7	7.9	6.2	10.4	3.3	5.2	
		7.9	2.9	1.0	0.5	0.2	0.1	0.1	0.0	0.1	
AIRPORT BUS-LIMO	5.00	665	125	21	10	1	4	3	1	20	850
		78.2	14.7	2.5	1.2	0.1	0.5	0.4	0.1	2.4	9.1
		13.5	5.3	2.1	2.1	0.4	3.1	4.5	3.3	17.4	
		7.1	1.3	0.2	0.1	0.0	0.0	0.0	0.0	0.2	
HOTEL-MOTEL LIMO	7.00	185	38	23	20	11	21	1	2	6	307
		60.3	12.4	7.5	6.5	3.6	6.8	0.3	0.7	2.0	3.3
		3.8	1.6	2.3	4.2	4.1	16.2	1.5	6.7	5.2	
		2.0	0.4	0.2	0.2	0.1	0.2	0.0	0.0	0.1	
TRANSIT	8.00	2087	512	149	46	18	9	7	4	17	2848
		73.3	18.0	5.2	1.6	0.6	0.3	0.2	0.1	0.6	30.4
		42.3	21.8	14.8	9.7	6.8	6.9	10.4	13.3	14.8	
		22.3	5.5	1.6	0.5	0.2	0.1	0.1	0.0	0.2	
OTHER	9.00	16	8	1	1	0	0	3	2	5	36
		44.4	22.2	2.8	2.8	0.0	0.0	8.3	5.6	13.9	0.4
		0.3	0.3	0.1	0.2	0.0	0.0	4.5	6.7	4.3	
		0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	
	COLUMN TOTAL	4933	2345	1001	474	266	130	67	30	115	9351
		52.7	25.1	10.7	5.1	2.8	1.4	0.7	0.3	1.2	100.0

TABLE A.2.34 a. Airport Access Modal Share by Land Use at the Local Origin or Destination of the Passenger, Phase 1, Phase 2

APTMODE	LANDUSEL COUNT ROW PCT COL PCT TOT PCT	RESIDENCE 1.00	MOTEL-HOTEL 2.00	SCHOOL 3.00	NORMAL WORKPLACE 4.00	OTHER WORKPLACE 5.00	OTHER 6.00	ROW TOTAL
RENTED CAR	1.00	68	293	45	15	155	17	593
		11.5	49.4	7.6	2.5	26.1	2.9	7.0
		1.6	13.4	11.9	2.5	18.1	6.0	
		0.8	3.5	0.5	0.2	1.8	0.2	
PRIVATE CAR	2.00	2968	350	80	377	226	73	4074
		72.9	8.6	2.0	9.3	5.5	1.8	48.3
		71.7	16.0	21.1	63.3	26.4	25.9	
		35.2	4.1	0.9	4.5	2.7	0.9	
TAXI	3.00	398	589	108	93	230	61	1479
		26.9	39.8	7.3	6.3	15.6	4.1	17.5
		9.6	26.9	28.5	15.6	26.9	21.6	
		4.7	7.0	1.3	1.1	2.7	0.7	
PUBLIC BUS	4.00	84	21	38	4	54	64	265
		31.7	7.9	14.3	1.5	20.4	24.2	3.1
		2.0	1.0	10.0	0.7	6.3	22.7	
		1.0	0.2	0.5	0.0	0.6	0.8	
AIRPORT-LIMO	5.00	430	630	75	68	105	28	1336
		32.2	47.2	5.6	5.1	7.9	2.1	15.8
		10.4	28.8	19.8	11.4	12.3	9.9	
		5.1	7.5	0.9	0.8	1.2	0.3	
AIRPORT BUS	6.00	168	233	28	29	62	25	545
		30.8	42.8	5.1	5.3	11.4	4.6	6.5
		4.1	10.6	7.4	4.9	7.3	8.9	
		2.0	2.8	0.3	0.3	0.7	0.3	
HOTEL-MOTEL LIMO	7.00	1	33	0	2	3	1	40
		2.5	82.5	0.0	5.0	7.5	2.5	0.5
		0.0	1.5	0.0	0.3	0.4	0.4	
		0.0	0.4	0.0	0.0	0.0	0.0	
OTHER	9.00	21	42	5	8	20	13	109
		19.3	38.5	4.6	7.3	18.3	11.9	1.3
		0.5	1.9	1.3	1.3	2.3	4.6	
		0.2	0.5	0.1	0.1	0.2	0.2	
	COLUMN TOTAL	4138	2191	379	596	855	282	8441
		49.0	26.0	4.5	7.1	10.1	3.3	100.0

In late September and early October 1971, the Port of New York Authority had two surveys, one of air passengers and one of rapid transit passengers, conducted at Cleveland. The purpose of these surveys, which we call "Phase 3", was to obtain information for a third point in time to compare with the CHAAS Phase 1 and Phase 2 survey data. The Phase 3 survey was necessarily much smaller in scale and scope than Phases 1 and 2. Phase 3 data was gathered nearly three years after the rail rapid transit extension was completed and after a fare increase. This time series data is being used to evaluate rail service to an airport in general, and specifically the proposed rail link between Manhattan and the John F. Kennedy International Airport.

A.3.2 General Criticisms and Recommendations

The Cuyahoga County Regional Planning Commission's comments and suggestions on the surveys begin on page 24 of the "Survey Procedures". Our comments are limited to the air passenger surveys.

The data from the air passenger surveys are organized by ascending local origin-destination location zone numbers. Responses with unidentified locations are first, followed by SCOTS zones (used within the SCOTS cordon) in ascending order, then followed by IBM state, county, city codes (used outside the SCOTS cordon), also in ascending numerical order. This order is not discussed in the CHAAS documents; knowledge of it is helpful in processing and analyzing the data.

Different variables are coded in a single card column, e.g. waiting time at the airport and preselecting of access mode (card column 57, Phase 2). These are recoverable by using the flight direction variable: if the flight direction code equals 1, one of the variables can be recovered; if the flight direction code equals 2, the other variable. Other single variables are coded differently in a single card column for the two flight directions, e.g. the disposition of private automobiles (card column 43, Phase 2). Analysis of one of these variables for both passenger flow directions cannot easily be made. There appears to be no reason for doing this. Processing is easier if variables are coded one per card column or group of columns and in the same way for all cases in a data file.

Other variables, such as the availability of private automobiles (card column 44, Phase 1), were obtained and coded for only one direction, usually outbound. A few variables, e.g. the availability of private automobiles (Phase 1) and the preselection of the airport access mode (Phase 2, inbound only) are available in one phase of the survey but not the other. This makes comparison of these variables over time impossible. Data for both directions and phases is necessary; even if, because of poor response to a question, the data is not fully reliable.

Several different zone structures are used in the CHAAS: zipcode; SCOTS,and census zones; and IBM state, county, city "zones". Different zones, apparently aggregated SCOTS zones, are used in Phase 3. These zones are not always compatible with each other, requiring laborious cross-referencing. Further, certain information is available for census zones that is not available for SCOTS zones and vice versa. It might be preferable to use only one type of zone in a study.

The only transportation system data in the CHAAS data set is the travel time reported by outbound passengers in Phase 1. Fares, travel times, and access trip times from all zones and the locations of limousine stations must be known for a transportation study and for systems modelling. Accurate information is most difficult to obtain several years after a survey and requires a lengthy and expensive effort to accumulate in usable form. It is recommended that such information be included in future surveys.

Information on the availability of private automobiles, a key variable to determine passenger modal choice behavior, is provided for outbound Phase 1 air passengers only. There are two aspects to private automobile availability: a car for the passenger to drive and park at the airport, and a car and driver to take the passenger to or from the airport. Data on these two aspects are important to have in any transportation survey but are not provided in the CHAAS.

Information about the passenger's familiarity with the various airport access modes is also important. Often a passenger is not aware of the full range of alternate modes available to him. This information could include how the passenger learned of the mode and how long he has known about it.

Attitudinal questions can provide necessary insight into the passenger's modal choice behavior. Several were asked in Phase 3, for example: "Why did you not use rapid transit?". Care must be exercised to ensure the passenger understands the question fully and that he gives either the primary reason only or all reasons but in order of importance.

Enough effort has been spent on determining "environmental" or given air passenger characteristics, such as age, income, and sex. These seem not to change appreciably over time or between different locations and are of minimal value in determining passenger access modal choice behavior.

These recommendations should not be taken to imply that even larger and more expensive airport access surveys and studies be undertaken. A great deal of information about airport access is available from previous studies. Massive studies might be interesting as studies of urban transportation, but may not be the best method of obtaining further or updated airport access information. Rather, small, periodic surveys at different locations, each gathering information about a few specific aspects of airport access, are recommended. These would give a wider cross-section and a time series element to this transportation data.

A.3.3 Problems with Specific Variables in the CHAAS

The arrival/departure time at Cleveland is given by codes 01 through 24 (card columns 4-5); however, the cut-off point between hours is not given. For example, is 11:30 to be rounded up or down, and is the half hour the dividing line? There are indications that all times are rounded up, i.e. 11:05 is 12.

Codes 7, 8, and 9 for the flight distance between airport cities (card column 10) are missing in Phase 2. As the full sample is represented in codes 1 through 6 and all 9 codes are used in Phase 1, there is a systematic error in the Phase 2 coding, rendering this variable unusable.

The remote origin or destination address (card columns 12-20) is given, but the airport used there is not. This increased the difficulty in determining the frequency and market shares in our Cleveland-Akron/Canton analysis in Chapter 4. For example, does a person flying from Akron to Berkeley, California, use San Francisco International, which has more flights, or Oakland, which is closer to Berkeley? Similar problems appeared for the New York and Washington D.C. markets.

There is an inconsistency between Phase 1 and 2 in coding the local origin/destination data (card columns 24-32). In Phase 1, passengers who stated only that their O/D was "the CBD" were coded in SCOTS zone 0019; in Phase 2 these responses were coded 0000. These responses/zones are unusable for some purposes, e.g. determining the effects on access mode choice of the distance and time between the O/D and the airport access mode station.

Data on all vehicle types used for the access trip (card columns 34-36) are not in the order used, rather they are as checked on the arbitrarily ordered form. This increases the difficulty in reconstructing the access trip.

The "Data File Formats and Code Descriptions" omits the code for rapid transit (8) for the access mode at the airport (card column 42) in Phase 2. Another problem with this variable is that in Phase 1 there are codes for both an airport limousine (5) and an airport bus (6); in Phase 2 there is a code for an airport bus limousine (5), but the airport bus (6) has disappeared without explanation.

The availability of a private automobile (card column 44) is given only for Phase 1 and for outbound passengers only. Its response rate among the set of outbound passengers is about 80%.

Preselecting of egress modes by incoming passengers (card column 51) is coded in the same card column and using the same code numbers as waiting time at the airport for outgoing passengers. If different variables must be coded in the same card column, at least different code numbers should be used. The response rate for the preselected mode variable is about 75%. Some passengers stated in the in-flight survey that they had not already selected their egress mode, but then listed a mode.

The questions to obtain data on usage of the Cleveland-Hopkins Airport (card column 70) vary between each phase and are asked so that the departing non-resident passenger could answer that he did/will not use Hopkins to return to Cleveland even though he actually did. Perhaps a better question for both directions and all passenger groups would be: "Did you or do you intend to use Hopkins Airport on the other leg of your trip to Cleveland?".