Ground Transportation at Major European Airports

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EUROPEAN AIRPORT TRAFFIC

European airport traffic is currently growing at an average rate of 13 percent per annum, which is in line with the growth rate in the United States. Table 1 gives the terminal passengers handled at the top ten European airports in 1966.

The percentage of international passengers handled at European airports is significantly heavier than at airports in the United States. At London's Heathrow Airport, for example, 9 million of the 11.7 million passengers in 1966 were international passengers, the remainder being on domestic flights. This is the largest number of international passengers for any airport in the world. At Paris (Orly) airport, 4.4 million of the 5.6 million passengers in 1966 were international. These figures can be compared with J. F. Kennedy International Airport where in 1966 there were 5.7 million international passengers out of a total of 17 million.

In this paper, the discussion of ground transportation problems at European airports will be principally confined to London and Paris since both these cities have airports where these problems are significant factors in the expansion of the airport.

At many other European airports, such as Amsterdam and Frankfurt, the level of traffic to date and anticipated in the near future allows for a ground transportation solution by improvements to the existing highway network, but at Heathrow, London, and at the city's third airport planned at Stansted[1], and also at Orly, Paris, and the new Paris Nord site, the ground transportation requirements are of sufficient volume, either now or in the near future, to justify the investigation of exclusive public transport systems.

TABLE 1

TERMINAL PASSENGERS AT TEN TOP EUROPEAN AIRPORTS

Airport	Passengers (millions)
London (Heathrow)	11.7
Paris (Orly)	5.6
Frankfurt	5.1
Rome (Fiumicino)	3.6
Copenhagen	3.6
Berlin (Templehof)	3.3
Amsterdam	2.7
Zurich	2.5
Palma	2.4
Madrid	2.3

The high growth rate of air passenger traffic is expected to continue unchanged throughout the 1970's into the early 1980's. For example, forecasts of the total terminal passengers in the London area, i.e., at Heathrow, Gatwick and Stansted, indicate not less than 50 million terminal passengers at the airports by 1981. What will affect the transportation problem more is the magnitude of the annual increment in the late 1970's where at airports such as Stansted the annual increase in terminal passengers will be of the order of 3 or 4 million.

Therefore, even if the current ground transport situation is under control intensive planning and development must be continually undertaken to deal with the effect of this high growth rate in the future.

[1]Since this paper was written, the British Government has decided to reconsider the proposed siting of the future third London Airport at Stansted. All references to Stansted can be taken as referring to the future third London Airport wherever it is sited.

Paper sponsored by Special Committee on International Cooperative Activities and presented at the 47th Annual Meeting.

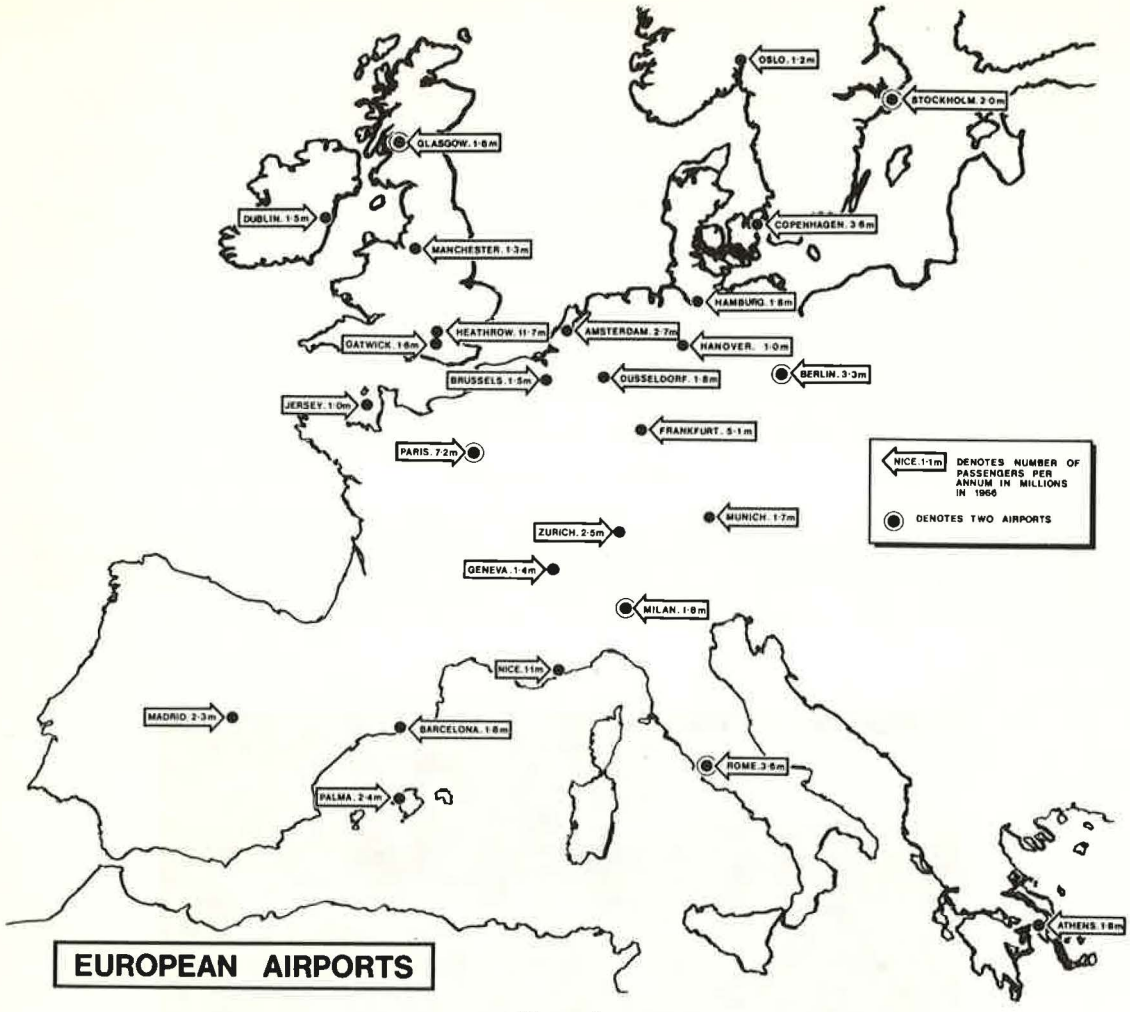

Figure 1.

AIRCRAFT

In the air this growth rate is being sustained not only by increases in the number of aircraft movements but also by increases in the size of aircraft. The aircraft movement rate at some major European airports is now only growing very slowly due to air traffic control limitations and safety requirements. The increase in aircraft size will take a leap forward in 1969-70 with the introduction of the first "Jumbo Jet," the Boeing 747, and it is anticipated that there will be a further jump in the late 1970's to 1,000-seater aircraft. For purposes of comparison the present 707/DC8 aircraft have capacities of about 150 passengers.

The introduction of the Boeing 747 into significant commercial service at European airports in the Spring of 1970 will

Figure 2.

involve considerable capital investment on new installations at airports. Construction work must soon be put in hand if the ground facilities are to be available.

In its maximum configuration, the Boeing 747 will carry 490 passengers and in Europe these passengers would generate some 300 private car or taxi trips to the airport if public transport is not available. Many of these vehicles will require parking facilities, whether on a short or long-term basis, and in addition, fast turnaround times for the aircraft of the order of one hour will involve an overlap of departure and arrival passengers and their associated vehicles.

This 490-seater aircraft will be used primarily for long-haul intercontinental traffic such as the North Atlantic route. The nature of this traffic is such that there are frequently considerable variations in planned schedules and the effect of delayed departure flights and bunching of arrival flights on ground transportation facilities, particularly car parking, will be just as acute as the effect on the operation of terminal buildings.

TYPE OF ACCESS

With few exceptions, all European airports are served only by road accesses of varying capacity. Some exceptions in Europe are London's Gatwick Airport (27 miles from the city center) which makes use of an existing major commuter railway, and Brussels which has a special rail link from the airport to the city center.

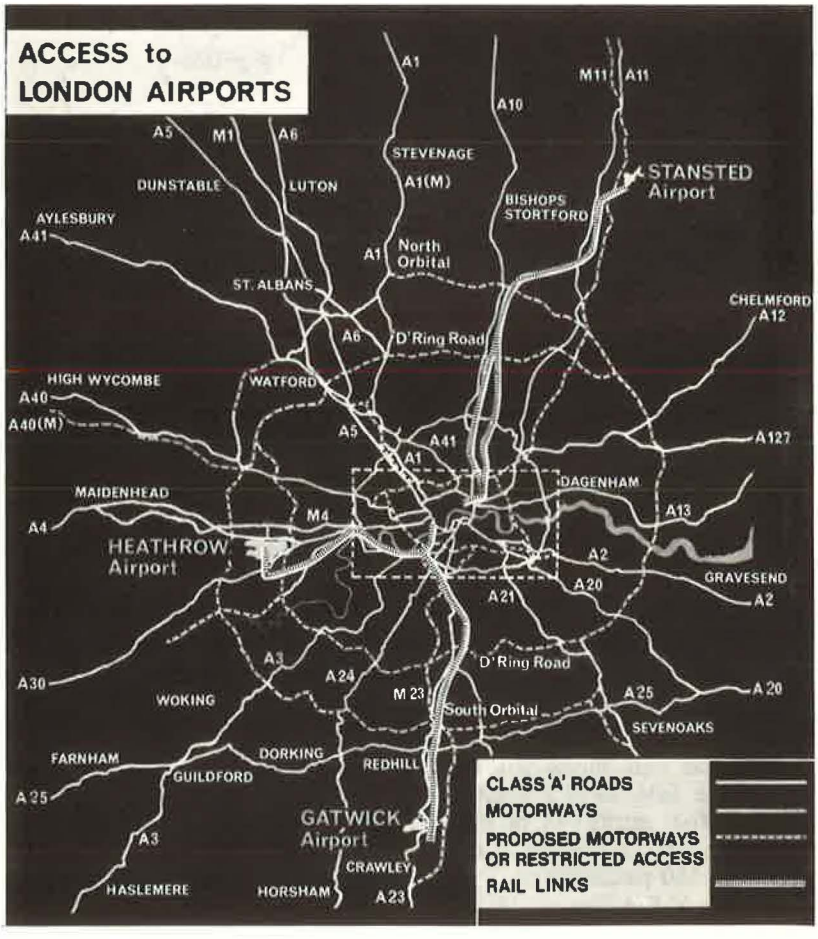

Figure 3.

Existing road accesses are almost invariably overloaded and at the larger airports serious consideration is now being given to the development of a public transport link with the city center.

As far as ground transport is concerned the choice is generally confined to the following alternatives:

1. The existing road system can be improved and new roads provided where necessary to improve this means of access to the airport; or
2. An exclusive public transport link can be constructed between the city center and the airport.

In both cases, economic considerations and cost/benefit studies can be deciding factors although the final decision may well be taken in the light of national policy in relation to urban transportation.

CHARACTERISTICS OF AIR PASSENGER TRAFFIC

The majority of large European airports serve old cities with a defined city center; they usually have a road system of limited capacity. The city centers are usually the location of tourist and business activities which are closely allied to air transportation.

It is not surprising, therefore, that a recent traffic survey (1) for London's Heathrow Airport showed that the city center is the major area of air passenger traffic generation. The results of this survey may be summarized as follows:

1. Of all departing passengers arriving at the airport by ground transport, 40 percent originated in Central London. A further 30 percent originated in the Greater London Area, excluding Central London.
2. The proportion of nonresidents of the United Kingdom using Heathrow is very high. They form 50 percent of all passengers and 80 percent of those passengers originating in Central London.
3. About 50 percent of all passengers used public transport to reach the airport—40 percent by the regular airline coach service from Central London and 10 percent by other means such as charter coach and public bus.
4. Air passengers from Central London made the greatest use of public transport with 70 percent of them using public transport in the peak season.
5. Public transport was used to reach the airport by 63 percent of nonresidents of the United Kingdom.

Similar surveys for Orly Airport, Paris, show even heavier concentrations at the city center. This distribution of passengers' origin and destination may be assumed to apply to most major European airports and is the major factor in considering the development of a transport link between airport and city center.

TOTAL JOURNEY TIME

It is essential when considering the ground transport stage of an air passenger's journey to realize that this is only one of a number of stages which in aggregate give a total journey time. The various stages can be summarized as follows:

1. The passenger's journey from his point of departure to the airport (this may be direct or via a town terminal);
2. The processing and waiting time at the airport prior to departure;
3. The aircraft flight;
4. The processing and waiting time at the airport on arrival; and
5. The journey from airport to destination, possibly via a town terminal.

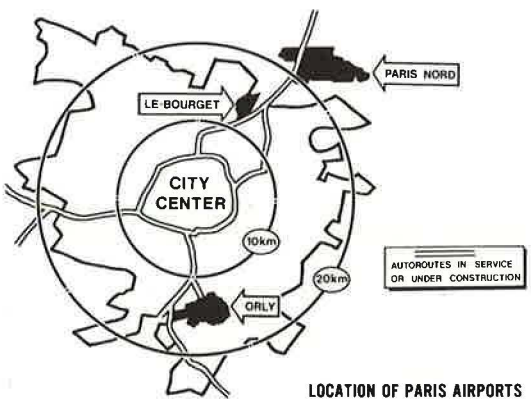

Figure 4.

'The air passenger's prime consideration is the total journey time imposed by these five stages and, even more important, the reliability of this journey time.

There has been considerable improvement in processing times at airports over the last few years and European airport practice is now approaching American practice although it must be borne in mind that the formalities imposed by the Control Authorities, Customs, Immigration and Health, apply to a greater percentage of European trips. Latest times for checking in at European airports for long-haul flights are now in the region of 40 minutes before take-off, whereas they were in the region of 60 to 70 minutes a few years ago.

Improved facilitation by the use of magnetized card passport and immigration information, which can be checked instantaneously by computer, will reduce processing times even further. Computerized techniques are also being developed for baggage handling. The net gain, however, may only be of the order of 10 to 15 minutes or so, which is not a large fraction of the total journey time, but nevertheless, may be considered significant by the passenger.

As far as the ground transportation stage of the journey is concerned, there has been an improvement in roads, but not necessarily journey time, to major European airports over the past few years as investment in major road projects has increased. Car ownership is increasing at different rates in different European countries and the extent of road congestion tends to vary from country to country.

The crucial effect on the passengers' total journey time is that it is becoming increasingly difficult for passengers to estimate the time needed for the ground transport stage of their journey and excessive margins of time are necessary to allow for possible traffic congestion. With the introduction of supersonic aircraft and the consequent significance of the aircraft flight time, a passenger's consideration will be diverted to the remaining stages of the total journey time.

When a passenger has possibly paid the price of speed in the air, he will be extremely critical of the ground transportation times and factors which may lead to any delay.

In a recent study (2) a comparison was made of the proportion of the total journey time which would be spent on the ground for a typical long-haul international journey of about 3,500 miles between a city in Europe and a city in the United States, for a conventional subsonic jet, such as a 707, and a supersonic aircraft. Whereas with the conventional jet the time spent on the ground amounted to 25 percent of the total trip, with the supersonic aircraft about 50 percent of the total journey time would be spent in ground operations. The effect of any unreliability or deterioration in ground transport times would be felt most acutely on supersonic flights and the situation might well be reached where the benefits accruing from a reduced flight time would only be noticeable on the longest of intercontinental flights.

These considerations lead to the conclusion that with growth and increase in speed of air transport a fast reliable public transport link should be available between the airport and the city center, which is the predominant area of air passenger traffic generation.

THE PUBLIC TRANSPORT LINK

Assuming the creation of a fast public transport link, two benefits can immediately be seen to arise:

1. The number of private cars, taxis and coaches using the airport will almost certainly be reduced. This eases the pressure on existing roads and car parking facilities and will undoubtedly facilitate the handling of larger aircraft without major extensions to existing installations.
2. The safety and reliability of the service will assist the development of the new aircraft and remove a significant portion of the uncertainty from passengers' minds concerning the time allowances for the journey between airport and origin or destination.

If the basic requirements of reliability and speed are to be met by any public transport link, it is clear that the current system of coaching between town centers and the

airport on public roads, which is the current European solution, will not meet the needs of the 1970's. It is also doubtful whether a conventional rail link forming part of a suburban service would meet these requirements since it would be deficient in the equally important requirements of comfort and baggage handling. Therefore, if a transport link is to be provided which will meet the stated requirements and encourage passenger usage, it must be located on an exclusive route between the city center and airport.

Having studied the requirements for a public transport link and the benefits which would accrue from the presence of such a link, it is essential to review the factors affecting its viability. They may be summarized as follows:

1. The distribution of land origin and destination of air passengers: a high concentration in the city center as met in European cities is a basic requirement.
2. The proportion of nonresident passengers: these passengers are normally without private cars and must rely on public transport, taxis and hired cars for their journey to or from the airport.
3. The extent of private car ownership and availability for the residents of the country concerned: for example, greater use is made of private cars to travel to or from Heathrow on weekends compared with weekdays due no doubt to the fact that cars are more often available for this purpose on weekends.
4. The number of passengers who would use the link: its profitability depends solely on airport traffic and therefore the airport must be handling a substantial number of passengers per year before a link can be justified. Traffic at Heathrow in the early 1970's will be sufficient to insure the economic viability of such a link.
5. The availability and price of taxis and hired cars and other specialized means of road transport such as self-drive hired cars or limousines: taxis and hired cars are not popular modes of transport between Heathrow and the city center in view of the distance and the high fare relative to the coach fare (at least eight times the coach fare) and only about 9 percent of the passengers use these modes. In Paris, the taxi fare is only about four times the coach fare and some 25 percent of passengers use this mode. Self-drive hired cars and limousines are relatively undeveloped in European countries in comparison with the United States.
6. The previously discussed road traffic congestion on roads serving the airport.

As stated previously, 40 percent of the passengers using Heathrow originate or terminate in Central London and many others pass through Central London on their way to or from the airport. Of all passengers, 50 percent are nonresidents of the United Kingdom. The nature of the traffic is such that a fast direct link with Central London would be very attractive and detailed studies show that it would be profitable. The relief which would be afforded to ground transport facilities at the airport by the mid-1970's would be significant.

For Orly Airport, the dispersal of origin and destination of air passengers is similar to London. However, proportionally, slightly fewer passengers travel between the regions of France and Orly via Central Paris. Most of the passengers from the regions are air passengers changing flights at Orly.

The ownership and use of the private car in Paris has risen steeply in the past few years and it is the policy of the French Government to develop a system of autoroutes for Paris to provide facilities for these vehicles rather than apply a policy of restraint. The outcome of this situation is that the use of private cars for journeys to and from the airport is increasing at a parallel rate to the growth in private car ownership. Orly is at present served by a major radial autoroute and when Paris Nord, which is to be developed as an airport to serve Paris by the mid 1970's, is in operation it will be similarly served.

TYPE OF LINK

A recent study (3) for rapid transit links in the Manchester area indicated that conventional steel on steel or duorail with improved signaling and other techniques provides the best answer to the urban rapid-transit requirement and would also be applicable to an airport link. This study considered four systems which have reached a

stage of development where there is a reasonable prospect that they could be operating by the early 1970's.

1. Alweg Monorail—bottom supported vehicles with rubber tires;
2. Safege Monorail—suspended vehicles with rubber tires;
3. Westinghouse Expressway—lightweight rubber-tired vehicles on concrete running surface; and
4. Duorail—either conventional steel-flanged wheels or rubber-tired wheels on concrete running surface.

It did not consider hovertrain or aerotrain forms of transportation which are now under development both in the United Kingdom and in France. These, with the possible exception of a linear induction motor, need examination to establish their position in relation to duorail.

A detailed study was carried out last year of all possible forms of rapid transit systems to serve Heathrow Airport and, in addition to the four mentioned variants, the possibility of exclusive traffic lanes for coaches was also considered. Each system was studied from the point of view of social cost-benefit and profitability and the report came out firmly in favor of a conventional duorail.

Arising out of this study, it has been agreed that Heathrow is to be served by a conventional duorail link between Victoria and the airport, which will be in operation by 1972. The service will be non-stop between city center and airport providing a 10-minute frequency of service through the day and a journey time of about 23 minutes. It will be capable of handling 3,500 passengers and their bags per hour in each direction and by 1981 will be used by 12 million passengers each year.

At Paris, Orly is at present served by an autoroute which is shortly to be improved to provide exclusive lanes to and from the airport over part of its length. There are similar plans for Paris Nord; in fact, the proposals for this airport assume that only 20 percent of the passengers will use public transport. However, there are plans to develop an express metro service between Orly and Paris Nord via the center of Paris with a limited number of intermediate stops. If road congestion develops to intolerable levels it is therefore possible for the Paris Airport Authority to divert their policy towards public transport.

ROAD TRAFFIC

The emphasis which has so far been placed on public transport links does not imply that the private car is unwelcome at airports. For many journeys from the suburbs and metropolitan regions of large cities, it is the most convenient mode of transport and has the advantage of complete flexibility. The private motorist does, however, suffer from the fact that he cannot establish any priority over other road users and in situations of acute traffic congestion is likely to suffer to a greater extent than the other users to whom delays are not so significant. The dispersal of land origins and destinations and the relatively small volumes of airport traffic compared with urban traffic as a whole means that, apart from the approach roads adjacent to the airport, funds are rarely allocated to road developments on the basis of airport requirements.

In addition the private motorist directly associated with the conveyance of air passengers is obliged to share the immediate approach roads to an airport, and in many instances the roads within the airport with other airport traffic such as staff, servicing traffic and spectators.

At Heathrow some 37,500 vehicle trips are currently made to the airport daily. Only one-third of these vehicles are conveying air passengers, the remaining 25,000 vehicles being associated with staff or other essential airport traffic. The peak-hour inflow is at present 4,700 vehicles per hour and by 1981 this figure will have risen to about 10,000.

Spectators are at present a serious problem at the largest airports in Europe which is some indication of the novelty of international flying. On summer weekends at Heathrow, those that arrive by private car can be a serious problem, occupying road and car parking space to the detriment of air passengers. Apart from adopting a policy of dis-

couragement, it is impossible to segregate the "legitimate" airport users from spectators. This problem will no doubt decrease as flying becomes more universal and this position has now been reached in the United States.

AIR CARGO

The growth of air cargo is usually termed "explosive." In Europe the annual increase over the last few years has average 20 percent per annum. However, the total weight of cargo carried by air is relatively small compared with other forms of transportation and at most European airports ground transportation of air cargo does not yet present a serious problem. In fact, due to the low volume and high value characteristics of the cargo, the road traffic associated with its delivery to or dispatch from the airport, is usually less than that associated with staff working in the air cargo sector of airport activity. At Heathrow, 1,800 employees' vehicles enter the cargo areas each day compared with 600 vehicles delivering or collecting air cargo.

The emphasis on air cargo also varies from airport to airport depending on the policy of the major air carriers.

At Heathrow the volume of cargo handled last year was ¼ M tons although by value Heathrow was the third largest port in Great Britain. By 1970, the throughput is anticipated to have risen to ½ M tons reaching 1 M tons in the mid-70's. The probable ultimate capacity of the cargo handling installations, which are being constructed by the Airport Authority and the airlines, is 2 M tons per annum, with containerization of air cargo becoming a commercial reality.

In the future, therefore, road transportation of cargo is likely to cause some problems at airports when significant volumes are reached in the 1970's, but the road capacity necessary to meet the needs of employees at peak periods should prove adequate for the ground movement of air cargo throughout the day.

Figure 5. Car Park No. 3, Central Terminal area, London Heathrow Airport.

CAR PARKING

As far as parking facilities at airports are concerned, Heathrow is probably ahead of any other airport in the world in the provision of multi-storey car parks to meet the ever increasing demand for parking space. By the spring of 1968, five multi-storey car parks will be in operation at Heathrow, providing 3,500 spaces for public use and 2,000 spaces for the use of airport staff.

This public parking space is located in multi-storey car parks immediately adjacent to each terminal building to reduce walking distances to a minimum. They are primarily intended for vehicles delivering or collecting air passengers and the storage of air passengers' cars for the duration of their stay is mainly carried out off the airport.

Future projections show that there will always be space for vehicles delivering or collecting air passengers but the storage of air passengers' cars will be predominantly carried out off the airport as at present.

Orly has provided sufficient surface parking space to meet the demand to date and is, at present, engaged in the construction of underground car parks outside the passenger terminal to serve primarily short-term needs. Multi-storey car parks are being constructed some distance from the passenger terminal to meet the long-term needs.

At other European airports, parking is normally provided at surface car parks but as expansion continues, multi-storey car parks will not only become necessary due to lack of space for horizontal expansion, but will also be economically justified.

SUMMARY

Only London of the major European cities has sufficient volume of air traffic to justify an exclusive public transport link with the city center. However, the configuration of other cities and the characteristics of the air passenger traffic will mean that when this traffic reaches certain levels, it will be possible for airport and city center to be linked by a fast, reliable mass transit system.

As aircraft speeds increase, the proportion of the air passenger's time spent on the ground will increase. This will focus attention on the need to improve ground facilities.

Future emphasis must be on the integration of an airport into the overall transportation system for a city, of which it forms an important part. Where public transport can play its part in serving the airport, it should be as fully developed as can be economically justified.

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Discussion

V. SETTY PENDAKUR, University of British Columbia—N. J. Payne's paper is important and timely both for Europe and North America. The increasing congestion on urban arterials, combined with increasing air speeds, continues to widen the gap between the efficiencies of ground and air transportation technologies. An increasing portion of the total travel time is now being spent on the ground due to problems in baggage handling, terminal waiting time and other delays. These problems threaten to nullify the advances made in air transportation.

In the United States, a greater number of airports are "tying in" to freeway systems. Average travel times of 40 to 70 mph prevail between major city centers and their airports. In a study of airport access (4), circulation and parking problems, Voorhees pointed out that it was possible in 1965 to get from downtown to most of the outlying airports in 25 to 30 minutes by car. Travel times from the city center to the airports at 20 top air hubs of the United States varied from 20 to 56 minutes (4, p. 74). Most of these airports have been able to tie in to the Interstate Highway System, built with federal funds.

Airport accessibility clearly affects air passenger development. In a study of several midwestern airports, Brown pointed out that decreasing airport accessibility would decrease the rate of growth of air passenger traffic (5). The loss in passengers is a result of the efforts of passengers to avoid the additional costs of inaccessibility by using alternatives to air transportation wherever more attractive.

When air transportation is considered as merely a portion of the overall communication spectrum, its vulnerability is highlighted. Stronger intermodal competition, which is primarily typical for short to medium-haul trips, increases the elasticity of demand for each mode. In the North American context this is particularly important because a large portion of air trips fall into this category: one-third of all U.S. air trips are shorter than 300 miles and one-half of all U.S. air trips are shorter than 500 miles (6). The elasticity of demand for air travel in relation to airport accessibility is much lower for long than short-haul trips. Therefore, ground transportation systems and their efficiency is a very important factor in air passenger traffic development in North America.

Central business districts are the strongest single origin-destination points of air passengers, yet, this passenger flow is not high enough to justify the construction of special rapid-transit links as pointed out by Jordan (7). However, higher passenger volumes and decreasing accessibility could combine to accentuate rapid-transit links. Examples of this are the systems in Cleveland, Ohio, and Tokyo, Japan. Payne's point about public transport links to airports is indeed an element of public transportation policy decision to be made on a systems basis.

Unlike the strong role assumed by the United States Government as a result of the Urban Mass Transportation Act of 1964, the Government of Canada has no policy as yet with regard to ground transportation to airports. It is only recently that the Central Mortgage and Housing Corporation, an agency entrusted with the administration of the National Housing Act, has become interested in studying the possible acquisition of transportation corridors, with the Federal Government participating financially in such acquisition. The pilot studies are being conducted but the policy is not yet clear.

The present involvement of the Government of Canada is limited to ground transportation within airport property only. If any assistance is extended beyond the airport property, the generated ground traffic will have to be the exclusive result of airport activities in order to qualify for assistance. However, the National Capital Commission in Ottawa is now negotiating with the Government of Canada for assistance to construct a freeway between the city center and the Uplands Airport. The publicly announced intention to construct a $1 million dollar two-lane toll bridge across the middle arm of the Fraser River to connect to the Vancouver International Airport is an indication of federal involvement without stated policy (8).

What is urgently needed is an understanding at the policy level that all elements of the transportation system (air, rail, water and ground) are integral parts of the same system and must operate at the highest level of their efficiency and continue to provide proper linkages. Federal involvement indirectly underwriting the costs of airport development to the tune of millions of dollars but totally ignoring the ground transportation link, is leading to decreased efficiency of the total system and undue chaos. As the urban areas grow and the vehicle systems change, it will be necessary to clarify and/or change the policy towards systems integration. Payne's conclusion that "...the configuration of other cities and the characteristics of air passenger traffic will mean that when this traffic reaches certain levels it will be possible for airport and city center to be linked by a fast, reliable mass transit system," is indeed a valid one. Yet the drastic need now is at the policy level where the federal involvement in air trans-

portation must be related to all elements of transportation to form linkages in the total portal-to-portal transportation process. Only through an understanding at the policy level can we accomplish the final conclusion of Payne: "Future emphasis must be on the integration of an airport into an overall transportation system for a city, of which it forms an important part."

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