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Planning Implications of STOL Transportation Systems

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ABSTRACT

Existing short haul modes of transportation are projected to grow at a lesser rate than demand for inter-urban travel, opening a new market for the air transport industry. STOL transportation systems could satisfy this need, but their success depends on improvements in technology and service efficiency that will make them acceptable for use in central business district terminals. The inauguration of this new air transport mode could remove erstwhile constraints of terrain that hinder some regional development.

One of the major objectives of a comprehensive transportation system is to provide effective redundancy. Each mode has its weaknesses which, at times, may preclude its usefulness. Heavy snow may halt bus service, but not affect train schedules. Dense fog may ground aircraft, but not seriously slow bus and train service. A power failure may halt train service, but may not stop air departures. Thus, ideally, there should be sufficient complementarity of transportation services to assure means of completing a trip. Beyond this primary requirement of a total transportation system, it should also offer a traveler enough alternative modes of transportation to and from the inner city to provide him with a satisfactory choice from various time-price relationships.

Every mode of transportation has its terminal speed of delivery, beyond which another mode must be introduced. Yet, although time and convenience are not valued equally by everyone using existing short haul transportation, the various modes subject everyone to what many consider

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an inadequate terminal speed of delivery. The deficiencies of the short haul market are an overemphasis on surface transportation, and an insufficient spread of alternatives of speed, fare structure, convenience, and comfort in the means of traveling to and from inner cities. These deficiencies in choice and flexibility are expected to become more severe in the future.

The total interurban travel market is growing somewhat faster than the GNP, so that, by 1980, about 60% to 70% of the total travel business is expected to be short haul–the stage lengths of up to 500 miles, and especially within distances of 100 to 300 miles.

To meet this growth, existing modes of transportation are taking steps to improve their service. For instance, average highway speed has increased at the rate of one-half mph/year over the last 15 years. The completion of the Interstate Highway System will further improve private automobile transportation. The combined effect on this and other factors, such as improved auto engines and fuels, is expected to reduce trip times by about 10% to 15% by 1980, at the same time that operating costs are expected to decline at a rate of 1% per year per passenger.

The same determining factors hold for bus transportation, with a 10% to 15% improvement in trip time forecast by 1980. However, fare increases are projected by then, so that overall bus traffic, while continuing to rise, will retain a smaller share of the transportation market.

Marginal improvements in rail transportation are foreseen for the future, but no great "breakthroughs" are expected. The projected high speed rail system for the Northeast Corridor has met delays and can't be economically evaluated at present; in any case, its impact is not expected to be serious by 1980. Novel rail and other ground transportation systems, such as the pneumatic tube train, are not expected to be in operation by 1980.

The short haul market represents the only segment of the common carrier market where the airlines have not captured the major share of the business, and it is, therefore, with great interest that the air transport industry is turning its attention to exploring its potential.

In analyzing their inability to compete effectively for the short haul trade, several detrimental factors have been revealed:

1. The failure of conventional take-off and landing (CTOL) aircraft to provide significant airport-to-airport transportation trip-time savings over surface transportation.

2. The substantially higher costs of air travel over those of private automobile, bus, and rail.

3. The profit potential of short haul airline operations is poor because of low utilization of aircraft as a result of traffic peaks, cancellations, and high passenger handling costs per mile of trip length.

4. Increasingly high rate of airway traffic delays, taxiing time, and air maneuver time caused by unfavorable approach and departure patterns, all of which add up to a higher percentage of total trip-time on short hauls.

5. The many interchanges of vehicles which must be made in a short time, in order for a traveler to complete inner city to inner city journeys. While CTOL airports are being located further and further out from city centers, interurban auto travel is being improved. The rush hour bus schedules from Kennedy Airport to the East Side Air Terminal are based on 90-minute travel time. Thus, ground time can easily double total trip time on short hauls.

It is feared by some in the air industry that if present trends continue, a percentage of the public now using air transportation will be lost to the private automobile. This, plus the expectation that the short haul market will increase substantially, has led to a search for a mode of air transportation which will compete effectively with other systems. At present, 20% of auto miles are generated on trips of 100 miles and over. If a significant percentage of this traffic, say about 15%, could be attracted to short haul air travel, it is estimated that its total domestic revenue passenger miles would be increased 106%. In order to do so, it would not be necessary to reduce the fares of air transportation to a level similar to those of competing systems, but rather that its fare structure be established at a level which would enable it to seize a share of the market because of the unique service and convenience offered.

To capture what it considers its fair share of the short haul market, the air transport industry will have to orient its operations in order to satisfy the following goals:

1. It should establish air terminal locations with far closer proximity to city centers than present airports, thus eliminating intermediate modes of transport which are now necessary to complete a journey.

2. It should design the layout and mode of operation of these new airports in order to achieve rapid passenger and cargo processing; this will not only keep aircraft utilization up, but will avoid an excessive accumulation of aircraft during peak periods.

3. It should make time savings over ground transportation and over CTOL-ground transportation combinations sufficiently large to convince passengers to pay the fare differentials which will be required by an advanced air transportation system.

4. It should meet these aircraft design requirements:

a. aircraft sizes: 50, 90, 120 passengers

b. design range: 500 statute miles at maximum continuous power and optimum cruise altitudes, with IFR (Instrument Flight Rules) reserves for 100 mile diversion and 45-minute hold at optimum holding speed

c. stage lengths: 50, 100, 250, 500 statute miles
d. terminal performance: landing critical distance: 1,350 feet over a 50 foot obstacle at sea level, and 100 foot based on one engine out and reverse thrust on two propellers
e. cruising speed: 300 knots, assuming cruising speed at 75% of maximum continuous rated power
f. contingency power rating: 110% of take-off rating for 2.5 minutes
g. passenger and carryon baggage (at 190 lb total): 90% of total
h. cargo: 10% of payload
i. landing weight: 95% of take-off weight
j. climb distance plus descent distance: not greater than 50% of the stage length, so that the Air Transport Association (ATA) formula for direct operation costs applies
k. crew of three: pilot, copilot, stewardess.

Of the various new aircraft types which have been proposed and designed to satisfy most of these requirements, STOL (short take-off and landing) aircraft have attracted a great deal of interest in the air transport industry. These are craft which have a descent capability of 800 feet per minute, on a 6 degree flight path angle, and require landing strips 600 to 1,350 feet in length. Because of the STOL craft's low speed and relatively steep approach, and its ability to actually reverse direction in case of overshooting, serious accidents upon take-off and landing are expected to be rare. The STOL craft may reduce its power, or not use it at all, during the landing approach; on take-off it needs a large powerhouse to accelerate rapidly and climb steeply. Hence, the payload to gross weight ratio is less for STOL than it is for CTOL aircraft. If STOL terminals will be located appreciably closer to inner cities than existing airports, noise generated by STOL craft must be considered a serious problem. This problem will be aggravated by the fact that faster aircraft tend to be noisier, because to maintain economy they have to be more compact, which generally means more highly loaded lifting units absorbing more energy. This is one of the areas in which research has been most active, and progress is expected to be made in the future.

It is believed by its proponents in the air industry that a STOL transportation system may capture some of the traffic from other modes, and may induce additional new traffic, which otherwise lacks sufficient motivation to travel. The argument for STOL aircraft rests on the assumption that its cruising speed will be comparable to CTOL aircraft, but that because of its steep rate of descent, and the short runways it requires, it has a landing capability near the center of a city, thus, permitting substantial gains to be made in total transportation times. For instance, present Central Business District (CBD) to CBD time, Boston to New York City, is 1 hr 40 minutes. With Stolports close to their respective CBD's, the flight time still remains 40 minutes, but the one hr spent on total ground time will be eliminated. Various benefits are expected from such convenient access to Stolports. One of these will be diminished reliance on taxis, buses, subways, and trains, and the ancillary facilities, such as highways, multiple terminals, and parking fields which are now often necessary to link outlying airports to CBD's. This, in turn, is expected to reduce substantially ground transportation charges, tips, and multiple baggage handling, which passengers find especially objectionable on short trips. Thus, whether STOL service becomes an accepted and profitable development hinges on the crucial question as to whether Stolports can be located in adequate proximity to the center of cities.

The lower block times to be achieved by STOL craft will allow the scheduling of more flights in a working day, and therefore, STOL transportation will approach more closely the "continuous system" which is the ideal of every traveler. It is hoped this will prove an added inducement which will foster an interurban taxi environment. Thus, STOL service will not only tap a potential market, but will also aim to develop a new one. On the other hand, should STOL service become an important new mode of passenger transportation, its superior speed of delivery will ultimately tend to cause changes and adjustments in the equipment and facilities, traffic servicing standards, and flight operations of existing CTOL transportation.

In addition to increased flight scheduling, the certainty of flight completion through expected all-weather capability is expected to be another benefit to the passenger. The low speed control characteristics of STOL will permit departures and arrivals in many weather minimums and conditions which halt CTOL operations, and will reduce the number of flight cancellations and delays due to weather, and also will remove the inconvenience resulting sometimes from landing at an alternate airport destination.

To achieve such schedule reliability, STOL service will have to have instrument flight capability superior to existing STOL and CTOL systems. Present instrument approaches by CTOL aircraft into airports serving most large cities require long, time consuming approach paths. Even under visual conditions, it sometimes takes as much as 15 minutes for an approach, due to rerouting for other traffic. Under instrument conditions, stacking consumes even more time. Delayed arrival times of up to 45 minutes are not unusual at Kennedy Airport. If STOL traffic had to be mixed with CTOL traffic, much of its timesaving advantage would be lost even under VFR (Visual Flight Rules) conditions. Additional reasons for improved instrument flight capabilities are that time-consuming approaches consume more fuel, thereby decreasing even further STOL's payload ratio; also, landing speed depends not only on stalling speed, but also on control characteristics of the aricraft. STOL traffic has to slow down to below airplane cruising speed, to about 40-50 knots, then it has to maneuver itself into an approach into the wind. This raises the problem of handling capability to control the craft precisely along an intended flight path, for there is increased wandering with slower speeds, which increases the workload on the pilot, and demands power corrections and greater fuel consumptions. Present approach patterns call for jet-type STOL craft to spend five minutes at low speeds, requiring operation for this length of time at 85% to 95% of hovering thrust at a commercially unacceptable high rate of fuel consumption.

All of these factors suggest independent and probably automatic glidepath control procedures, and the need to keep approach pattern time at a minimum. Air Ground Control (AGC) will eliminate aircraft pattern holds, will reduce ground taxiing time, and should result in superior block times as compared to CTOL, especially on shorter route distances. Furthermore, the introduction of a separate AGC system for STOL craft, where they will be using existing CTOL airports, will free their long runways from clogging by aircraft requiring only a small portion of the runway, thus, increasing the capacity of existing airports like Kennedy and O'Hare to service CTOL craft.

The small space required for a Stolport (a separate Stolport needs some 20-30 acres of land, depending on the number of gates, compared to the 4,000 acres required by an all-weather jetport for New York City) allows siting at the most convenient point wherever traffic volume justifies the realtive modest investment for land. For STOL service to capitalize on its capability to penetrate close to the CBD, it must locate its terminals in high-volume passenger traffic areas, those most likely to have primarily the highest job density and the highest residential density of managers, proprietors, and executive officers.

The majority of the potential passenger market for STOL service will probably be the high income employment level, people who especially must commute to CBD's. At present, business travelers comprise three-quarters of all helicopter passengers; two-thirds of all the passengers using connecting planes; and four-fifths of all passengers making air to ground connections. Fifty per cent of the persons living outside the New York area who are employed in the CBD are classified as executives or professionals. Time and convenience, in both commuter and regular business travel, are held in high value by these groups, and it would seem that a substantial percentage of them would be willing to pay a premium price for saving time, for the convenience of close proximity to the CBD, for reliability of schedules, and for frequency of journeys.

In order to tap the short haul market, provide a necessary service and fill a gap in the total transportation industry, a number of proposals for STOL service to the New York CBD have been made.

One of these has been put forth by Oscar Bakke, former director of the Eastern Region for the Federal Aviation Administration (FAA). He proposes Stolports at the periphery of Manhattan Island, at first on unused waterfront pier locations, and also possibly in East River Park and in Central Park. If the Stolport structure was elevated and situated over piers serving the major transatlantic surface carriers, he suggests, new opportunities of service to the maritime industry would be provided. The proposal for using the periphery of Manhattan would appear sound in principle, but a Stolport in Central Park would seem politically out of the question, while location at the East River Park would have the added, and possibly unacceptable, risk of descent and ascent paths between the various bridges. A site along the Hudson River shore seems more feasible, but not necessarily connected to maritime transportation, since the passenger market each of these groups is aiming for does not coincide.

Another proposal has been made by Rutgers–The State University and the Eagleton Institute. They have developed a floating airport, which they call the "Rutgers Aquadrome" that is cylindrical in form, with a circular landing surface and passenger processing and other operations below. Such a field has the advantage of omnidirectional landing and launching capability, permitting continuous operations under any wind conditions. Other advantages of these Aquadromes are that they can be floated to any wateredge location which may be desired, giving them great flexibility of service; they would be relatively inexpensive to build, especially if they were mass-produced; and, of course, they obviate land purchase. The Rutgers study proposes a first site near the tip of Manhattan Island.

My own suggestion would be to locate a Stolport at the western terminus of 48th Street. This terminal would be tied to the proposed new midtown distribution system, which will link 57th, 42nd, and 33rd Streets. Thus, it would be convenient to all the midtown commuter terminals, both rail and bus, as well as interconnect to all of the line-haul subways, including the future Second Avenue subway. Such a Stolport location would meet the service demand of the rapidly developing west side office area around Times Square, and also at Lincoln Center, and would regenerate more intensive land use of the "soft" underdeveloped area from Eighth Avenue to the Hudson River and from 42nd to 57th Streets.

Location at 48th Street would appear a better location than one which has been proposed for the 55th to 68th Street area. For one thing, it would be even closer to the highest density of commerical activity, and would be accessible to an area extending from river to river, rather than tapping a passenger market which is divided by Central Park.

Another possible site would be alongside the World Trade Center, with the Stolport tied to the Hudson Terminal of the Port Authority Trans-Hudson Corporation (PATH) system and the west side subways. If some kind of a distribution system were also established for this downtown area, and linked to the Stolport, it would serve the many government and business executives working in the Wall Street-City Hall area.

On a short-term view, with the environment assumed to be fixed, STOL service lends itself to a two-range, or even a three-range system, of stages 50 miles and less, of 200 miles, and of 500 miles. The interlocking and overlapping of these three route distances would effectively blanket the three "megalopolitan" regions of the United States.

For the New York Metropolitan Region, Rutgers has designated eleven cities for development as regional transportation centers, terming them second in importance to Manhattan. These include New Brunswick, Linden-Rahway-Newark, and Paterson in New Jersey; Hempstead, Farmingdale, Mount Vernon, and White Plains, in New York; and Stamford, Bridgeport, and New Haven, in Connecticut. This could be considered a model of a STOL system at the commuter distance, with STOL craft probably making multiple "local" stops on a given route.

A longer range system could be created by establishing Stolports in the central cities of what the Regional Plan Association calls the "Commutersheds of the Atlantic Urban Region": New York-Hudson-Newark, Philadelphia-Camden, Boston-Cambridge, Washington, D.C., Baltimore, Providence, Hartford; a finer network could include Worcester, New Haven, Springfield, Albany, Bridgeport, Harrisburg, Wilmington, Allentown, Trenton, Reading, Lancaster, Wilkes-Barre, and York.

These cities could be serviced by both "express" and "local" flights. Of course, making a passenger fly through stops other than his own would take more time than an express flight, but this would have to be compared to the fact that any STOL "local" service that a passenger chose would probably have a time advantage over similar routes by CTOL craft. Assuming an AGC system, and ground operations geared to reduce ground time to a minimum, STOL craft would be in a flight configuration most of the trip-time. Therefore, the total trip would be only marginally increased by multiple stops. However, this time varies considerably for CTOL craft, since these are subject to considerably longer approach paths and ground times. The more the number of stops, of course, the greater the difference between STOL and CTOL trip times.

Assuming a long term view, with the environment open to alternative development possibilities, STOL service could play a key part in fostering growth in desired locations and regions, and in opening up areas hitherto physically inaccessible or uneconomic in transportation costs. The low investment required for terminal facilities and land also makes it an attractive instrument for meeting changing travel demands caused by economic or population shifts.

Finally, as with most technological innovations, STOL aircraft would not only serve an existing and growing need, but would open up possibilities for as yet unforeseen activities.