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A PROGRAM DEFINITION STUDY FOR THE IMPROVEMENT OF SHORT-HAUL AIR TRANSPORTATION

Volume I - Recommended Program Plan

Battelle-Columbus
505 King Avenue
Columbus, Ohio 43201

January 1973

FINAL REPORT

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Prepared For

FEDERAL AVIATION ADMINISTRATION
Quiet Short-Haul Air Transportation Systems Office
Washington, D.C. 20591

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ERRATA SHEET

RESULTS OF NOISE SURVEYS
OF
SEVENTEEN GENERAL AVIATION TYPE AIRCRAFT

Damon C. Gray
Hydrospace-Challenger, Inc.
2150 Fields Road
Rockville, Maryland 20850

December 1972

Insert the attached page A22-S1 between pages A22 and A23

June 29, 1973
ATTACHMENT

ERRATA SHEET

Report No. FAA-EQ-73-1

Page A22 - Delete runs 7111, 7112 and 7212.

The reduced data for the above runs showed the noise levels at Measurement Station 1 for the 1000' flyovers at approximately the same level as the 500' flyover for the North American 112 aircraft. As the source of this discrepancy could not be located, a series of flyovers at 500' and 1000' at maximum continuous power were made to determine the noise levels of the NA 112. Noise measurements for these flyovers, conducted at Albany, Georgia, on June 12, 1973, and witnessed by FAA personnel were as follows:

Run #	Altitude (AGL)	Noise Level (dB(A))
1	1000'	74.8
2	1000'	73.3
3	1000'	73.3
4	1000'	73.6
5	1000'	75.2
6	1000'	73.1
7	1000'	74.5
8	500'	--
9	500'	80.5
10	500'	80.3
11	500'	79.5
12	500'	79.9
13	500'	81.0

Average for 1000' flyovers = 74.0 dB(A) with a 90% confidence level within 0.6 dB. Average for 500' flyovers = 80.2 dB(A) with a 90% confidence level within 0.6 dB.

Test conditions: Wind/velocity - 230/7
Temperature - 79° F.
Relative humidity - 74%

Aircraft: NA 112; N112AR

Equipment: B&K 2203 sound level meter
Nagra IV-D tape recorder

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FAA-QS-73-1, I		

4. Title and Subtitle	5. Report Date
A PROGRAM DEFINITION STUDY FOR THE IMPROVEMENT OF SHORT-HAUL AIR TRANSPORTATION Volume I - Recommended Program Plan	JANUARY 1973
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
9. Performing Organization Name and Address Battelle-Columbus 505 King Avenue Columbus, Ohio 43201	10. Work Unit No.
	11. Contract or Grant No. DOT FA72WA-2820
12. Sponsoring Agency Name and Address FEDERAL AVIATION ADMINISTRATION Quiet Short-Haul Air Transportation Systems Office Washington, D. C. 20591	13. Type of Report and Period Covered FINAL REPORT
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This document, Volume I, presents a recommended program plan for Federal-initiative in the Government's continued pursuit of an improved short-haul air transportation system. The plan, put forth in the style of a Federal-Government plan, was developed in response to the broad program requirements set forth in the contract statement of work and, more specifically, was based on the system development needs, opportunities, and constraints identified in the course of performing the study. It provides the responsible Government departments and agencies with a resource they can use in the formulation and adoption of an official plan for short-haul air transportation development.

The companion to this document, Volume II, contains a set of six working papers developed during the course of the contract. These papers, covering a multitude of subjects, contain the results of work undertaken both for the purpose of planning, defining, and extending the understanding of the short-haul air transportation development problem.

17. Key Words	18. Distribution Statement
Short-Haul Air Transportation Systems Planning Systems Analysis	Availability is unlimited. Document may be released to the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151, for sale to the public.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	153	

Form DOT F 1700.7 (8-69)

PREFACE

This document is the first of two volumes dealing with, "A Program Definition Study for the Improvement of Short-Haul Air Transportation", a study conducted for the Federal Aviation Administration by Battelle's Columbus Laboratories under contract number DOT FA72WA-2820. The research was performed at Battelle-Columbus under the direction of the Aeronautical Systems Program Office, a component of the Transportation, Aeronautics, and Space Systems Section.

This document, Volume I, presents a recommended program plan for Federal-initiative in the Government's continued pursuit of an improved short-haul air transportation system. The plan, put forth in the style of a Federal-Government plan, was developed in response to the broad program requirements set forth in the contract statement of work and, more specifically, was based on the system development needs, opportunities, and constraints identified in the course of performing the study. It provides the responsible Government departments and agencies with a resource they can use in the formulation and adoption of an official plan for short-haul air transportation development.

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1.0 INTRODUCTION

The problems of congestion, noise, and deteriorating service in the air transportation system have been increasingly apparent in recent years. Two recent major study efforts, the Civil Aviation Research and Development Policy study and the Northeast Corridor study, have both identified segregated short haul as a major possibility for reducing these problems. This document presents a plan which defines a formalized program for Federal initiative in fostering this type of air transportation development.

The difficulties to be overcome are several. First, there are uncertainties in what the technology can produce, what the market response will be, and when a new system will be critically needed. Second, there are institutional difficulties inherent in the diffused nature of air transportation decision making. The plan treats the uncertainty problem by proceeding along several paths, and keeping the maximum number of options open. It contains mechanisms for studying the institutional factors, and for involving the various non-Federal participants in the program.

The plan contains three major thrusts: (1) furthering the technology for short-haul vehicles; (2) gathering data and carrying out analyses to provide a basis for major decisions about short-haul air transportation systems for the 1980's; and (3) encouraging introduction and growth of segregated short haul within the existing system.

In all aspects, the plan recognizes the multiparticipant nature of air transportation, and the limitations of the Federal role in it. Non-Federal action is necessary in order to implement new short-haul services. The problem of motivating and encouraging such action is given strong consideration.

2.0 BACKGROUND

2.1 Short-Haul's Role and Problems

Use of the nation's domestic air transportation system continues in the majority for short-haul purposes. More than half of all domestic air passenger trips are short-haul--trip lengths of less than 500 miles. Approximately 47 percent of the one-way domestic passenger trips serviced by trunk and local service airlines fall in this category[(1)*] as shown in Figure 2.1. Essentially all of the passenger trips provided by commuter and intrastate airlines are short haul. This short-haul market orientation is not unique to aviation, or even to transportation. Similar characteristics, for example, are to be found in the communications field: telephone calls, 81 percent; first-class mail, 70 percent; telegrams, 52 percent.[(2)]

While some 14,600 city pairs in the United States form the base of the short-haul air transportation market, the service in these markets is by no means evenly distributed. The top ten city-pair markets, involving some twelve cities, account for over one-fourth of all short-haul traffic.[(3)] The nation's 22 major hub airports are the focus for much of the concentrated short-haul activity. These hubs form a common point for the local traffic between the hub and outlying cities. The hubs also serve as important transfer points between short-haul and long-haul operations, providing mutual access. Figure 2.2 illustrates these hubs and their principal short-haul networks related to them.

In recent years there has been a steady erosion in the quality and economic viability of short-haul air transportation. The portal-to-portal trip time for short-haul travelers has steadily increased. In some instances, it is no better than it was 25 years ago when DC-3 aircraft made up the majority of the airline-aircraft inventory. Air carriers have consistently had greater difficulty with profitability in short-haul

*Numbers in parentheses are References.

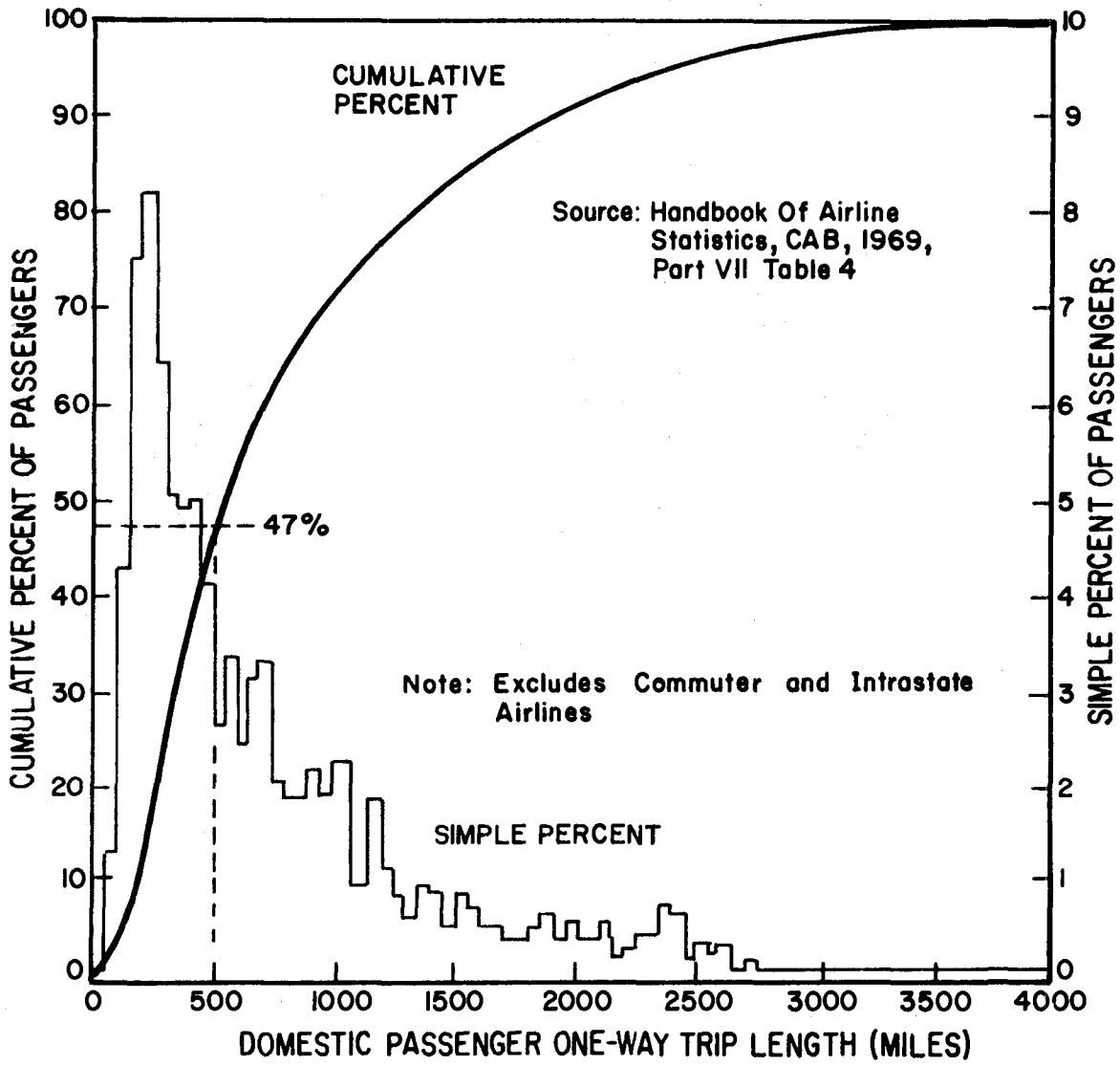


FIGURE 2.1 - DISTRIBUTION OF PASSENGER ONE-WAY DOMESTIC TRIPS ON TRUNK AND LOCAL SERVICE AIRLINES

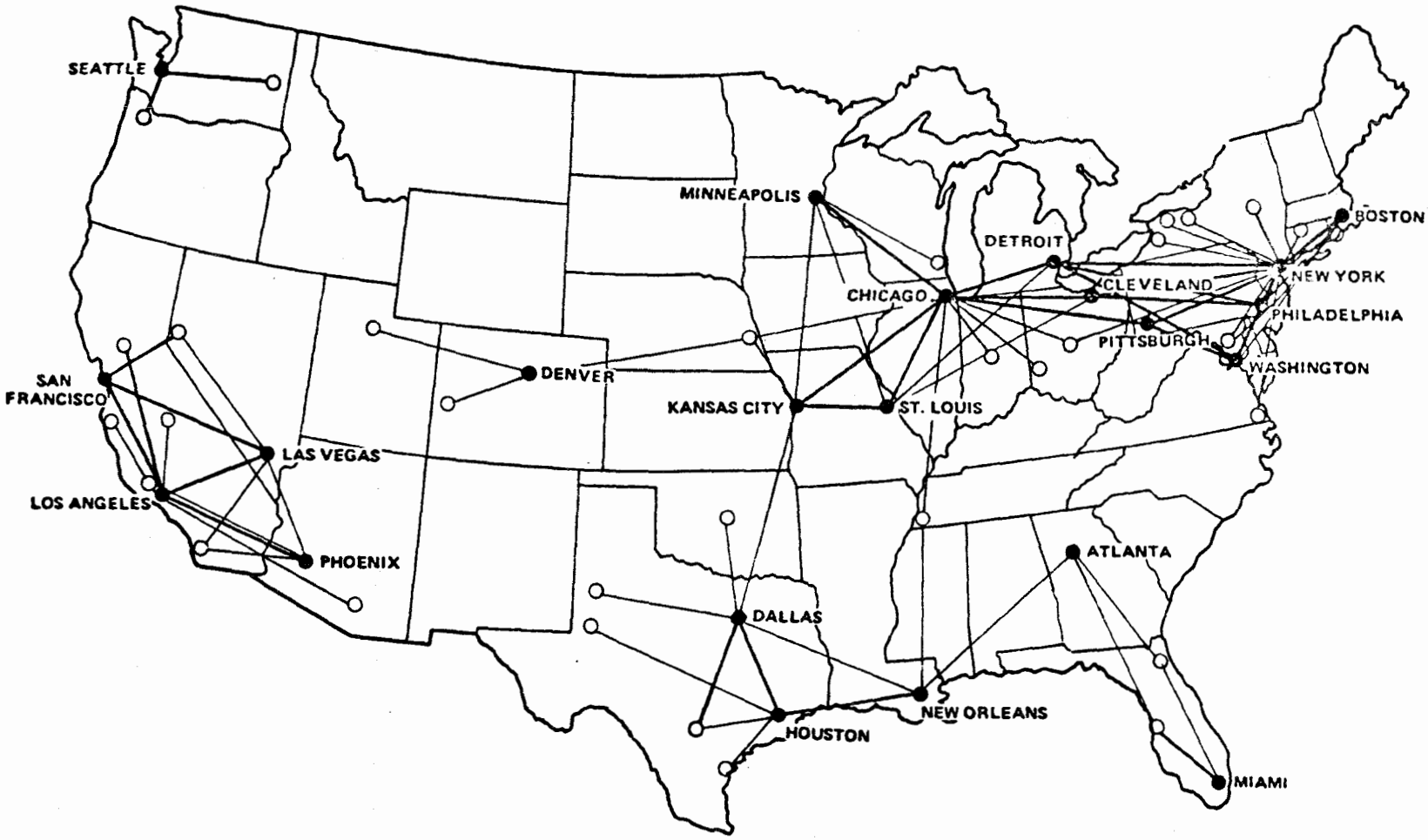


FIGURE 2.2 PRINCIPAL SHORT-HAUL NETWORKS AT THE 22 MAJOR HUB AIRPORTS

markets, particularly the trunk and local service carriers whose fares are regulated. To a large extent, these problems are closely related to the rapid growth in air transportation and the problems that have developed because of it.

During the past 20 years, aviation has seen an eightfold increase in the number of scheduled passenger enplanements, and a threefold increase in the number of scheduled aircraft operations. This growth has been accommodated by a network of scheduled service airports which has remained nearly constant in number--at about 650--during this period. The resulting increases in airport activity, particularly in the nation's major metropolitan areas, have brought aviation into direct conflict with the increasing concern for land use and the environment.

These factors underlie the citation of noise and congestion as air transportation's most serious problems. Such were the findings of the joint DOT-NASA Civil Aviation Research and Development (CARD) Policy Study.[4] Several earlier investigations also served to highlight these problems.[5-10]

The costs of congestion have been shown to be enormous to carriers, users, and the public alike. In 1969 alone, congestion resulted in $158 million in additional airline operating costs, a loss of 22-million passenger hours valued at $90 million, and the dumping of an additional 22-million pounds of pollutants into the atmosphere. Further, it was necessary to restrict the operations at five major hub airports.

The evolving public reaction to noise has had its impact on air transportation. The ambient noise level in large urban areas has increased by about 10 decibels (dB) per decade for the past 30 years and is expected to continue at this rate unless action is taken. The noise levels in the airport environs have motivated public reactions which have halted airport developments, threatened airport curfews, and generated an increasing number of lawsuits.[11]

Short-haul air transportation is both a principal contributor to and victim of noise and congestion. Noise and congestion are closely coupled to aircraft operations. While about half of all domestic passenger

trips are short haul, a significantly higher proportion of aircraft operations are connected with stage lengths less than 500 miles. At the nation's 22 largest hub airports, on a typical weekday, short-haul aircraft arrivals account for 70 percent of the scheduled traffic, on the average. This fraction varies from 38 to 89 percent in the extremes[12] as illustrated in Figure 2.3. At the same time, short-haul travelers suffer disproportionately from the effects of congestion. Congestion (both en route and on the ground) brings about delays which are basically independent of the length of the flight.

2.2 Planned System Improvements

In response to growing aviation problems, plans have been developed and are being implemented for the purpose of relieving the problems of noise and congestion. Generally, these plans cover system-wide improvements which do not distinguish between short- and long-haul air transportation.

Bolstered by the Airport and Airways Development Act of 1970, the Federal Aviation Administration has undertaken an airport-airways capacity program aimed at providing important relief to a major part of the air space and airport-airside congestion problems.[13] The plans call for changes in air space allocation and rules, and equipment improvements. In this second category, plans call for completion of the NAS En-Route Stage A improvements by 1974, completion of the ARTS III Terminal System by 1973, continual upgrading of en route navigation aids, definition and implementation of an area navigation system toward the end of the decade, and development of a microwave landing system with initial installation planned for 1979.

In concert with the FAA, a number of the large metropolitan areas have made use of ADAP funds to expand and/or modify airports to improve airport-airside capacity. Others are expected to follow. Typical improvements include the lengthening of runways, the development of new parallel and/or dual-lane runways, the construction of high-speed turnoffs, and the addition of new taxiways, holding areas, and aprons.

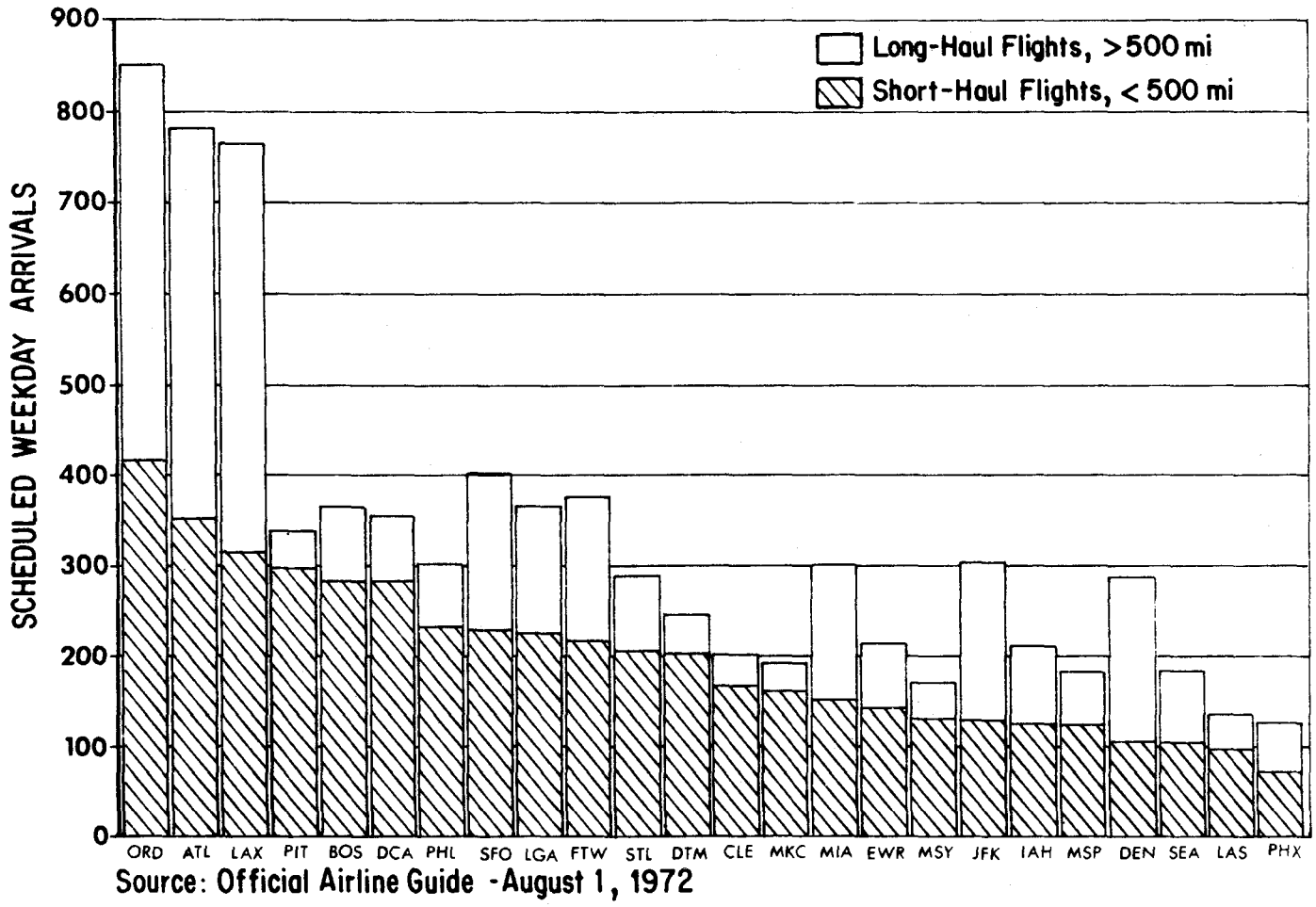


FIGURE 2.3 SCHEDULED DOMESTIC SHORT-HAUL AND LONG-HAUL WEEKDAY ARRIVALS AT 22 MAJOR HUB AIRPORTS

Congestion in terminals is being attacked jointly by airlines and airport operators by developing new, or modifying and extending existing facilities. Parking and access road improvements are also being made at several airports.

In the area of noise reduction, the FAA issued Part 36 of the Federal Aviation Regulations in November, 1969. It requires of newer generation aircraft the maximum noise reduction that technology will permit within what are assumed to be reasonable economic constraints. In cooperation with NASA, FAA is investigating retrofit programs for the remainder of the fleet and has, together with airlines, instituted new operational procedures aimed at bringing further noise relief.

The existing plans for the improvement of air space and airport capacity will provide a degree of relief to the current and projected congestion problems at major hubs. However, it is uncertain whether these measures will be adequate to satisfy both community impact constraints and, at the same time, provide for the necessary growth of air transportation. Most significant descriptors of air transportation activity are forecast to double by 1980.[13-15] Even the more conservative forecasts indicate the saturation of a number of additional airports prior to 1980. The problem is further complicated by the lack of development of efficient urban access/egress systems in most cities, and the attendant ground congestion which has developed. The notable exceptions are the few cities in which improved urban access/egress was provided to airports as part of an overall urban mass-transit system.

Additional measures for dealing with congestion and noise have been suggested. These include such actions as off-peak-hour scheduling, greater use of wide-bodied aircraft, exclusion of nonscheduled flights, diversion of short-haul traffic from long-haul facilities and retrofit of the existing air carrier fleet with quieter engines. All warrant examination and can, for the most part, be examined as a part of current ongoing programs.

2.3 Emergence of the Short-Haul Program

The present Federal emphasis on short-haul air transportation has its roots in activities which began in the early 1950's. Research and development work on a variety of aircraft concepts featuring steep approach and departure characteristics, and minimal requirements for take-off and landing area has continued for nearly two decades. The early work in this area was undertaken by the DOD and NASA, motivated primarily by possible military applications. The interest in civil applications of such vehicles began growing in the early 1960's. The period beginning about 1964 was marked by a number of studies, investigations, demonstrations, and other activities pertaining to such applications. Some of the more noteworthy are shown in Figure 2.4.

During the late 1960's, when congestion and delay problems were developing to crisis proportions, serious interest was shown by many segments of the aviation community in the prospect of developing a short-haul STOL system. It was believed that such a system, operating largely separate from conventional long-haul facilities, could substantially improve short-haul service and profitability, and relieve the noise and congestion problems at major airports. However, such a system did not materialize because of the impasse which developed among the many parties involved. Figure 2.5 illustrates several of the actors involved and their interdependency. The symptoms of this impasse were described by the Civil Aeronautics Board as follows:[16]

> "A chief obstacle to progress toward metroflight has been the cycle of inaction that has affected the participants in its development; local authorities lack incentive to develop landing sites in the absence of some assurance that appropriate VTOL/STOL aircraft will be available to use them, manufacturers are reluctant to begin active production until they have sufficient orders, and carriers are unwilling to order equipment unless they can look forward to suitable landing sites."

The short-haul air transportation program, as it now exists, emerged from these historical developments in response to the Federal

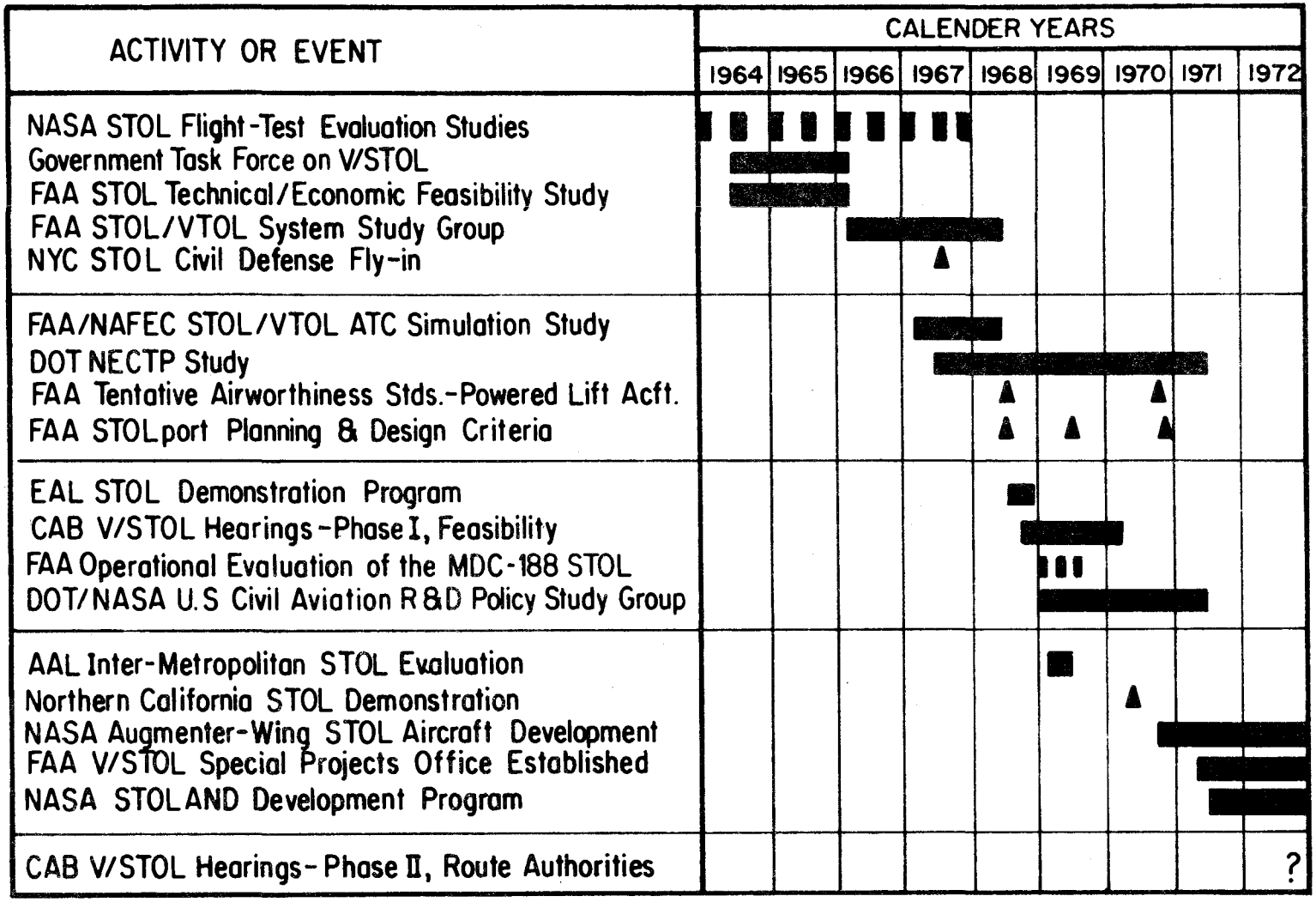


FIGURE 2.4-SHORT-HAUL RELATED ACTIVITIES: 1964-1972

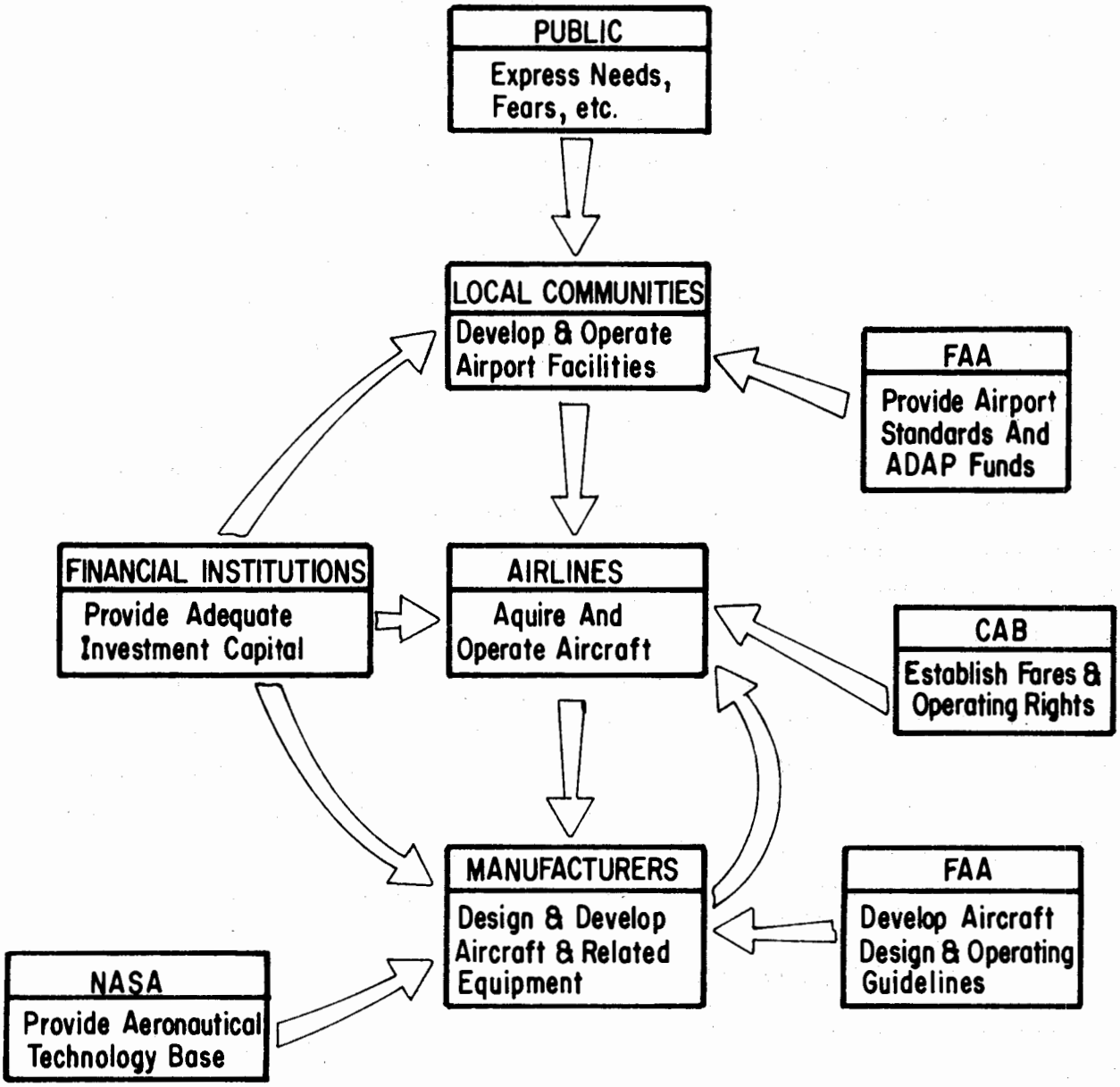


FIGURE 2.5- TYPICAL INTERDEPENDENCIES INVOLVED IN SHORT-HAUL DEVELOPMENT AND OPERATION

government's recognition that concerted Federal initiative is required if the impasse described above is to be overcome. Specifically, actions by the CAB, NASA, and FAA are the foundation for the program. The CAB, following its Phase I Northeast Corridor VTOL investigation,[16] has continued with its exploration of present short-haul operations, possible new regulatory approaches to service authorization, and discussions with metropolitan areas concerning their needs and plans in this area. The NASA has planned and implemented important technology development programs supportive of short-haul development. The FAA established a V/STOL Special Projects Office (subsequently redesignated as the Quiet Short-Haul Air Transportation Systems Office) in early 1971. This action provided for a mission-oriented group to foster the evolutionary development of an improved short-haul aviation subsystem. It was charged with the responsibility for providing internal coordination within FAA, developing improved interagency cooperation, and establishing appropriate cooperation with local authorities and industry.

The Short-Haul Air Transportation Program is focused primarily on the benefits that might be realized from improvements predicated on the notion of segregating short-haul operations from long-haul facilities. The viability of this approach was underlined in two major investigations. A major conclusion of the CARD Policy Study[4] was...

> "A new short-haul system, separate as much as possible from the present long-haul system, could help relieve congestion at existing airports, especially those in areas of high traffic density."

The results of the Northeast Corridor Transportation Program[5] indicated that...

> "...precluding the expansion of overall CTOL capacity, diversion of short-haul demand from conventional air service is the best way to benefit both the diverted short-haul passengers and the remaining CTOL travelers making longer trips".

3.0 THE PLANNING PROBLEM

Through its short-haul air transportation program, the Federal government has committed itself to fostering the development of short-haul air transportation systems which can improve the quality and economics of short-haul service and, at the same time, relieve the noise and congestion problems constraining all segments of air transportation. The program emphasis is on those alternatives involving the segregation of short-haul from long-haul operations and facilities.

As before, numerous activities are currently under way in support of this commitment. These include technology development programs, studies and analyses, and selective developments. However, the immediate requirement is for a definition of how to proceed from this point so as to maximize the chances for the program's success. The need exists for a plan of action which meets this requirement and a mechanism for revising it as required.

A necessary prerequisite to formulation of a rational plan is to identify the problems and issues involved. These are rooted in the vehicle-airport alternatives and the related technical, social, economic, and institutional issues associated with their possible implementation.

3.1 Segregated Short-Haul Concepts

The alternative vehicle-airport means by which segregated forms of short-haul operation might be achieved are several. They can be viewed as having evolved from aircraft-oriented state-of-the-art improvements.

3.1.1 Aircraft Concepts

Past research and development activities have either led to the production of or identified several potential vehicle configurations of potential usefulness in short-haul applications. Compared to conventional

transports, all have the common distinction of having lower minimum operating speeds and other benefits related to lower speeds. These include:

- Reduced landing/take-off distance;
- Steeper climb and descent angles;
- Improved lateral maneuverability.

All of the above are beneficial to the extent that they conserve on real estate and air space requirements and aid in reducing or altering the noise impacts on communities during terminal area operations. Accordingly, some have come to refer to the vehicles as terminally configured vehicles (TCV).

The existing/proposed vehicles for short-haul achieve their lower minimum operating speeds by enhancing the lift capability of the vehicles at lower operating speeds over that inherent in most conventional take-off and landing (CTOL) aircraft. This is or can be achieved in a large number of ways. Most designs have been typecast rather loosely as reduced take-off and landing (RTOL), short take-off and landing (STOL), or vertical take-off and landing (VTOL) aircraft depending on the field length requirements.* For illustration purposes, the related field lengths can be roughly viewed as:

- CTOL - 4,000 ft or greater
- RTOL - 4,000 to 3,000 ft
- STOL - 4,000 to 500 ft
- VTOL - 500 ft or less.

The generic short-haul aircraft concepts of present interest are labeled on the basis of both their landing/take-off field performance and other descriptors describing the type powerplant or means of lift enhancement. Several are illustrated in Figure 3.1.

3.1.1.1 RTOL

The RTOL aircraft is generally taken to be a fanjet-powered aircraft with field performance capabilities in the 4,000 ft range. Certain existing

*Field length requirements are related not only to the physical capabilities of the aircraft but often include added safety margins.

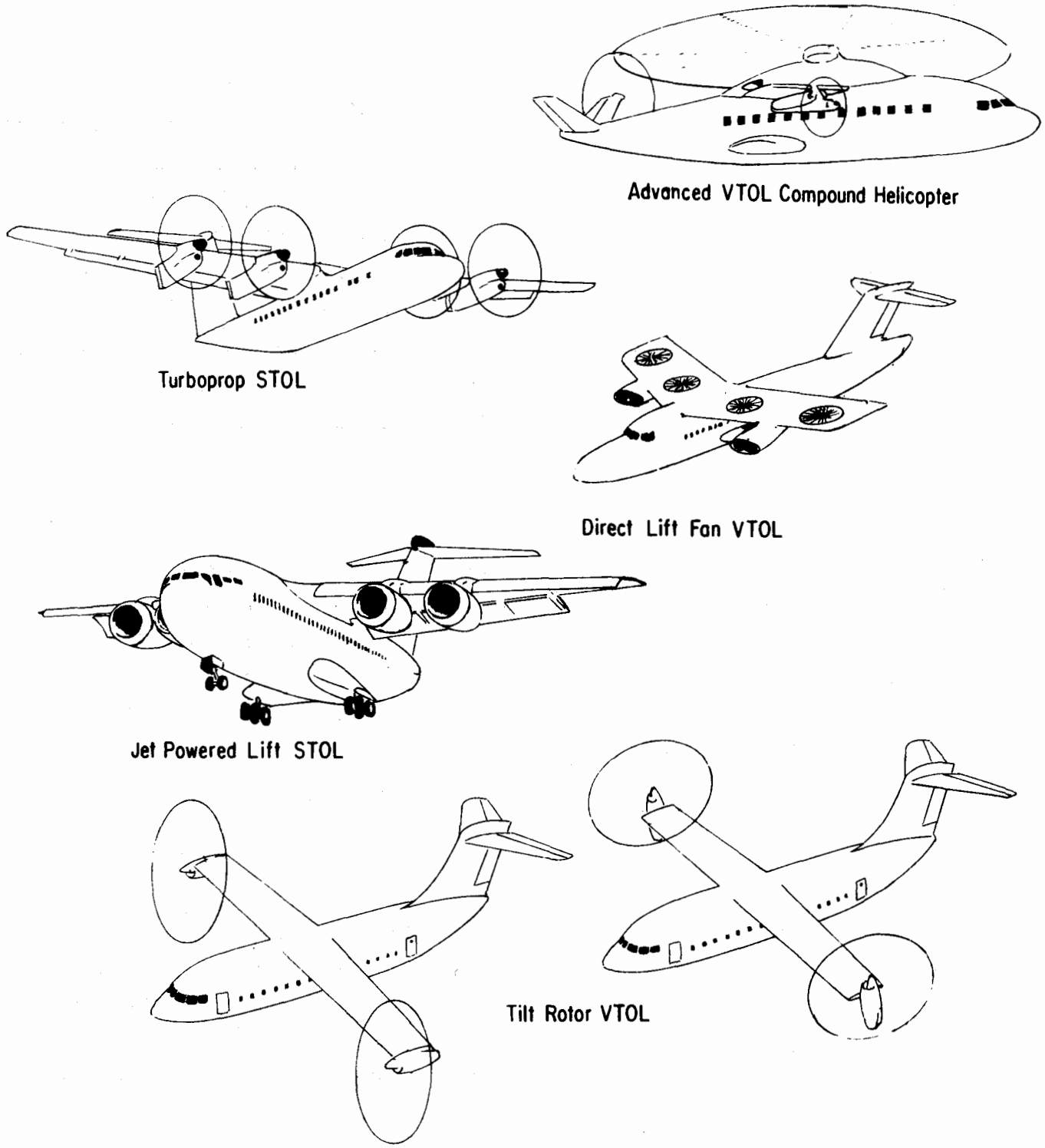


FIGURE 3.1- SHORT-HAUL VEHICLE CONCEPTS

CTOL aircraft have been viewed as possible candidates for conversion to this class. Several, such as the Boeing 737 and DC-9, already come quite close to a landing field length of 4,000 ft and could meet this value through the addition of improved mechanical-lift devices (e.g., leading-edge flaps, triple-slotted trailing-edge slates). Reducing the take-off distance of such aircraft poses a greater problem. The improved lift devices, while helpful, are likely inadequate. Higher airplane thrust-to-weight ratios would be needed, necessitating larger engines. New RTOL aircraft designs have typically been viewed as wide-body aircraft utilizing new quiet engines. The earliest at which such aircraft might be available is 1976.

3.1.1.2 Low Wing Loading STOL

Small turboprop-powered transports with STOL capability are actively employed in short-haul service. These aircraft employ both low wing loading and improved mechanical-flap systems to achieve STOL performance. Low wing loading, the classical means for reducing minimum operating speed, involves sizing the wing for the desired minimum speed. Advanced designs in this class, with much larger seating capacities (40 instead of 16), can be expected as early as 1975.

3.1.1.3 Prop STOL

One of the earlier propulsive-lift concepts for achieving STOL capability was a turboprop-powered aircraft utilizing large-deflection flaps. The lift augmentation is achieved by deflecting the propeller slipstream downwards. A military transport utilizing this principal was designed and built in Europe. It is estimated that civil aircraft based on this principal could be available as early as 1975.

3.1.1.4 Jet STOL

Extensive interest has been shown in a turbofan-powered STOL transport of wide-body design. This transport would make use of propulsive-lift concepts employing an integration of powerplant and wing to enhance the vehicle's lift capability. The externally blown flap and augmentor-wing propulsive-lift concepts are presently favored. The very earliest that this type aircraft might be available is in 1978.

3.1.1.5 Helicopter VTOL

The helicopter is a widely researched vehicle which has seen extensive military application. While common-carrier civil applications have not been prevelant, nor always successful, the helicopter presently fills important intraurban air service roles in some major metropolitan areas. Advanced helicopter designs, such as the compound helicopter, offer the prospect of improving the helicopter's economy and range and extending its short-haul operations out to 100 or 200 miles. Advanced helicopters would not be expected before 1978.

3.1.1.6 Other VTOL

Other advanced VTOL concepts, employing direct lift, have been the subject of past military R&D and some civil-application interest. The lift-fan and tilt-rotor designs are two of the more well known VTOL concepts. It is not likely that these advanced VTOL concepts would surface operationally before the mid 1980's.

3.1.2 Airport Concepts

The principal of segregating short-haul from long-haul traffic is essentially an airport-oriented one. Several basic short-haul concepts for airports have been suggested, as illustrated in Figure 3.2. These are:

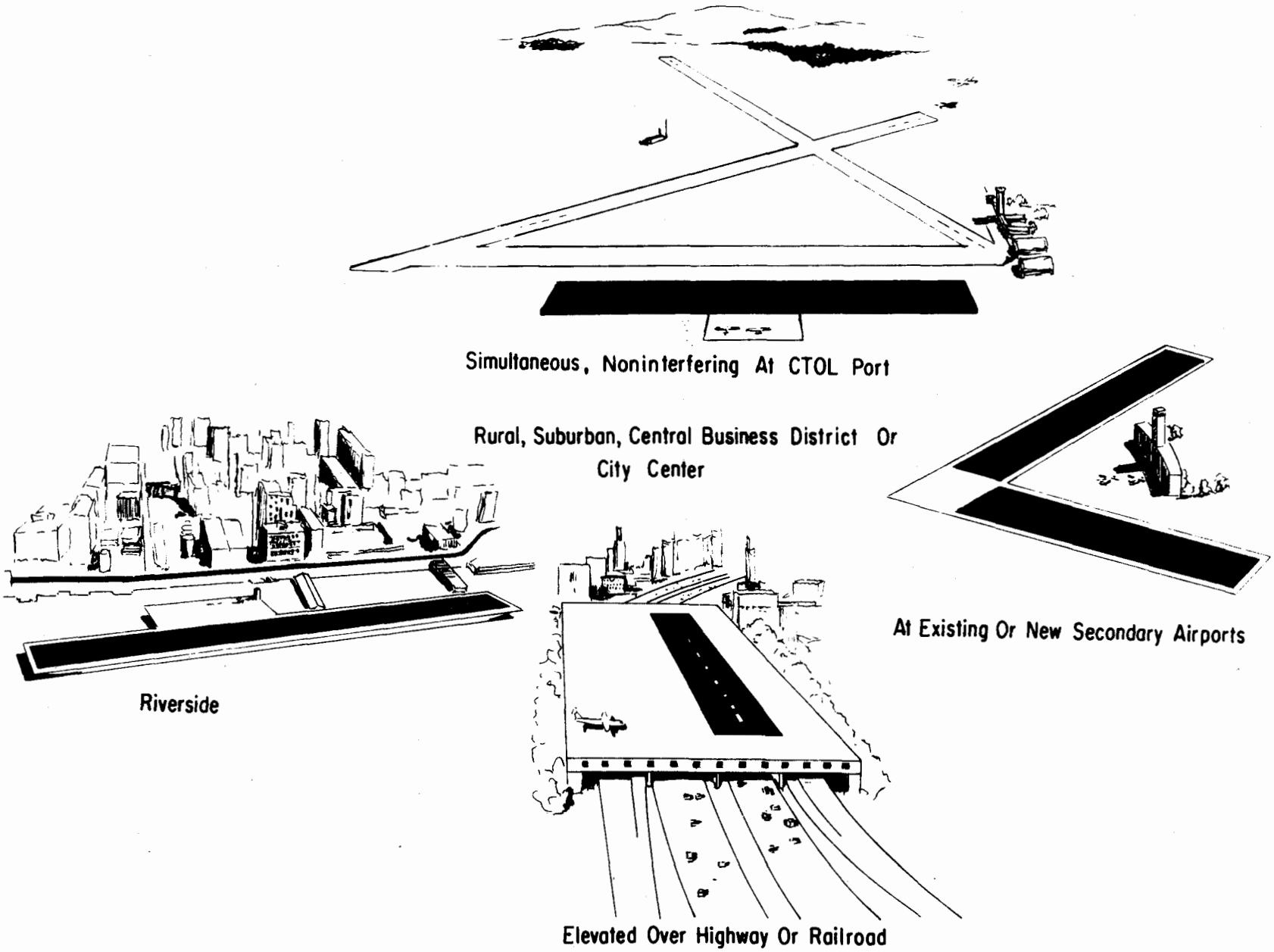


FIGURE 3.2 SHORT-HAUL AIRPORT CONCEPTS

- The reconfiguration of large hub airports to provide segregated short-haul runways and terminals apart from those used for long haul;

- The redesignation and/or reconfiguration of large hub airports for exclusive short-haul operation in metropolitan areas where two or more large airports exist;

- The upgrading and use of underutilized secondary/feeder airports and other underdeveloped airports for exclusive short-haul operation; and

- The development of new suburban and CBD airports, including elevated types in CBD areas, for exclusive short-haul operation.

To a limited extent, the segregation of traffic at large CTOL airports is practiced. Low wing loading STOL transports and low-speed general aviation aircraft frequently use separate, shorter runways. However, this segregation is possible only under VFR conditions, or under IFR conditions where runway spacing and landing aids permit. Generally speaking, these present arrangements offer little potential for increasing the airport-airside and terminal air space capacity of the airport under IFR conditions.

The second and third concepts above are seen in the limited forms of segregated short-haul service now practiced.[17] One half of the 22 largest air traffic hubs are served by multiple airports at least one of which is primarily oriented toward service for local origin/destination short-haul travelers. These hubs, and their long-haul versus short-haul counterparts are:

- Chicago (O'Hare versus Midway and Meigs);
- Cleveland (Hopkins versus Burke-Lakefront);
- Detroit (Metro-Wayne versus Detroit City);
- Houston (Intercontinental versus Hobby);
- Los Angeles (International versus Burbank, Ontario, Long Beach, and Santa Ana);
- New York (JFK versus LaGuardia, White Plains, and Islip);
- Philadelphia (International versus North Philadelphia);

- Pittsburgh (Greater Pittsburgh versus Allegheny County);
- San Francisco (International versus San Jose);
- Seattle (Seattle-Tacoma versus Boeing); and
- Washington, D.C. (Dulles versus National).

In many of the airports, runway facilities permit, and short-haul service is provided with, CTOL transports such as the Boeing 737 and 727. Most, however, are the focus for low wing loading STOL transports and smaller utility aircraft.

In addition to these airports, there are a multitude of other airports in each metropolitan area, both civil and military, which might be candidates for development for short-haul use.

Where conditions permit and the need exists, new suburban and CBD airports could be established to provide for segregated short-haul service. Here, the emphasis would likely be on STOL and VTOL aircraft with small real estate requirements. In congested CBD locations, the elevated STOLport or VTOLport becomes a potential option. Elevated VTOLports have been established and used in regular service.

3.2 Constraints and Issues

The multiplicity of civil-aviation participants, users, and their complex interactions represent a formidable constraint to spontaneous implementation of the segregated short-haul air transportation concepts noted above. Significant interactions also exist between the various civil aviation segments and the nontraveling public. In many cases, the benefits to one segment are a cost to another segment. In other cases, a particular segment must be assured that interfacing segments will take the necessary action before supporting actions will be undertaken.

A number of issues must be dealt with during the Federal government's effort to overcome existing constraints. These issues derive, for the most part, from unresolved questions which must be answered to the satisfaction of relevant public- and private-sector decision makers. Investigations and analysis of segregated short-haul concepts indicate a need for answers to the types of issues and questions noted below.

3.2.1 The Market Demand for High-Density Short-Haul Service

The concentration of market demand and aircraft operations are fundamental causes of the noise and congestion problems requiring corrective action. A first order of business concerns the identification of metropolitan areas where segregated short-haul concepts offer the greatest potential for relieving these problems. This naturally limits the initial area of concern to short-haul city pairs where high-density travel exists. The following types of market demand forecast questions must be analyzed before deciding which metropolitan areas and which concepts to concentrate on during subsequent short-haul improvement program efforts.

- Which city pairs will generate the largest amounts of short-haul traffic
- What proportion of the forecast demand will be interconnecting traffic and what proportion will be local origin-destination traffic
- How will the local origins and destinations be distributed within the metropolitan areas of the congested hub cities
- Will the local origins and destinations in the hub cities be concentrated enough to justify a consideration of diverting some portion of scheduled short-haul aircraft operations to one or more nonhub airports

- Will the interconnecting short-haul hub traffic be large enough to justify consideration of segregated short-haul operation at the existing hub airport
- To what extent are the above categories of forecast market demand dependent upon service variables like departure-arrival times, trip frequency, fares, total trip time, ride comfort, schedule dependability, convenience of ground access/egress, and ease of intermodal transfer
- Will an actual service demonstration program be necessary to confirm analytical demand elasticity values for the segregated short-haul concepts being considered
- What effects will future demographic shifts have on market demand forecasts?

3.2.2 Airport Community Acceptance

Community reaction to the various segregated short-haul concepts can be expected to vary greatly depending upon the specific characteristics of the metropolitan area and airport locale involved. This diversity creates a need to analyze the community-acceptance problem on an individual community-by-community basis. Assuming a set of potential cities and locales have been singled out for further study, it then becomes necessary to develop scenario-specific answers to questions like the following:

- Who are the individuals, groups, or agencies that might oppose the short-haul improvement concept being considered for their locale
- To what extent are these potential opponents in a position to prevent concept implementation
- What factors are relevant to the opposing factions and to what degree
- Could short-haul airport facilities be designed to incorporate nonaviation functions of benefit to the community

- To what extent and in what manner have local aviation-planning authorities had to deal with opponents during past airport-development efforts
- What degree of influence do aviation proponents have in the local decision-making process
- Are there ways to compensate for the negative impacts of expanded airport operations?

3.2.3 Air Carrier Willingness to Provide Segregated Short-Haul Service

Any decisions at the local and Federal level are dependent on air carrier plans to provide the types of service being considered. Short of new route authorities, the existing carriers in the city-pairs singled out for study are the ones of interest. These carriers will have many questions about the merits of any new service concepts as well as questions about the impact of these concepts on the presently served markets. A representative sampling of such questions include the following:

- What impact will the new service have on existing CTOL markets
- Will the total aircraft buy by all carriers be sufficient to insure a reasonable aircraft purchase price and reasonable operating cost
- Is the financing available to purchase the number of aircraft required
- How much competition can be expected between carriers in each city-pair market
- What market shares will be necessary to insure a profitable operation
- What assurances and actions are required on the part of other aviation participants that supporting system elements, procedures, etc., will be in place when aircraft are introduced into scheduled service
- To what extent should new aircraft deliveries be timed to coincide with retirement of CTOL aircraft fleets presently used to provide short-haul service
- Will the present fare structure be adequate to sustain a reasonable profit level

- What frequency of service and passenger capacity will be necessary to assure maximum market penetration and economical load factors
- How much promotion and advertising effort will be necessary to attract passengers to the new service?

3.2.4 Impact on General Aviation

Interfaces between scheduled carrier operations and general aviation operations are a continuing source of friction. This will continue to be true especially for the segregated short-haul concept in which scheduled short-haul operations are diverted to airports other than the major hub airports. Recent FAA policy has been directed toward congestion relief at scheduled air-carrier airports through the designation of reliever airports for general aviation. Airport designation policy will have to be modified if a new category of scheduled short-haul airports is found to be necessary. The following questions will have to be dealt with during the short-haul airport designation process.

- Will general aviation be compensated in any manner for either displacement, interference, or increased congestion at airports presently used by general aviation
- If general aviation airports are redesignated for scheduled short-haul use, will other provisions be made to meet continued general aviation growth
- Will any segments of general aviation benefit from mixed operations with scheduled air carriers
- Will the increased sophistication in avionic equipment requirements of the scheduled short-haul airport prevent any segments of general aviation from continuing to operate
- What impact will expanded short-haul operations have on growth rates in the various segments of general aviation?

3.2.5 Manufacturer Willingness to Develop and Produce Aircraft

A decisive influence on manufacturers is the amount of air-carrier demand for their products. To the extent that a clear cut and adequate market exists, manufacturers will be more likely to undertake

the financial risks of developing and producing the desired equipment. The requirement for new advances in short-haul aircraft technology adds to the uncertainty and magnitude of the capital investment needed to undertake development and production. A number of financial and technological questions are of concern to potential equipment manufacturers.

- What requirements must be met to certify the equipment for scheduled service use (aircraft, engines, and avionics)
- What performance characteristics will the air carriers require (range, cruise speed, payload capacity, weather capability, ride quality, and noise footprint)
- What economic requirements will the air carriers consider to be satisfactory (unit sales price and operating cost)
- To what extent will there be a need to reduce development expenses through civil commonality with military technology
- How many carrier orders will be necessary for a manufacturer to enter production
- How many domestic and foreign manufacturers will be expected to compete for available markets
- What are the potential sources of investment capital to support development and production?

3.2.6 Availability of Investment Capital

A capital-intensive improvement program of the kind considered here will require many sources of capital. In the private market place, manufacturers and air carriers will have to consider outside sources of capital in addition to internal funds. Extensive Federal and local government funds will also be required depending on the degree of investment called for by the improvement concept undertaken. Some of the most fundamental questions in this area include the following:

- What requirements will be imposed by the potential sources of capital before the necessary funds are made available
- How will the risks of investing in short-haul air transportation improvements compare to other investment opportunities

- What, if any, commitments must be made at the local or Federal government level before private capital is made available?

3.2.7 Airport Operator Requirements

One of the airport operator's prime concerns is the economic viability of his operations. He is concerned not only with balancing operating revenue and operating costs but also retiring debt obligations in a satisfactory manner. The anticipation of future capacity requirements is a necessary part of determining future resource requirements. However, as local conditions vary over a wide range, each airport operator is in a potentially unique situation. For any given situation, the following questions need to be addressed:

- What landing-fee policy will be necessary to support facility, equipment, and personnel expansion requirements
- Will future increases in aircraft operations be sufficient to meet operating-revenue requirements without the need to increase landing fees
- When revenue bond financing is being considered, how much of an air-carrier commitment is needed before planned improvements can be executed
- To what extent will airport expansion create the need for new or improved ground access/egress
- How do airport-airside capacity increases impact the need for airport landside capacity increases?

3.2.8 Coordination with Ground Access/Egress Modes

Ground access/egress time represents a relatively large proportion of a typical short-haul air travelers total trip time. For this reason, there is a special need to include this portion of the trip in the planning of short-haul improvements. The following questions are representative of factors which should be considered during intermodal planning:

- Will the capacity of existing access/egress modes handle forecast increases in airport traffic demand

- Should air passenger access/egress be included as part of urban mass-transit planning
- To what extent should a policy of multimodal ownership be pursued?

3.2.9 Local Government Initiative

Local aviation planning agencies and related governmental units are a key element in the process of implementing the types of air transportation improvements being considered. Where airport developments are concerned, much of the initiative rests with local government units. The local decision-making process generally represents the place where proponents and opponents of airport expansion resolve their differences.

- To what extent should ADAP Planning Grant efforts be distributed between the more conventional expansion concepts and segregated short-haul concepts
- What is the need for FAA guidelines to support planning for segregated short-haul concepts
- How much air-carrier support is needed before local officials will proceed with commitments for resources to support the new service concepts
- Is a common planning jurisdiction in the metropolitan area of interest a prerequisite to successful short-haul airport planning
- To what extent should local communities share in the cost of planning and developing short-haul airports
- If a scheduled short-haul airport designation process is undertaken by the FAA, to what extent should local planning authorities be involved from the start in the site-selection effort?

3.2.10 CAB Regulatory Policy

Existing CAB policy on route awards and fare structures will require re-examination to determine whether segregated short-haul concepts create new requirements. Certain promotional activities, either under way or in the planning stages at the CAB, will affect the future evolution of short-haul transportation. Some of the questions requiring answers in these areas are as follows:

- Should airport-to-airport route authorities be awarded in addition to existing city-to-city route authorities
- What type of carrier should be authorized to provide segregated short-haul service
- How much competition should be allowed over city pairs in a segregated short-haul route system
- Will a flexible fare policy serve to account for inherent economic differences in operation between short-haul and long-haul service
- Do government authorities have the power to exclude certain classes of scheduled operation from a particular airport
- To what extent are financial incentives necessary for the private sector to implement desired improvements (like the pending CAB-proposed legislation for a guaranteed-loan program)
- Would a contract basis for route awards serve to encourage short-haul air-carrier risk taking
- To what extent should intermodal mergers and inter-carrier mergers be encouraged as a means to resolve problems unique to short-haul service?

3.2.11 FAA Regulatory Policy

The new aeronautical technology necessary to support segregated short-haul concepts will likely require some new Federal Aviation Regulation rule making. FAR amendments and Advisory Circulars will be necessary in a number of areas including aircraft certification (FAR Part 25), operating procedures (FAR Part 121), engine noise standards (FAR Part 36), and airport design standards. Related questions include the following:

- To what extent do the necessary FAR's need to be finalized before equipment manufacturers will proceed with development and carriers will commit to purchase orders
- Will planned NASA research and technology programs dealing with short-haul concepts be adequate to establish FAR requirements

- What impact will FAR requirements have on the development of airport design standards for segregated short-haul concepts
- How severe must the engine noise standards be to accommodate the concerns of airport community residents
- Should ADAP policies and procedures be modified to accommodate any peculiar aspects of segregated short-haul concepts
- To what extent, if any, should Federal financial support be increased for the development of airport landside and airport airside facilities, equipment, or acreage?

3.2.12 Impact on ATC System Operation

The introduction of segregated short-haul concepts will have a direct impact on the present ATC system. Various limitations in the present system must be overcome to realize the full potential of segregated short-haul service. The FAA, as developer and operator of the ATC system, has the major responsibility for providing the necessary capabilities at the proper time. Much of this preparation involves long-lead-time efforts. Questions requiring near-term answers include the following:

- To what extent will presently planned ATC improvements accommodate the requirements imposed by segregated short-haul operations
- When will any modifications not already planned need to be in place to support scheduled service
- Are there metropolitan areas where ATC capabilities need to be upgraded sooner than other metropolitan areas
- Are reduced separation standards required, and to what extent for en route, terminal area, and/or runway operations
- Will interim landing aids be required before the planned introduction of the national microwave instrument landing system
- Will any unique surveillance and communication improvements be necessary
- To what minimum weather capability should the required ATC improvements be designed

- What impact will segregated short-haul operations have on ATC procedures and rules
- To what extent should the pilot/aircraft/ATC interfaces be automated?

3.2.13 The Direction of Federal Research and Development

The NASA, FAA, and DOD have varying degrees of responsibility for the development of technology which can be used to support segregated short-haul concepts. Historically, these agencies have been a major source of the technology base from which manufacturers have developed civil-aviation products and services. Technology needs to be brought along to the point where the uncertainities of private-sector risk-taking are reduced to reasonable proportions. This is especially true for the segregated short-haul concepts being considered here. A representative sample of questions regarding Federal research and development policy include the following:

- To what degree must the aircraft-technology data base be developed by the Federal government before manufacturers and air carriers will undertake financial commitments
- Which aircraft concepts represent the greatest potential for eventual commercial application
- What ATC and airport development activities need to be pursued in support of the aircraft technology being developed
- How should the timing of aircraft-development activities be phased to correspond with ATC and airport-development activities
- To what extent must civil-aircraft-technology developments be phased to correspond with related military development activities?

3.3 The Federal Government's Role

The Federal government has a number of traditional roles in air transportation which will carry over into the future. Among these are economic regulation (CAB), standards for airports, aircraft, and airmen (FAA); flight safety (FAA); environmental standards (FAA and EPA); assistance in airport development (FAA); operation of the air-traffic-control system (FAA), and technological development (NASA). These traditional roles, however, have not precipitated significant high-density, short-haul changes in the private sector, and there is no reason to suppose that they will do so in the future. New roles in terms of initiative and coordination seem to be required.

The Federal role cannot be one of dictating directions. The private-sector participants will continue to function in a more-or-less independent fashion. However, within this context, there are two ways in which the Federal government can encourage private sector risk taking: (1) open up additional options for consideration by the private sector, and (2) take the initiative in developing a plan for cooperative action.

3.3.1 Open Up Additional Options

Suggestions for Federal action, based in large part on the frustrations arising from the constraints and issues described earlier, have come from many quarters. Listed in the approximate increasing order of the Federal commitment required, they include such examples as:

- Do nothing
- Produce a specific system development plan and persuade others to follow it
- Clarify economic regulatory policy for short-haul operations
- Clarify certification criteria for short-haul aircraft and airports

- Carry out additional system studies to demonstrate short-haul system viability
- Support growth of existing segregated short-haul operations
- Expand present technology programs relating to short-haul
- Conduct major demonstration programs
- Alter ADAP funding formulae to encourage short-haul airport developments including access/egress systems
- Increase subsidies to existing short-haul operations.

Because of the uncertainties surrounding the results that could be expected from any of these courses, none can be either embraced or rejected at this time.

3.3.2 Initiate Cooperative Program Planning

Through the Short-Haul Air Transportation Program, the Federal government has committed itself to fostering the development of improved short-haul systems predicated on the concept of segregating short-haul operations from long-haul facilities. The only conditions attached to this commitment are that these developments improve short-haul service, bring significant relief to the noise and congestion problems, and move forward with maximum reliance on local authorities and the private sector.

Effective conduct of the short-haul program requires that a plan of action be developed concerning how to proceed. In planning how to proceed, the Federal government is confronted with several major obstacles which must be dealt with.

- The present air transportation system infrastructure is such that the responsibility for development, operation, and regulation is spread over a large number of organizations, both Federal and non-Federal
- Many of the concepts under consideration represent a significant departure from the present system and raise many technical, social, economic, and institutional issues

- No precedent exists for successful total-system planning in transportation systems of the scale and complexity of air transportation
- The Federal government is limited in the means by which it can foster or encourage various developments: technology development, regulation, and economic incentives are the traditional means available.

System planning and development under the circumstances described above present a significantly more difficult problem than those which have been successfully dealt with in various military and civil space-system developments. The distinguishing characteristic here is the multiplicity of decision makers and their different goals and objectives. While many traditional management and analysis tools can be employed in short-haul air transportation development, unique requirements exist for new coordination and decision-making mechanisms. Figure 3-3 adapted from Reference 18, illustrates the complexity of the system synthesis and analysis effort in this multiparticipant environment.

For most of the segregated short-haul concepts under consideration, considerable uncertainty continues to exist with respect to the benefits, costs, and risks which would accrue to each of the participants involved. Moreover, where the public interest is concerned, the broader impact of these alternative developments and the levels of Federal commitment required to bring them about is unknown. Under these circumstances, a considerable part of the short-haul program's near-term emphasis must necessarily stress continued evaluation of these concepts.

However, if the existing constraints to implementation are to be overcome, these evaluations must be conducted in a coordinative and decision-making framework which is adapted to the present air transportation infrastructure. Continued emphasis on technology development is also required and can be justified. Further developments, particularly in the area of short-haul vehicles, are required both to provide the evaluation effort with data of adequate quality and to provide a development base for all short-haul improvement options since none can be discounted at this time.

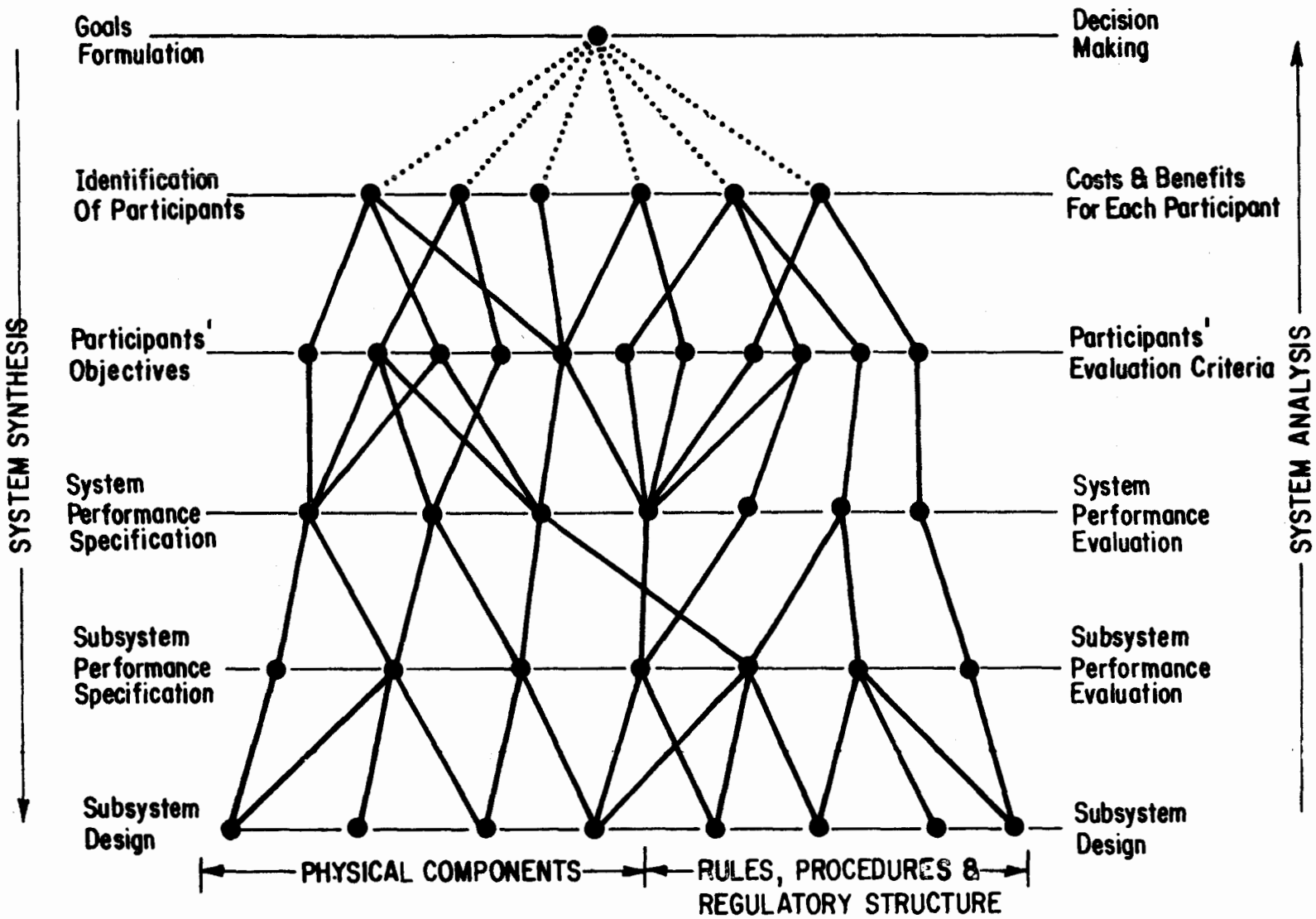


FIGURE 3.3. MULTIPARTICIPANT SYSTEM ANALYSIS AND SYNTHESIS

Attention to and development support of existing forms of segregated short-haul service represent another major facet of the program. Such operations are prevalent in a number of areas of the country and are provided primarily by air-taxi and commuter airlines, and certain intrastate carriers. While these operations do not presently provide extensive congestion and noise relief, they serve a large number of travelers. Further, their continued existance and viability may provide an important starting point for advanced short-haul systems. Finally, these operations represent an important demonstration arena in which technical, operational, and marketing data of value to the program's evaluation efforts can be acquired at low cost.

A final program-planning requirement involves defining the level and timing of activities of the type described above. In accomplishing this, the program must be responsive to:

- The course of developments in the overall air transportation system, particularly as they relate to noise, congestion, service quality, and econonics
- The pace of developmental activities initiated by local communities and the private sector
- Special information requirements such as the Secretary of Transportation's desire to have air transportation recommendations for the Northeast Corridor by 1976.(5)

4.0 THE PROGRAM PLAN

4.1 Planning Approach and Major Program Elements

4.1.1 The Principal Thrusts

In accordance with the concept of keeping the options open, this program is designed to proceed along three parallel lines. First is a group of activities to further the technology--to make possible aircraft and engines with capabilities better suited to high-density short haul than any now available.

Second is a group of activities, mostly analytical, to lay a foundation for decision-making concerning short-haul in the 1980's when new technology aircraft would be available.

Third is a group of activities aimed at fostering growth of segregated short-haul service within the existing system, using available aircraft and existing, or only slightly modified equipment, rules and procedures.

4.1.2 Timing Considerations for the Program

A consideration with major influence on the plan is that of time constraints. The principal factors in pacing the program arise in four areas:

- Pace of technology developments
- Problems developing in the existing system (noise and congestion)
- Initiatives by non-Federal participants
- Special information requirements for decision-making.

Timing of some of these is substantially uncertain, and the program plan must deal with these uncertainties. The time-phasing problems presented by these four factors are discussed below.

4.1.2.1 Pace of Technological Development. Timing of aircraft and engine developments is discussed in more detail in Section 4.5, but it appears that short-haul service with the first of the new-technology aircraft, a propulsive-lift STOL is some 10 years in the future. With jet VTOL it is, perhaps, more like 15 years. The time at which decisions will have to be made (as to whether to initiate such service) is much closer, more on the order of 5 and 10 years, respectively. Decisions on which technologies to pursue, and at what level of effort have already been made, but they must be continually reassessed in the light of progress made.

The long lead time in this type of work must be accounted for in the planning, but the uncertainty in the lead time is not a major problem. In particular, it must be recognized that, until the new technology aircraft become available, the only candidates for implementation of segregated short-haul are RTOL, low-wing-loading STOL, and helicopters.

4.1.2.2 Noise and Congestion Problems in the Existing System. The current policy of restricting operations at congested airports will probably prevent the congestion problem appearing in the same form as it did in the crisis period of 1968-9, but it could reappear at almost any time in the form of substantial unmet demand. It is forecast that demand will continue to grow. Also, the system capacity is increasing in response to improvements now being made. Additional improvements are part of current planning. The questions are: Will demand outrun capacity, and, if so, when?

The answers to these questions are not known. The reasons for this are several, but the more significant are:

- The rate of increase of demand cannot be accurately forecasted
- The effectiveness of present improvement programs cannot be accurately predicted
- There exists no satisfactory quantitative methodology for dealing with congestion/capacity problems on a system basis.

Because of these difficulties, substantial system capacity problems could develop at any time during the planning horizon of this program, and with little advance warning.

The noise problem has two parts: How much noise is produced by air transportation, and how much community reaction results from that noise? Concerning the first, it does not appear that the noise associated with air transportation will diminish appreciably over the next few years. The new aircraft coming into service have noise levels lower than those of the existing fleet. Furthermore, they have higher passenger capacity and thus may be expected to generate fewer operations for a given volume of passengers handled. The total noise impact around major airports may decrease somewhat, but the decrease will not be particularly dramatic.

As for changes in community reaction, little can be predicted with confidence. Environmental awareness has been increasing for several years, especially in the metropolitan regions which are subject to congestion. If this trend continues, the results could be curfews, additional flight path restrictions, and possible restrictions in the number of operations; all adversely affecting capacity. Such developments could occur at any time.

For both noise and congestion, it appears that major difficulties could develop at almost any point in the planning horizon of this study. This is a major source of timing uncertainty; an uncertainty which must be dealt with in constructing the plan.

4.1.2.3 Non-Federal Initiatives. There have already been a number of cases in which local authorities, airlines, or airframe manufacturers have initiated actions in segregated short-haul which require government response. Some of these actions relating to airport developments are:

- New York City: A proposed multimodal Hudson-River facility, incorporating an elevated STOLport, is now under active study and review by the New York City government

- State of New Jersey: The Department of Transportation for the State of New Jersey is actively pursuing an ADAP-funded program to identify a STOLport site serving the larger New York Metropolitan area

- Washington, D.C.: The National Capitol Planning Commission, the Washington Council of Governments, and the D.C. Planning Commission have an active contract for a heliport site survey. Twenty-eight helicopter operators and manufacturers have offered their services if a temporary site can be established

- Chicago: Serious efforts are under way to build the short-haul air service levels provided between Meigs Field and Midway, and other cities as a means of relieving pressures at O'Hare Field. Two airlines are cooperating with the City in this effort

- State of Florida: The Florida State Department of Transportation has concluded there is a need for an intrastate STOL short-haul system between Disney World and other key cities in the State. A Disney World STOLport has been built to FAA specifications and other cities are studying possible sites

- Houston/Dallas: The Dallas Department of Planning and Urban Development has located two multimodal terminal sites which would include elevated STOLports and is planning a $6-million bond issue to obtain the necessary options and land/air rights. In Houston, two STOL runways have been added at Houston International Airport and are supporting operations from Clearlake City. Houston is considering the use of other elevated STOLports over highways to broaden air service in the area

- Colorado: The State Department of Industry and Economic Development is studying the matter of providing improved short-haul aviation throughout the state. Attention is specifically focused on the Denver region and the special transportation needs of the 1976 Winter Olympics

- San Francisco: NORCALSTOL, an affiliate of the Chamber of Commerce, has performed two temporary STOL demonstration service experiments and is examining sites as possible STOLport locations

- Los Angeles: The Department of Airports has submitted an ADAP request to develop STOL service to Catalina Island. Other efforts are under way to examine the broader matter of short-haul air service throughout the Los Angeles Basin

Seattle-Portland: The Western Region Conference Study identified this area as one needing improved short-haul service. The State of Washington is examining possible airport system plans to meet such requirements.

It is expected that such situations will continue to arise, and the plan must include mechanisms for dealing with them. The timing of such activities cannot be predicted in advance, so they constitute a major source of uncertainty in program phasing.

4.1.2.4 Developing Information for Major Federal Decisions. To the extent that new short-haul implementation requires major Federal commitments, data and justifications need to be available to support the recommended course of action. In general, the time phasing of this data preparation is keyed to the time phasing of the implementation in question. There exists, however, a requirement for recommendations for the Northeast Corridor decision in 1976, which subsumes practically all forseeable activities of this kind. While this particular recommendation is for the Northeast Corridor only, it is clear that recommended developments in the corridor should be part of a comprehensive and integrated national program. This NEC requirement, then, fixes the time scale for all the long-range study portions of the program.

It appears that the NEC date has a substantial effect on timing and sequencing of activities. With the requirement as it now stands, much of the analysis work will have to be run in parallel, causing some loss in efficiency and increasing the requirements for close coordination between activities.

4.1.3 Program Organization

A highly simplified view of the program activities, and the way in which those activities contribute to the three major thrusts of the program is indicated in Figure 4.1 These activities are described in more detail in Sections 4.2 through 4.5, with the summary appearing in Section 4.6. Many of the program activities will contribute to more than one of the major thrusts. This effect can be seen in Figure 4.1 in the multiple outputs shown for several of the activities.

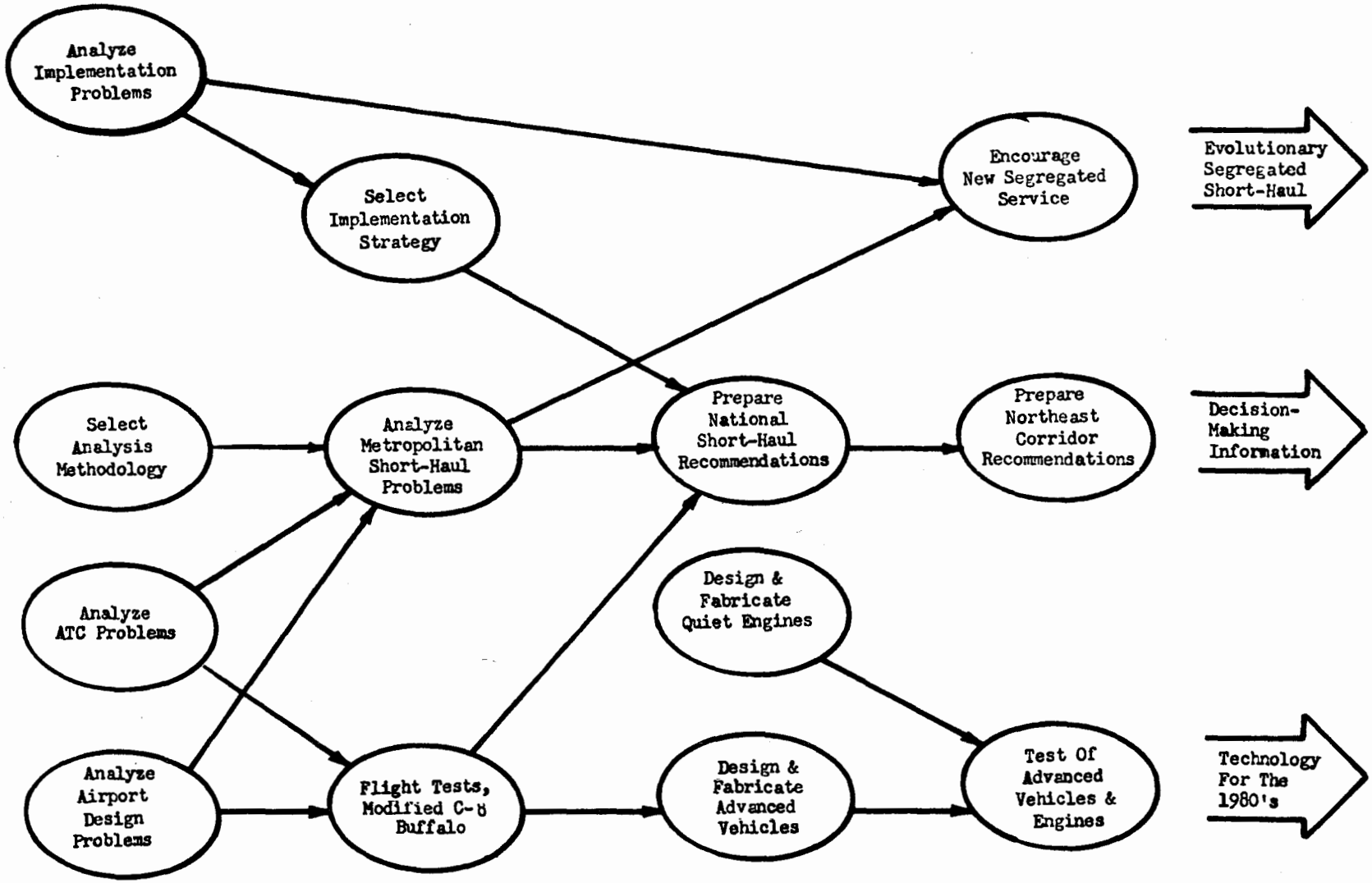


FIGURE 4.1 MAJOR PROGRAM ELEMENTS

In all, some 39 individual activities are described, some of them quite complex in themselves. For purposes of description, the tasks are divided into four categories, along technology lines: Transportation Systems Analysis, Airport Activities, ATC/Navigation Activities, and Aircraft Activities. In Section 4.6, the interrelationships among the individual tasks are indicated, though this is addressed also, in less complete form, in the individual activity descriptions.

The time span covered by the plan is FY 1973 through FY 1977. After that time, the nature of the activity can be expected to change. One of the major thrusts, that of preparing material for major decisions, will have been completed, and only technology work and near-term service implementation will remain. There will still be substantial analysis activity, but it will all be in support of the two remaining thrusts.

4.2 Transportation Systems Analysis Activities

4.2.1 Scope

The Transportation System Analysis Activities are concerned with studying the economic, institutional, regulatory, and environmental aspects of possible short-haul systems, and with analyzing the problems of implementing such systems.

Activities which are included, and the Federal organizations to be principally covered with each, are:

- Collection and application of travel demand, demographic and economic data on metropolitan areas (FAA, CAB)
- Analysis of consequences and characteristics of various possible air transportation configurations (FAA, CAB, and NASA)
- Study of regulatory implications of the various short-haul concepts (CAB)
- Analysis of implementation problems, including the attitudes of, and influences acting on, all participants in short-haul implementation (FAA,CAB)
- Integration of information and results from all portions of the program (FAA)

- Supplying guidance to other portions of the program on desirable directions for investigation (FAA).

The principal products to be generated are:

- An overall understanding of the advantages and disadvantages of the various short-haul concepts as applied to different circumstances (formalized in a "guidelines" document)
- Short-haul recommendations and implementation plan for use in reaching a decision on Northeast Corridor commitments
- The best possible understanding of the implementation consequences of various Federal initiatives
- More convincing methodology in analysis of transportation system performance
- Improved dissemination of short-haul information to all participants
- Recommended short-haul solutions to particular local transportation problems.

Up to the present, FAA, CAB, and NASA have been involved in studies of these kinds, as have state, regional, and local authorities, airlines, and airframe manufacturers. In this program, maximum use will be made of results and methodology developed in these prior studies. In addition, there will be involvement of non-Federal groups in carrying out system studies within the Federal program.

4.2.2 Statement of the Problem

The first task is to select and exercise methodologies for answering two types of questions:

- What are the impacts (on all participants) of various short-haul concepts, applied in various situations
- How could these short-haul concepts be brought into being, considering the diffused nature of air transportation decision making?

The second task is to integrate the results of such studies, together with results from other parts of the program, into data and recommendations for use by decision makers.

4.2.3 Approach

Two rather different types of methodology are needed. They are discussed separately in the following subsections.

4.2.3.1 Synthesis and Analysis of Short-Haul Transportation Systems. In this portion of the program, particularly heavy emphasis can be put on utilization of past work. Since the middle 1960's, there have been many studies of the properties of possible future short-haul air transportation systems. Some of these have been proprietary, so the total number is hard to estimate. Based on public information, however, it seems that there must be several dozen. Some of the more significant are:

- 1965 Stanford Research Institute/McDonnel Aircraft for FAA [19,20]
- 1966 McDonnell Aircraft/Stanford Research Institute for FAA[21-23]
- 1967 Lockheed Study [24,25]
- 1968 Institute of Defense Analysis Study of VTOL Market[26,27]
- 1968 Boeing Study for NASA[28]
- 1969-71 MITRE studies for NECTP[29-31], CARD[32,33], and AAC[34]
- 1970 Canadian Transport Commission Study[35]
- 1970 University of Toronto study for the Canadian Transport Commission[36, 37]
- 1970 CAB Northeast Corridor Investigation[38,8]
- 1971 NASA-Ames Study[39].

There are many additional studies which could be mentioned. References 40 through 51 cover some, and the bibliographies of References 36, 37, and 52 contain others. A recent study by the Transportation Systems Center carries out a comparative analysis of several of these studies.[53]

In addition to these past studies, there are three major NASA-sponsored analyses now under way by Aerospace,[54] Lockheed,[55]

and McDonnell-Douglas[56]. All involve system evaluations, and when completed, they will address many of the aspects of interest.

Concerning this extensive body of work, the following can be observed:

- Most studies have emphasized economic viability; usually from the standpoint of the carrier, sometimes from the standpoint of the aircraft manufacturer
- With minor exceptions, the economic viability of new short-haul systems has been found adequate
- Several of the studies have analyzed noise impacts, but treatment of other noneconomic questions has been much less complete
- Very few have addressed the congestion problem. The MITRE approach has been used for this,[34] and a later phase of the Aerospace study is expected to address it. Also, the studies confined to a single metropolitan area, such as those of New York[43] and Atlanta(50), give more attention to this aspect. There have been, of course, many studies of congestion per se, but not in a transportation system context
- Institutional and regulatory problems of the new systems have been given comparatively minor consideration
- Most studies utilize some form of supply-demand interaction, although a few treat demand as given, then optimize the supply. Again, the MITRE study goes farther than most in representing this interaction, as do the methods suggested by DeVany and Garges [51]
- Virtually all the studies ignore the time dimension of the problem: such questions as the proper rate of introduction of new services, the time required to develop markets, and the steps by which the system evolves from its present condition to the desired configuration. Universal practice is to study a single point in time, divorced from what has happened before, and from what may be expected to happen in the future.

Perhaps the most significant observation about the past studies is that they have not led to implementation, or to the types of action which would prepare the way for implementation. Either the economic results have not been persuasive, or uncertainties in the noneconomic aspects have inhibited action.

Based on these observations, the system performance analysis for this program should have the following features:

- It should consider one metropolitan area at a time. This is the smallest region in which airside congestion effects can be studied. Inclusion of all flight legs originating or terminating in the metropolitan area results in a hub-spoke route pattern, which has been used in many of the past studies
- Long-haul and general aviation activities must be included to the extent that they contribute to the congestion problems being studied
- The interaction between transportation sypply and demand should be treated as accurately as possible. The principal objective will be to assess the effects of new short-haul concepts (changes in transportation supply), so simple assumptions about demand will not be useful
- The evolution of the system with time should be considered in the analysis. Some of the more significant feasibility questions are associated with this aspect
- The methodology should give at least as much attention to uncertainties in the results as it does to the results themselves. For decision-making purposes, the question of confidence is all-important
- To further enhance credibility, study scenarios, assumptions, input data, and methodology should be subjected to the widest possible scrutiny.

The credibility problem is a serious one. There must be a new approach to the treatment of uncertainty in the system, and in communicating study results to decision-makers. The problem is that any study of this type must be based on a rather extensive set of assumptions. The results of the study are, in large part, determined by those assumptions. They are typically selected by the analyst, who is, thereby, strongly influencing the outcome.

It is commonly thought that if only the right set of assumptions are employed, the right answer will emerge. It may well be, however, that there exists no "right" set of assumptions. The decision-maker faces an entire spectrum of possibilities. His problem is to choose

a course of action, based on the possible outcomes, and their relative likelihoods. This is a very imprecise process, but most decision-makers feel that if guessing is necessary, they should be doing it, not the analyst.

It could be suggested, then, that decision-makers should select the assumptions. This is essentially the approach used here, but substantial consideration must be given to the interface. Decision-makers are not accustomed to participating in detailed analysis procedures, and will not review a long list of assumptions. It will be necessary for the analysis process to predigest the assumptions, find which are the most critical, and present a small number of items for evaluation by the decision-maker.

What is needed is not so much different analysis techniques, as different methods of organizing inputs and outputs. The uncertainty problem must be dealt with squarely and in a comprehensible way, and the analysis effort should be devoted to sharpening and organizing the decision-making problem.

Since the various metropolitan areas differ in many respects, and since the purposes of various studies may differ, the study process may not always be the same. However, in general, a study would proceed through the following steps:

- Selection of a metropolitan area for study. There are at least three types of reasons for selecting an area for study: (1) there is some specific problem in the area for which a solution is being sought; (2) the area is "typical" in some sense, so that a study of it would contribute to an understanding of national short-haul issues; or (3) study of the area will contribute to the data required for the Northeast Corridor decisions
- Selection of the study scenario. Most studies will focus on the changes brought about by implementing some new short-haul concept. It is necessary to select a particular concept or concepts for study, and it is also necessary to analyze the baseline system (no new short haul). Selection of the new concept for study is the system synthesis activity. It would be based on the particular metropolitan situation, the objective of the study, and the existing level of understanding of probable consequences as drawn from earlier studies.

In addition, it will be necessary to establish the demand characteristics of the metropolitan area and of the cities at the other ends of the short-haul service links considered. Locations and characteristics of all airports to be studied must be fixed. Long-haul and general-aviation activity levels must be established, and community constraints and institutional structures identified

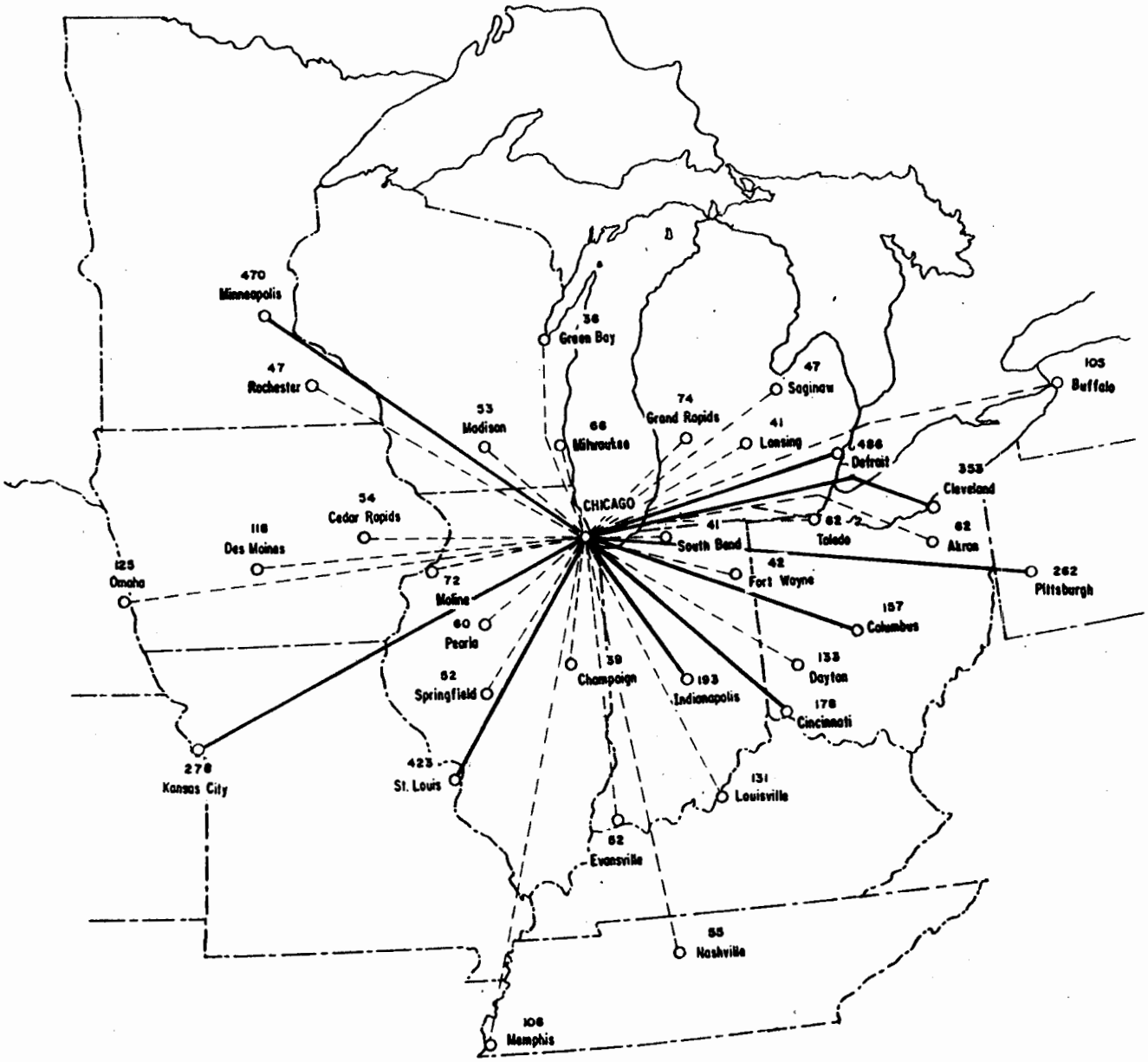
- Selection of analysis methodology. The fundamental problem is to determine a number of system characteristics from the scenario definition. For most studies, the process would be about the same, but some variation would be expected. After several studies have been completed, a collection of methodologies should be available to cover most of the remaining problems

- Evaluation of system characteristics. Applying the appropriate methodology, those system characteristics which are of interest to any of the participants would be evaluated, both with and without the new short-haul concepts. These include noise impacts at each airport, congestion at each airport, service quality for all service links, and economic characteristics as seen by air carriers, airport operators, and the Federal government.

To illustrate the scope of one of these metropolitan area studies, the short-haul service paths centered on Chicago are shown in Figure 4.2. The annual local O&D passengers (in thousands) are shown above the names of each of the cities. These are the passengers most susceptible to diversion from the major CTOL airport.

If it is postulated that Midway would be used to divert this traffic, then the problem is to determine:

- What portion could be diverted in which years
- What would the congestion problems be at Midway
- What degree of congestion relief could be expected at O'Hare over the time period considered
- What would be the economic outlook for the carriers serving Midway
- What would be the economic outlook for the carriers serving O'Hare
- What airport and terminal modifications would be required
- What navigation and landing aids would be needed?



Note: Numbers Represent Annual Local O-D Passengers In Thousands For 1968.

Source: "Passenger Demand In Shorthaul Markets", CAB, March 1971

FIGURE 4.2 - MAJOR SHORT-HAUL TRAFFIC TO AND FROM CHICAGO

Figure 4.3 shows only the Detroit routes in schematic form. There are similar possible routes to the other cities, and these would be considered in the analysis but they are omitted from the figure for clarity.

In order to provide a basis for system-wide decisions, a comprehensive national picture will be built up by a series of individual metropolitan area analyses of this type.

4.2.3.2 Assessment of Federal Implementation Options. The second type of question to be addressed is that of estimating what would happen in the way of short-haul implementation in response to various possible Federal actions. The costs of these actions are also of interest, though they may be somewhat easier to determine than the responses of non-Federal decision makers. In estimating these responses, the different participants pose rather different problems. The decision-making group for aircraft manufacturers is rather small. The response of local communities involves millions of persons. The study technique will have to be adapted accordingly.

In dealing with all participants, however, it will be mandatory to present rather concrete and well-described alternatives to elicit a response. Accordingly, the first step would be to carry out a preliminary analysis of all the options. This would define them more accurately, and estimate costs and possible time schedules. Then a number of parallel studies would be carried out to estimate reaction of each of the participants to the possibilities so defined. Following this series of studies, the prospects for each option would be reassessed, and recommendations could be formulated for subsequent action.

The amount of past work in this area is not nearly so large as that for Synthesis and Analysis. The CARD study [57] of institutional factors, covers a number of points of interest, but not all that are required here. Perhaps the only portion of this area which has received extensive attention is the effect of aircraft noise on communities. It is not possible to review all this work here, but the surveys of Kryter[58-59] and the bibliographies of References 36,

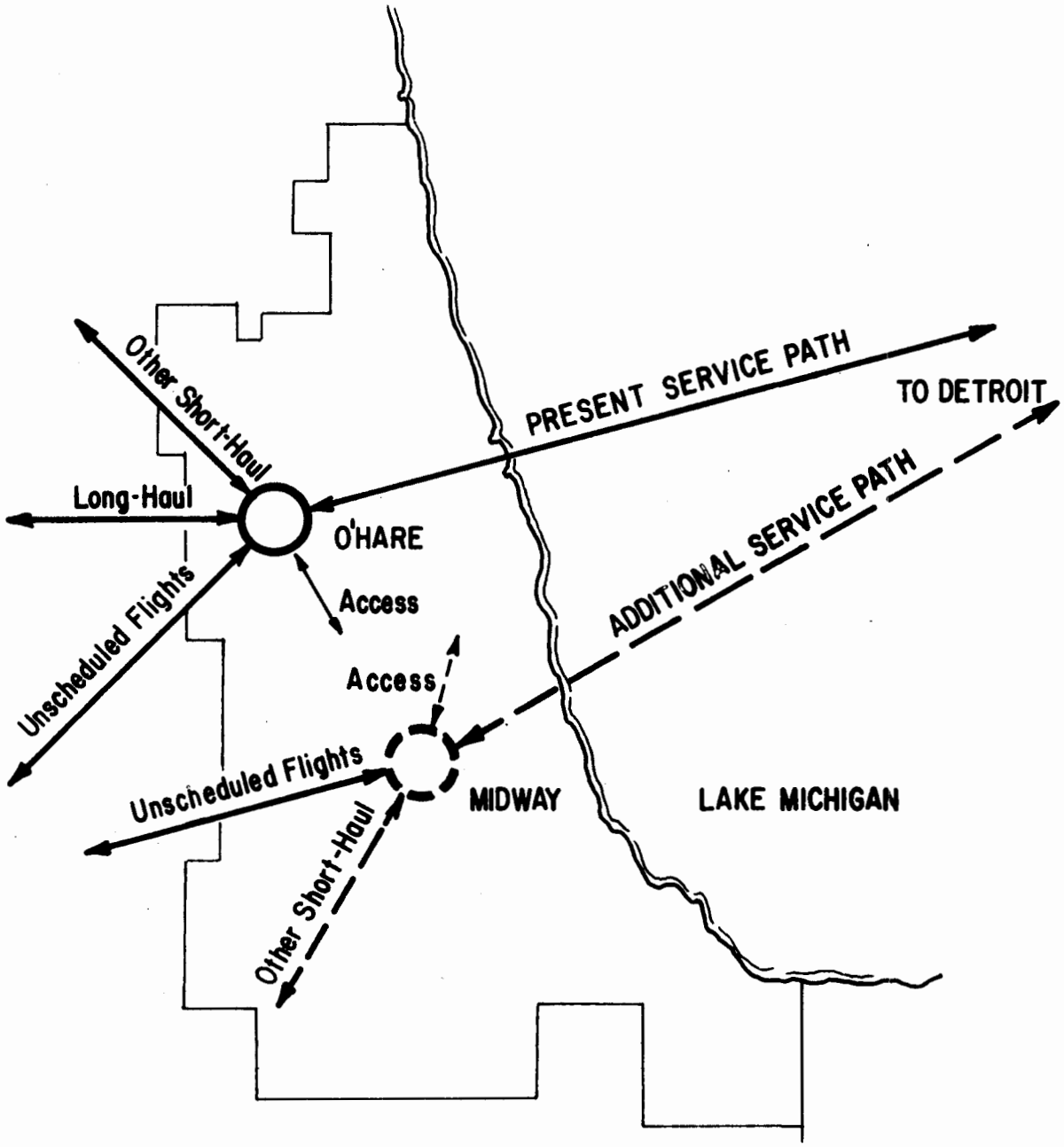


FIGURE 4.3 - EXAMPLE ALTERATION OF CHICAGO AIRPORT SITUATION AND RELATED SERVICE PATH CHANGES

37, and 52 contain additional sources. Despite all this work, it is not possible to predict accurately the community response to noise, although a general estimate can be given.

Broader ranges of community-related issues have been considered in several recent studies[60-62] indicating that this is one of the most difficult areas in which to determine attitudes.

In some instances, airlines have been willing to discuss aircraft requirements[63-65], and other system issues[66,67], but for the rest of the area considered here, prior formal work is limited.

4.2.4 Planned Activities

In this section are listed the specific activities to be undertaken to meet the requirements outlined above. Each activity is described separately, and the relationships among them are indicated in Figure 4.4. The interconnections among the activity areas for the entire program are indicated in Section 4.6.

Activity 101: Survey the Existing Short-Haul System

Responsible Organization: FAA/CAB

Objective: To assemble a comprehensive description of the existing short-haul air transportation system; equipment; institutions; and service.

Requirement: The results of this task will be used in a number of ways throughout the program. They will be used in formulating system criteria (Activity 104), in analyzing existing segregated services (Activity 102), in carrying out the metropolitan area studies (Activity 106), and in formulating the national recommendations (Activity 117). They will also be useful in preparing the planning data book (Activity 115), and in several other portions of the program.

Discussion: For the most part, this survey will be compiled from existing sources. A start has already been made[68,17] but more needs to be done. The CAB routinely maintains tabulations of much of the data related to

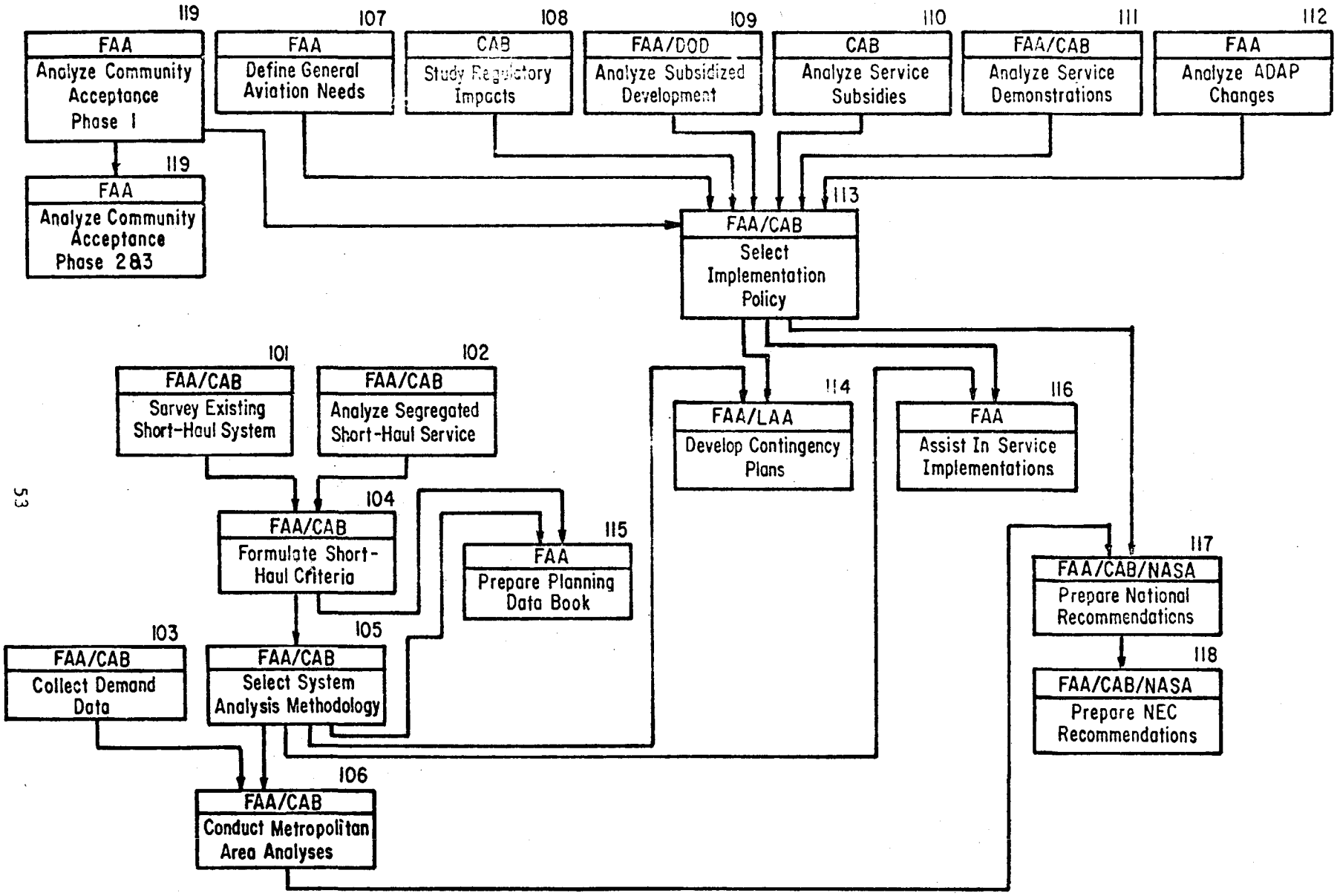


FIGURE 4.4 TRANSPORTATION SYSTEMS ANALYSIS ACTIVITIES

certificated carriers. For the rapidly changing commuter picture, CAB data are less complete, and additional sources will be needed. For airports, results will be drawn from Activity 206, though that activity will not be completed prior to the completion of Activity 101.

It would be easy to develop a large mass of detailed information on this subject, but the objective should be to confine attention to those aspects of the present system which are of most concern to this study: the system quality as seen by the various participants. The criteria used by the participants are developed in more detail in subsequent studies, but enough is known at present to make possible a suitable selection of material in the survey effort.

The topics to be considered would include:

- Measures of the degree of accessibility of short-haul air transportation to residents in different localities
- Service quality (fare, frequency of service, trip time, comfort, and convenience)
- Economic characteristics, as seen by air carriers and airport operators
- Financial and social costs placed on the taxpayers and the general public
- Employment and contribution to the GNP attributable to short-haul air transportation.

Also, the age distribution of aircraft in the current fleet will be determined, as this will have an important influence on implementation of new short-haul systems.

Performance Period and Milestones: This activity should be initiated by January, 1973, with completion by August, 1973.

Activity 102: Analyze Existing Segregated Short-Haul Services

Responsible Organization: FAA/CAB

Objective: To identify those services in the existing system, which most closely approximate the segregated short-haul concepts of interest, and to analyze each to determine:

- What factors have led to the current level of service
- What information relative to demand modeling and modal split can be

- What information relative to mode choice dynamics can be obtained
- What unique operational techniques were developed in order to initiate the service
- What are service costs to the carrier and airport operator?

Requirement: Results of this activity will be used in formulation of short-haul criteria (Activity 104) and in determining the analysis methodology to be used (Activity 105).

Discussion: The existing short-haul system can be an excellent, low-cost laboratory for validating otherwise theoretical concepts. While some work of this kind has been initiated[69], it appears that much more information can be extracted. Fundamentally, the process will be one of calibrating analytical models of the service against the observed results, to assist in evaluating the effectiveness of the models. As a result of the study, probably suggestions can be made relative to possible improvements in the situations studied. If those improvements are implemented, further data would be obtained.

Performance Period and Milestones: This study should be initiated by January, 1973, with completion by August, 1973.

Activity 103: Collect Demand/Demographic Data for the Largest Hubs

Responsible Organization: FAA/CAB

Objective: To collect demographic data for at least the 22 hubs, for the purpose of modeling demand as a function of airport location.

Requirement: For each of the metropolitan area analyses (Activity 106) demand modeling will be required. The contingency planning efforts (Activity 114) and the near-term service implementations (Activity 116) will also require this type of information.

Discussion: No generation of new data is included here. It is simply a utilization of existing sources, with estimation being made in cases

where critical data are missing. The actual sequence of work will be closely coordinated with developing requirements in Activities 106, 114, and 116.

Not only present data, but projected future growth patterns will be required. Much of the information can be obtained from local metropolitan planning agencies.

Performance Period and Milestones: Work on this activity will parallel that of Activities 106, 114, and 116. To supply Activity 106, work should be started no later than May, 1973, and an earlier start might be required if needs develop sooner in Activities 114 or 116. Efforts will probably be required from time to time throughout the program.

Activity 104: Formulate Criteria for Short-Haul Air Transportation

Responsible Organization: FAA/CAB

Objective: To develop a statement of the system characteristics which will be used to judge the quality of short-haul air transportation. The list of criteria may be extensive. It should reflect the interest of all participants in air transportation without attempting to judge one against the other. The participants considered should include:

- Air travelers
- Air Carriers
- Local airport authorities
- Local communities
- The investment community
- Airframe and engine manufacturers
- The Federal government

Requirement: These criteria are needed for three purposes:

- To provide a basis for organizing the survey of Activity 101
- To provide a basis for evaluating improvements in short-haul air transportation as the program proceeds
- To develop the requirements for transportation system analysis methodology, Activity 105.

Discussion: As most system studies have contained some discussion of criteria, there is substantial material from which to draw. What is required is primarily collection, evaluation, and organization of available material.

Target values have been discussed for some criteria such as ROI for air carriers. For others, such as flight safety, there is little quantitative methodology and no quantitative target. Each criterion will be examined from this standpoint.

In putting together this list of criteria and the supporting discussion, maximum use should be made of judgmental inputs from many sources. It may be possible to make the list noncontroversial, inasmuch as there is no intent here to weigh one against the other. At the same time, the list should be kept to a length which emphasizes the major considerations which bear on policy making.

Performance Period and Milestones: This activity will begin not later than February, 1973, and be completed by August, 1973.

Activity 105: Select and Implement System Analysis Methodology

Responsible Organization: FAA/CAB

Objective: To assemble a collection of quantitative and nonquantitative procedures which will provide the capability to:

- Evaluate the results of a variety of segregated short-haul innovations
- Consider the interests of all participants
- Depict adequately the uncertainties present in the results
- Consider the evolution in results over a period of years.

Requirement: The methodology developed here will be used in the metropolitan area analyses leading to the national recommendations (Activity 106) and may also be applied in the contingency-planning efforts (Activity 114) and in assisting near-term service implementations (Activity 116).

Discussion: Selection of methodology will draw heavily on the numerous past system studies, some of which are referenced above. In fact, some existing computer programs can probably be used with minor modification.

The essential situation to be modeled is that of a single metropolitan area, its airports, and the short-haul routes serving those airports. Long-haul and unscheduled traffic at these airports must be considered in respect to their contributions to noise and congestion. Since metropolitan areas and study objectives differ, a collection of methodologies will be required, rather than a single procedure. For a particular problem, a suitable set of techniques can be assembled.

The considerations involved in selecting a methodology have already been discussed, and that discussion need not be repeated here. The product of this activity will be a group of tools for determining the impacts of various segregated short-haul alternatives. Some will be computer programs, others will be nonquantitative or partly quantitative procedures to be followed.

Performance Period and Milestones: This activity should be initiated by February, 1973, and completed by August, 1973.

Activity 106: Conduct a Series of Metropolitan Area Analyses

Responsible Organization: FAA/CAB

Objective: To conduct analyses of the influence of short-haul innovations on a group of metropolitan areas, including at least the 22 hubs which may suffer major capacity problems within the next 10 years. The time period to be analyzed is the 1980's.

Requirement: The results of a group of these studies will be needed in preparing the national recommendations (Activity 117). They will also provide directions for ATC and airport studies (Activities 302 and 303). Analyses of this type may also be used in the contingency-planning efforts (Activity 114) and in near-term implementations (Activity 116).

Discussion: High-density service in the 1980's is frequently mentioned as the major area in which segregated short haul will contribute to relief of air transportation problems. It is the focus of the Northeast Corridor decision and it has equal importance in the nation as a whole. This group of studies, then, is concerned with one of the most significant issues of the entire program.

The studies will make use of the methodology developed under Activity 105 as well as inputs from Activities 302 and 303. The situation of each hub will be analyzed, and the forms of segregated short haul which seem most reasonable will be selected. The results obtained by introducing these options will be analyzed over a period of years. For each hub, results will be estimated both for the new short-haul system selected and for the existing short-haul system developed as currently planned. The differences between the two are the most significant result. Effects will be evalutated from the standpoint of all participants.

The fundamental objective of the series of studies is to provide a basis for national short-haul decision-making. The studies, taken as a group, should provide answers to questions like the following:

- Which are the most promising short-haul innovations, and where are they most beneficial
- What would be the characteristics of the fully developed system
- What rate of introduction of segregated short haul will be the most suitable; where should initial introduction be undertaken
- What size of market for aircraft will be developed by segregated short haul
- What changes in the ATC system and in airport design are required to make the selected options viable?

These questions cannot be answered within a single study of the series. The answers must be based on the entire group of results. However, in selecting the individual studies to be done, and in deciding how to carry them out, these larger objectives may exert a strong influence.

Performance Period and Milestones: The first of these analyses should be initiated by August, 1973. Work would continue as needed throughout the program in Activities 114 and 116. More specific milestones are:

- June, 1974 - Completion of the Northeast Corridor Analyses
- April, 1975 - Completion of additional analyses in support of the national recommendations.

Activity 107: Define General-Aviation Needs in Major Metropolitan Areas

Responsible Organizations: FAA

Objective: To develop a method for estimating the effect of the segregated short-haul concepts on general aviation.

Requirement: General aviation impacts are required for Activity 113.

Discussion: Introduction of segregated short-haul service will have various effects on the different types of general-aviation operators, some positive and some negative. It can be observed that terminally configured vehicles may be more compatible with general-aviation vehicles in the terminal area than are present CTOL transports. Thus, facilities developed for short haul might be available to general aviation to some degree.

On the other hand, one of the principal short-haul options is use of airports not now having scheduled service. Such airports are now used extensively by general aviation, and institution of passenger service may interfere, to some extent, with general aviation usage.

These factors must be considered in projecting levels of general-aviation activity in future years, and with future airport combinations. Such projections are in turn required in order to analyze the effect of short-haul innovation on congestion, noise, and air-space problems.

Work is now under way to assess the impact of increased costs on general-aviation activity levels. This is a part of the problem being considered here, but the desired forecasts will need to consider

other factors not directly relatable to cost: changes in airport location and ground access, degree of congestion in the air and on the airport, required skill levels, and others.

Performance Period and Milestones: This activity should begin by October, 1973, and be completed by April, 1974.

Activity 108: Study Regulatory Impacts of Short-Haul Concepts

Responsible Organization: CAB

Objectives: To develop information on which to base decisions on the questions:

- Would new carriers and new route awards be required for any of the short-haul concepts now being considered
- What is the competitive relationship between any new short haul and existing short-haul service
- What degree of competition is appropriate within segregated short haul
- What fare policy should be employed in segregated short haul?

Requirement: Answers to these questions are required in order to:

- Select an implementation approach (Activity 113)
- To provide guidance to the particular near-term situations being considered in Activity 116.

Discussion: Certain segregated short-haul services are operating under the current regulatory structure. One of the results of Activity 102 would be to indicate the extent to which lack of growth in the existing services can be attributed to regulatory factors.

For systems in the future and particularly high-density segregated service, problems can be expected which have not been encountered in the existing system. Some aspects of these questions have been considered by the CAB in recent investigations[8,38].

Performance Period and Milestones: This activity should be initiated by April, 1973, and completed by April, 1974.

Activity 109: Analyze Subsidized Aircraft and Engine Development

Responsible Organization: FAA/DOD

Objective: To estimate the costs and benefits of the various techniques which could be used to directly motivate production of a suitable short-haul vehicle.

Requirement: This is one of a number of Federal implementation steps. As such, its costs and benefits need to be known in order to assess implementation strategies (Activity 113).

Discussion: There are a variety of techniques which have been used in the U.S. and in other countries to stimulate civil aircraft developments. These range from loan guarantees through common civil-military developments to fully funded prototype and production activities. All have the effect of reducing the uncertainties facing the manufacturer, so that he is more likely to undertake a commitment to production.

In the short-haul situation, it is not known just how much stimulus would be required to produce action. In appears that the technology is not yet in hand to produce an aircraft with the characteristics favored by the present trunk and local-service carriers. If this is true, no amount of stimulus will be adequate to initiate production of such an aircraft. In the case of current-technology, low wing loading STOL and helicopters, the applicability to high-density markets, and hence, the need for large quantities of aircraft is open to question. Subsidies could result in production of such aircraft within a few years, but it is not clear what type and amount of subsidy, if any, would be needed.

The approach, then, would be to prepare a list of possible steps, and estimate their costs. Then, reactions would be obtained from manufacturers of various classes of aircraft. From these reactions, an estimate would be made of what would be required on the part of the Federal government to stimulate production of: (a) a near-term short-haul aircraft, and (b) an advanced-technology aircraft.

Performance Period and Milestones: This activity should be initiated by December, 1973, with completion by April, 1974.

Activity 110: Analyze Service Subsidy Possibilities

Responsible Organization: CAB

Objective: To generate several mechanisms for stimulating segregated short-haul service by means of direct payments to carriers and to estimate the service which would result and the costs to the government from such mechanisms.

Requirement: This is one of the implementation strategies which is to be considered in Activity 113.

Discussion: Service subsidies have been in effect for some years for some local-service routes, and the subsidy formula is currently under review. These subsidies are in low-density markets. As for high-density markets, permanent subsidies might well be inappropriate, but initial payments might remove much of the financial uncertainty which now faces carriers who might consider initiating segregated operations.

The risks facing such a carrier will be analyzed and the effects of various types of subsidy formulas will be estimated. If the subsidy is to be temporary, the difference between a subsidy and a demonstration program might not be large.

Performance Period and Milestones: This activity will begin by April, 1973, and end by April, 1974.

Activity 111: Analyze Service Demonstrations

Responsible Organization: FAA/CAB

Objective: To:

- Determine the types and magnitudes of benefits which could be obtained from service demonstration programs
- Estimate the costs associated with such programs
- Evaluate the regulatory problems posed by running a demonstration, especially one in a high-density market
- Design one or more demonstration programs for use as candidates in the Federal implementation program decision.

Requirement: This is one of a number of Federal implementation steps, and as such, its costs and benefits need to be known in order to select an implementation strategy (Activity 113).

Discussion: A demonstration program involving fare-paying passengers has been frequently suggested as a means of breaking the short-haul impasse. To investigate high-density service problems, the demonstration would have to offer a substantial volume of service, and would, thus, be a major undertaking.

In general, the objective of such a program would be to increase confidence in the viability of segregated short-haul service, but more specific objectives need to be defined. Once the objectives are determined, a demonstration could be designed to accomplish the objectives. There are a number of problems to be considered. For example, it is axiomatic that the demonstration would have to be carried out with aircraft which are available at the time of the demonstration. If it is desired to test reaction to an advanced-technology aircraft, the demonstration would have to await manufacture of these aircraft, and in that event, it could not contribute to the decision to commit the aircraft to production. If a different aircraft is used in the demonstration, the results are always open to question. Analysis of questions of this type would be done in this task.

Performance Period and Milestones: This activity will begin by October, 1973, and be completed by April, 1974.

Activity 112: Analyze ADAP Funding Formula Changes

Responsible Organization: FAA

Objective: To:

- Review the capital funding problems of local airport authorities in relation to the segregated short-haul concepts
- Estimate the effects of changes in the existing ADAP rules
- Estimate the costs associated with such changes.

Requirement: This is one of a number of possible Federal implementation steps. As such, its costs and benefits need to be known in order to evaluate the implementation problem (Activity 113).

Discussion: There has been very little study of this type in the recent past, so this effort is essentially a new start. The approach would be to design several reasonable programs of changed funding formulas, and elicit responses from a number of local airport authorities to these changed formulas. Based on these responses, estimates of the effects and of the costs of the revised programs would be prepared.

Performance Period and Milestones: This acitivty will begin by April, 1973, with completion by April, 1974.

Activity 113: Select Recommended Implementation Strategy

Responsible Organization: FAA/CAB

Objective: To select the best course of Federal action for bringing about implementation of the desired segregated short-haul system.

Requirement: This is one of the major components of the national recommendations (Activity 117) and the Northeast Corridor recommendations (Activity 118).

Discussion: The central issue in this activity is the complex web of motivations acting on the various participants in air transportation. Overall, the study of these motivations will proceed in three phases. The first is embodied in Activities 107 through 112, and Activity 204. Each of these involves a preliminary analysis of a possible Federal action step. These studies are designed to outline the possibilities as well as possible from the Federal standpoint. The two remaining phases are included in this activity. They are:

(1) Consultation with appropriate representatives of the non-Federal participants to obtain reactions to the possibilities defined in Activities 107-112 and 204

(2) Analysis of the results of (1) to estimate the probable consequences of the various action steps and to select the preferred implementation option.

The participants whose reactions need to be considered include:

- Local communities
- Aircraft operators
- Airport operators
- Aircraft and engine manufactures
- The investment community
- General aviation.

The approach in each case will be somewhat different. Local communities present special problems which will be addressed in Activity 204, which runs in parallel with this activity. Close coordination between the two will be required in order that Activity 204 can deal with the right questions.

Performance Period and Milestones: This activity will begin by April, 1974, with completion by April, 1975. Approximately the first half of this period will be devoted to obtaining the participants reactions; the last half to analyzing them, and selecting a recommended approach.

Activity 114: Develop Congestion Contingency Plans

Responsible Organization: FAA/Local Airport Authority

Objective: To study each of the 22 critical hubs to determine what contribution segregated short haul could make to a capacity problem developing in the near term (prior to 1982) and to prepare implementation plans for those hubs in which a meaningful contribution seems possible.

Requirement: These contingency plans are the principal response to the possibility that congestion (or capacity limitation) could occur well before new-technology aircraft are available and with relatively little prior notice.

Discussion: The near-term possibilities for high-density short haul must be analyzed on the basis of specific metropolitan areas. After the initial analyses of Activities 302 and 303 are completed, it will be possible to begin working with each of the metropolitan areas

to develop an approach. The methodologies of Activity 105 may be applied in carrying out studies of the various problems.

The available options will depend on the time at which relief is needed, so several plans may be needed for each metropolitan area for different time periods. Also, the plans will require updating as time goes on, and more accurate information becomes available.

Performance Period and Milestones: These plans can be started at any time, though as the program proceeds, there will be more information available from other studies. An initial survey of the 22 hubs should be followed by initiation of work on any hub which seems to offer promise.

Activity 115: Prepare Planning Data Book

Responsible Organization: FAA/CAB

Objective: To prepare and update as required a central source of information on segregated short-haul air transportation.

Requirement: This data book will serve as a major means of communication among the short-haul participants. In particular, it is needed for a data base for Activity 116.

Discussion: One of the problems in short-haul air transportation seems to be a lack of a common frame of reference. There is little agreement on definitions, methodologies, or on predicted system characteristics. The planning data book is intended to be a compilation of the best-substantiated current knowledge in all these areas.

It will contain the best available data on all system elements such as aircraft, airports, and ATC. It will discuss a range of system analysis methodology. It will contain estimates of system performance, under various conditions, to the extent that such estimates can be validated. It will contain summaries of operating experience that is relevant to the subject, e.g., costs and revenues in existing segregated short-haul service.

It should provide a planning basis for all participants, but it should be especially useful to local airport authorities, as they frequently do not have the means for data-gathering and analysis of this type.

Performance Period and Milestones: Some elements of work on this activity could begin immediately but major inputs will come from Activities 101, 102, 104, and 303 so a start about July, 1973, is indicated with the first edition completed by January, 1974. Subsequent revisions will be carried out, as needed, through the remainder of the program.

Activity 116: Assist in Near-Term Service Implementations

Responsible Organization: FAA

Objective: To encourage the initiation and growth of new short-haul service which is similar to the segregated concepts of interest in this program.

Requirement: This is one of the major outputs of the program. Evolutionary developments in segregated short haul must be encouraged in accordance with the objective of keeping all options open. These near-term services will provide data for many other activities in the program. It is also possible that some of these services could evolve into high-density operations. In fact, this could be a principal path for bringing high-density short-haul air transportation into being.

Discussion: In Section 4.2.3, several current examples are given of situations in which new services are being seriously considered. It is expected that additional opportunities of this type will appear during the course of the program.

There are a number of things which can be done within existing authority to assist in these efforts. Analysis work will be required in some cases; in others, it would be assisting in Federal coordination and approval activities. In some cases, new equipment or procedures might be involved.

Each problem will be quite site specific, and each will have to be addressed individually. This type of activity will continue throughout the program, but it cannot be accurately planned in advance. Much of the initiative has to come from non-Federal participants. These efforts

will draw on results from almost all other parts of the program, to whatever extent they are available at the time the need arises.

Performance Period and Milestones: Substantial work in this area is currently under way, and will continue as needed throughout the program.

Activity 117: Prepare National Short-Haul Air Transportation Recommendations

Responsible Organization: FAA/CAB/NASA

Objective: To prepare recommendations for short-haul air transportation for the 1980's.

Requirement: This is one of the major program outputs. It will play an important role in national decision-making relative to short haul.

Discussion: These recommendations will be the end product of much of the analysis work in the program. They should consider all significant aspects of short-haul air transportation. In particular, the recommendations should contain:

- A description of the most desirable short-haul air transportation system configuration
- An evaluation of that system in terms of transportation quality, economic performance, and community impact
- An analysis of the regulatory problems associated with the short-haul system
- A plan for implementation, including major action steps and funding requirements for the Federal government and non-Federal participants.

Performance Period and Milestones: Formulation of the recommendations will be started by April, 1975, with completion by October, 1975. Following this, a set of national short-haul guidelines will be published summarizing all the analysis results up to that point. The guidelines document will be completed by April, 1976.

Activity 118: Prepare Northeast Corridor Recommendations

Responsible Organization: FAA/CAB/NASA

Objective: To prepare recommendations for short-haul air transportation for the 1980's in the Northeast Corridor.

Requirement: This is one of the major program outputs. A need for such recommendations was identified in the final Northeast Corridor Transportation Project Report.[5]

Discussion: This activity is not essentially distinct from Activity 117. The problems of the Northeast Corridor will play a major role there. National recommendations will be heavily influenced by the corridor situation. Accordingly, this activity involves primarily separating that material relating to the corridor, and preparing a separate document. The same type of material will be contained in the Activity 118 document as will be found in that for Activity 117.

Performance Period and Milestones: Work will be started on the Northeast Corridor recommendations by July, 1975, with completion by January, 1976.

Activity 119: Analyze the Community Acceptance Problem

Responsible Organization: FAA

Objective: To clarify the causes of community opposition to airport developments and lay a basis for predicting the type and extent of opposition to be expected under various circumstances.

Requirement: Information of this type will be needed in support of Activity 116. It is also required for the implementation portion of the national recommendations (Activity 113).

Discussion: A number of recent studies have agreed that community acceptance is one of the major problems facing air transportation. The principal cause of community reaction appears to be noise, but there are, apparently, other components as well. It is possible that segregated short haul can make a major contribution to relief of the community acceptance problem. For this reason, the problem warrants serious attention as part of this program.

By "community acceptance" is meant acceptance of an airport project by community citizens, as opposed to acceptance by the local airport authority and/or the local government. The latter two groups have viewpoints on airport questions which are somewhat different from that of the citizens, and, thus, they may favor a project which is ultimately stopped by citizen reaction. In analyzing possible short-haul implementations, then, it is necessary to consider the reactions of community citizens as well as those of the local government and the airport authority.

The first requirement is a better understanding of the problem. In essence, it is desired to know the nature and extent of the public attitudes which lead to opposition to airport projects. The questions to be answered include the following:

- What noise levels are acceptable under what circumstances
- What role does pollution play in community attitudes toward airports
- What types of individuals and groups are most likely to initiate active opposition
- What are the motivations of those individuals and groups, and where do they live with respect to the airports
- To what degree is opposition based on airplane characteristics, airport characteristics, attitudes toward air travel, and general reactions against large business or governmental activities or other causes?

These questions have been extensively discussed over the past few years, but only the first has been attacked systematically. Despite more than a decade of investigation, both in the U.S. and abroad, this question had not been completely answered. It may be that the reason is that it cannot be severed from the other questions. Until all the significant effects are understood and controlled, it may be that studies of noise alone will continue to give mixed results.

Since very little is known about some of the effects, the approach to the problem should be closely tied to actual results. It will contain three phases:

- A review of all the case histories which seem relevant to the problem, cases in which opposition was successful, and cases in which it was not (with particular emphasis on segregated short-haul situations)
- An opinion-polling and interview program to test hypotheses generated from analysis of the case histories
- Analysis of the results of the first two phases, and preparation of guidelines for approaching the community acceptance problem

The results of this work will be used in two ways in future programs. First, it will be used to guide the design of airport projects prior to submitting them for public approval; and second, it will be used to guide the process of obtaining such approval.

In addition to defining the fundamental factors involved, the program will be designed to quantify the factors to the extent possible. It has been suggested that some formula for cash payment to those suffering disbenefits from airport development could overcome the problem. Payments have been involved in some past and current cases, but little rational basis exists for deciding on an effective payment formula. If, as part of this study, it is possible to get at the question of cash value of airport disbenefits, it would be most helpful in determining policy.

Performance Period and Milestones: Work in this area will continue throughout the program, dealing with implementation activities. The study portion, consisting of the three phases outlined above will be timed as follows: Phase 1 started by October, 1973, completed by April, 1974; Phase 2 started by April, 1974, completed by October, 1975; and Phase 3 started by October, 1975, completed by June, 1976.

4.2.5 Milestones and Funding Requirements

Figure 4.5 shows the durations of the activities, together with the major milestones produced. The key to the milestones in the figure are given in Table 4.1.

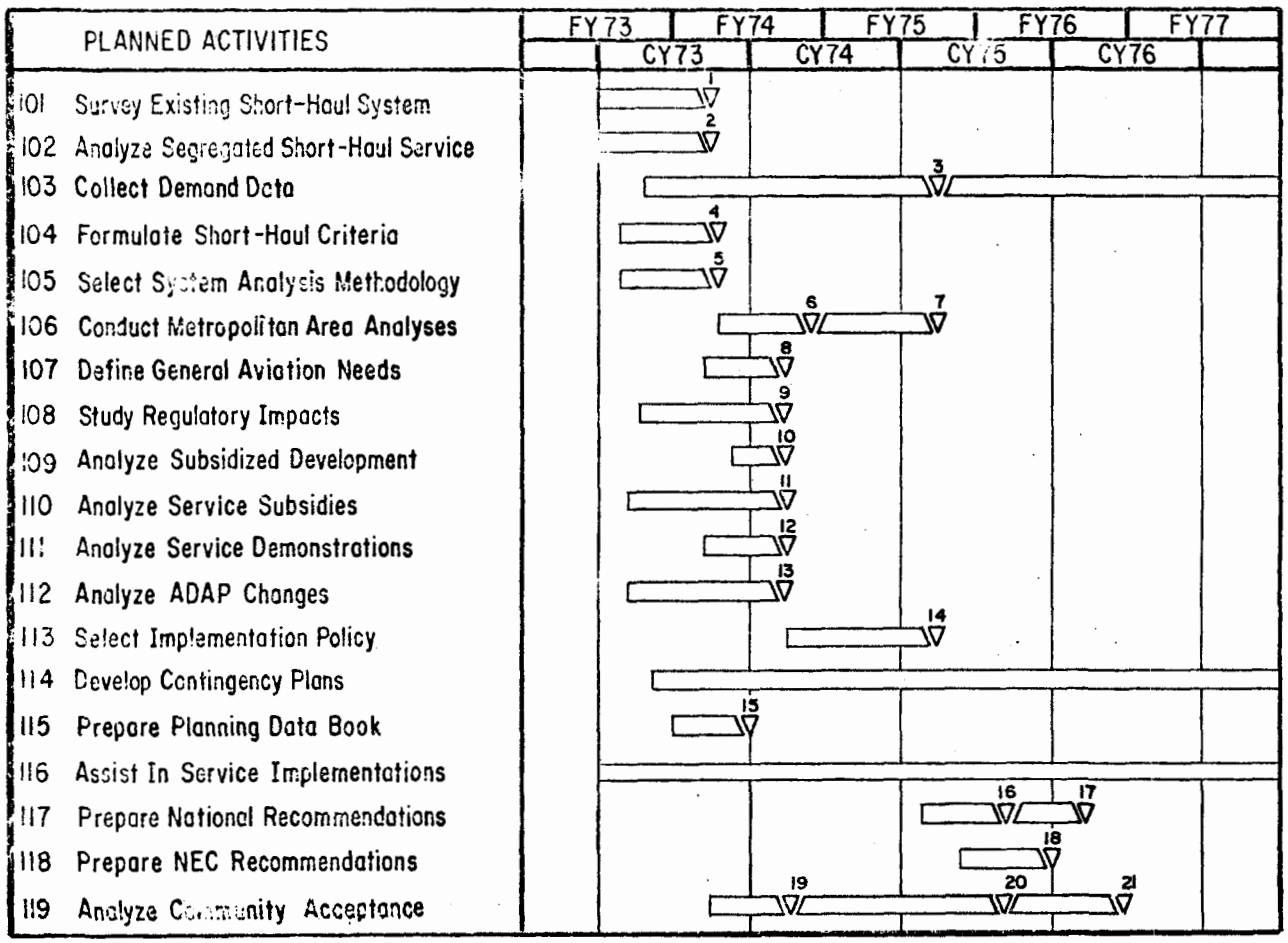


FIGURE 4.5 TRANSPORTATION-SYSTEMS-ANALYSIS ACTIVITIES AND MILESTONES

TABLE 4.1 MILESTONES FROM FIGURE 4.5

Milestone Number	Identification
1	Complete survey of existing system
2	Complete analysis of segregated services
3	Complete demand data for Activity 106
4	Complete short-haul criteria
5	Complete system analysis methodology
6	Complete NEC metropolitan area analyses
7	Complete other analyses
8	Complete study of general aviation needs
9	Complete study of regulatory impacts
10	Complete analysis of subsidized development
11	Complete analysis of service subsidy
12	Complete analysis of service demonstrations
13	Complete analysis of ADAP changes
14	Complete selection of implementation strategy
15	Complete first edition of planning data book
16	Complete formulation of national recommendations
17	Publish national guidelines
18	Complete NEC recommendations
19	Complete analysis of community acceptance, Phase 1
20	Complete analysis of community acceptance, Phase 2
21	Complete analysis of community acceptance, Phase 3

Table 4.2 shows the funding requirements for this area. Included here are the funds for planning and coordinating the activities of the entire program, though this is not listed as a separate activity.

TABLE 4.2. TRANSPORTATION SYSTEMS ANALYSIS FUNDING REQUIREMENTS ($ Millions)

Agency	Fiscal Year					
	1973	1974	1975	1976	1977	1973-77
FAA	0.915	1.767	1.615	1.460	1.420	7.177
NASA	0.970	0.920	0.890	0.860	0.700	4.340
CAB	0.235	0.368	0.245	0.110	0.050	1.008
Total	2.120	3.055	2.750	2.430	2.170	12.525

4.3 Airport Activities

4.3.1 Scope

The Airport Activities are concerned with investigating what changes may be required in the existing and planned national system of airports, and the underlying guidelines, standards, and grant programs to accommodate the alternative means of achieving segregated short-haul operations. Where appropriate, and in conjunction with local authorities, planned alterations would be made.

The activities include studies of available airport facilities and landing sites, design and costing studies, analysis of urban requirements for airports, simulation and capacity studies, and limited experimental flight-test work. The scope of this work covers:

- Airport airside - the configuration of runways, taxiways, aprons, gates, ground-control and guidance, and safety items
- Airport landside - terminals, facilities for processing passengers, baggage, and cargo, parking, and intra-airport transportation
- Urban access/egress - available modes, capacity requirements, and costs.

The planned work will identify what types of airport configurations and related standards may be necessary to support the segregation of short-haul traffic from long-haul facilities in the major metropolitan areas of the country. Further, it will identify the options which may be available for facility expansion and development in each of the metropolitan areas of interest. This latter work will depend heavily on the local situation in terms of acceptance by the nontravelling public, land use, finances, and other implementation matters. Finally, the program effort will provide guidance on what alterations may be required in airport standards, and in the existing airport-grant program to facilitate local airport development.

The development of airports and related urban access/egress systems is the purview of local authorities. Thus, their initiative is an important element in this phase of the short-haul improvement program. The Federal government, on the other hand, can and should develop the necessary data, guidelines, and procedural materials to facilitate local action.

4.3.2 Statement of the Problem

The present national system of airports, as defined in the National Airport System Plan, numbers some 3,200 primary, secondary, and feeder airports. Many of the larger of these are the focus of much of the concentrated short-haul activity in the United States.

These existing airports, and the present plans for improving them, do not give special recognition to the several means which have evolved for accommodating segregated short-haul operations. In particular, the more serious airport arrangements which are under consideration are:

- The reconfiguration of existing CTOL airports to provide segregated short-haul runways and terminals apart from the existing facilities
- The upgrading and use of certain secondary/feeder airports for scheduled short-haul operations as well as unscheduled traffic now using such facilities
- The development of new suburban and CBD airports, including elevated ones in the latter case, for exclusively short-haul operations.

All of the arrangements are meaningful as long as the aircraft under consideration are assumed to be terminally configured (less requirements for real estate and air space than present CTOL designs).

At the more general level, these alternative airport concepts/configurations raise important questions:

- Are there realistic facilities and sites in the metropolitan areas of interest which could be used for these purposes and, at the same time, be made acceptable to the communities

- What would the characteristics, capacity, and costs of such facilities be
- Are the provisions of the present Planning Grant and Airport Development Aid Programs adequate to the task of developing such facilities?

At a more technical level, the types of questions which arise are related to the adequacy of present airport design guidelines:

- At airports with segregated long-haul and short-haul operations, how are short-haul runways and taxiways to be configured to both minimize aircraft ground maneuver time and avoid interference with other operations
- With CBD short-haul airports, particularly elevated versions, what special safety precautions are needed with respect to runway overrun and unusual air currents
- What types of operating and noise standards need to be developed for short-haul type airports?

In addition to the above, the schedule requirements for any one or more of the alternative airport concepts is not known. Therefore, there is a need to determine the kind of phasing of actions needed to support the transportation systems analysis work and to prepare the way for the introduction of such systems. In this last category, an important consideration will be to define what requirements exist for facility and site preservation.

4.3.3 Approach

Because it is not possible to conclude with reasonable certainty what types of short-haul concepts will evolve, nor in which areas these developments will first take place, the exact requirements for airport modifications and development are not known. Near-term effort on multiple options will be undertaken both to keep all options open, and to facilitate Federal government and local community definition of viable alternatives.

Efforts will be expended to develop more precise information concerning the characteristic design features, costs, capacity, and community impact of the alternatives. Experimental and testing activities will be carried out to anticipate and resolve unique operational problems.

Concurrently, extensive efforts will be undertaken to examine individual community needs, airport facility resources, the best options for given metropolitan areas, and, ultimately, the necessary changes in guidelines, policy, and grant programs to facilitate short-haul improvements.

The activities will be selected and phased so as to complete most of the facility definition work by the middle of 1974, assist with recommendations for the national system by mid-1975, and establish the necessary airport design guidelines by mid-1976.

The presently planned FAA activities in the airports area are complementary to, and included as part of the planned activities. Additional activities will be required and are included as necessary.

4.3.4 Planned Activities

In this area, the work has been divided into ten activities, which are described separately below. The interrelationships among the activities is indicated in Figure 4.6. The relationship to other activities in the program is indicated in Section 4.6.1.

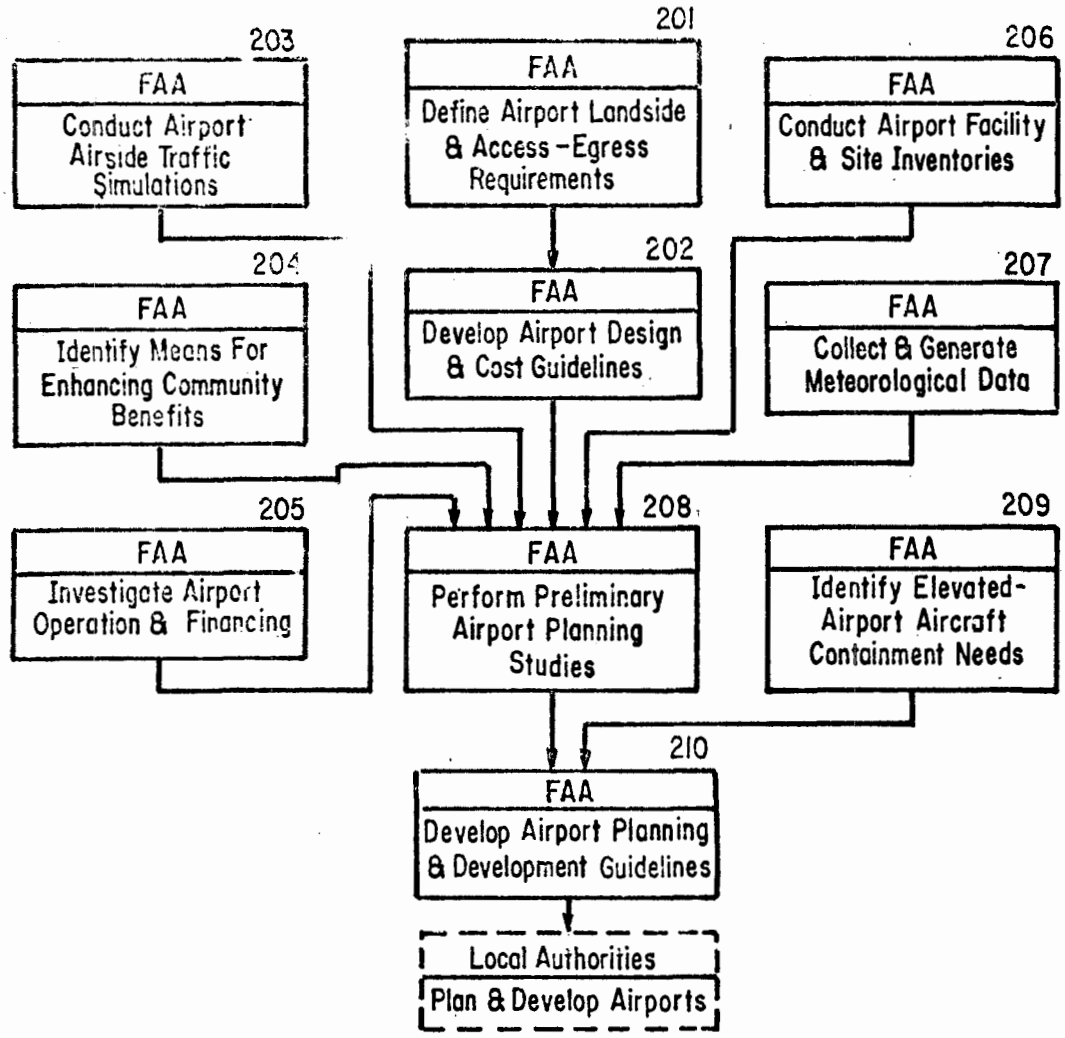


FIGURE 4.6 AIRPORT-SYSTEM-DEVELOPMENT ACTIVITIES

Activity 201: Define Airport Landside and Access-Egress Requirements

Responsible Organization: FAA

Objective: To develop guidelines for the capacity requirements of airport landside facilities and urban access-egress systems which would be compatible with various types of short-haul airports and service levels.

Requirement: Airport development has frequently taken place without a full realization of requirements for landside development and access-egress to handle the anticipated levels of activity and preclude congestion and delay. To avoid this in future short-haul airport development, this type of information must be considered along with airport airside data in evaluating, planning, and developing sites. The results of this activity are needed as input to Activity 202, Develop Airport Design and Cost Guidelines.

Discussion: Alternative means for providing urban access-egress, including intraurban air taxi as well as ground modes, will be examined together with basic airport landside arrangements. Emphasis will be given to indicating compatible matching between landside and access-egress, and the passenger capacity levels and associated developmental costs related to various combinations. Underlying this work will be the development and use of simplified flow analysis models to identify the interrelationships among capacity, demand, and delays. The results of this work will provide a compendium of generalized designs and performance data useful in overall airport analysis, planning, and development.

Performance Period and Milestones: This activity will be started in January, 1973, and completed in December, 1973.

Activity 202: Develop Airport Design and Cost Guidelines

Responsible Organization: FAA

Objective: To develop a generalized set of airport design, cost, and performance curves with which to define the airport requirements associated with providing various levels of transportation service with various types and mixes of short-haul aircraft.

Requirement: Generalized airport design and cost information is needed in subsequent efforts involving the interaction of Federal authorities with local authorities in examining the feasibility of specific facilities and/or sites as prospective short-haul airports. The results of this activity are needed as input to Activity 208, Perform Preliminary Airport Planning Studies for the Northeast Corridor. The same results are also needed for other regional studies in addition to the Northeast Corridor.

Discussion: Parametric relationships among airport capacity-related parameters such as configuration (runway, taxiway, gate geometry); the number of runways; the number of gates; the characteristics of aircraft operating at the airport; runway length, width, and bearing strength; taxiway width and bearing strength; and ATC equipment and procedures, and costs of construction and maintenance need to be developed. These relationships need to be mathematically modeled to permit efficient evaluation of various airport configurations that might exist, as well as evaluation and selection of the best configuration to provide the required capacity.

Input data required includes: (1) cost of land, (2) physical characteristics of aircraft which will operate at the airport, (3) cost of grading, (4) materials costs, and (5) labor costs by category and dollars per man-hour. The output will be either an evaluation of a specific airport configuration or sets of curves relating specific parameters. These curves can be used as design guidelines, but final evaluation should be done using the entire model.

Performance Period and Milestones: This activity is under way and will be completed in June, 1974. A preliminary output is needed in August, 1973, to begin the Metropolitan Area Analyses.

Activity 203: Conduct Airport Airside Traffic Simulations

Responsible Organization: FAA

Objective: To provide realistic data concerning the airside capacity which can be realized at specific CTOL hub airports that might be reconfigured to segregate short-haul from long-haul traffic.

Requirement: Determining with any certainty the ground capacity increases which might be achieved at CTOL airports reconfigured for segregated short-haul/long-haul operation is impeded by the complexity of the resulting airport runway/taxiway configurations and complex traffic movements. Under these conditions, airport-airside simulation studies of specific CTOL airports will be required to make such determinations. The results of this activity are needed as input to Activity 208, Perform Preliminary Airport Planning Studies for the Northeast Corridor. The same results are also needed for other regional studies in addition to the Northeast Corridor.

Discussion: Airport-surface simulation models developed during the last 3 years will be applied to these types of airport concepts to develop results with acceptable confidence levels. Because of the resource requirements for such work, it will need to proceed more or less on an airport-by-airport basis. Conclusions concerning the practicality of this class of operations can be made only after several cases have been examined. Initial attention will be directed toward those CTOL airports which now consitute the Northeast Corridor system. Results concerning reconfiguration costs, changes in community impact, and alleviation of congestion will be generated. Work on CTOL airports in other regions would proceed subsequently.

Performance Period and Milestones: This activity will be conducted from April, 1973, through April, 1975. Milestones of interest are:

- June, 1974 - NEC airport investigations complete
- April, 1975 - Non-NEC airport studies complete.

Activity 204: Identify Means for Enhancing Community Benefits

Responsible Organization: FAA

Objective: To develop a shopping list of airport-related nonaviation facilities and functions that might be incorporated as part of or in conjunction with airport development to enhance the benefits the development would bring to the surrounding community.

Requirement: The public's objections to airport expansion or development and their success in halting such projects is a matter of public record. Reduction of negative impacts on the community may not in itself prove adequate to gaining acceptance: enhancing positive impacts may be necessary. Innovation in this area as a part of airport planning will be an important factor in developing any efficient community acceptance program. The results of this activity are needed as input to Activity 208, Perform Preliminary Airport Planning Studies for the Northeast Corridor. The same results are also needed for other regional studies in addition to the Northeast Corridor.

Discussion: A variety of airport-associated developments with prospects for enhancing the airport's benefits to the community will be identified. Existing airports will be examined for the existance of such developments. Where they are found, studies will be conducted to ascertain local authority and community reaction. The configuration, area requirements, and costs of development and operation will be identified. The extent to which these developments were planned as part of the airport, and their ownership will be explored. Unique development possbilities will also be identified and studied. The development spectrum can be broad and include the following categories: recreational facilities; trade centers; light industrial developments; office-condominium complexes. The results of these studies will provide a shopping list of potential means for enhancing community acceptance of airports. The implications of such developments--ownership, impact on tax base, buffer value, applicable grant programs--will also be explored.

Performance Period and Milestones: This activity will begin in January, 1973, and extend through June, 1974.

Activity 205: Investigate Airport Operation and Financing

Responsible Organization: FAA

Objective: To develop viable alternatives for the operation and financing of short-haul airports, with stress on the importance of internalizing the recurring costs.

Requirement: From the aircraft operator point of view, valid estimates of the costs of operating aircraft from an airport are crucial in determining profitability. Potential airport owners/operators are concerned with the requirements they must meet in developing airports and in the prospect of successfully retiring debts and meeting operating costs. The results of this activity are needed as input to Activity 208, Perform Preliminary Airport Planning Studies for the Northeast Corridor. The same results are also needed for other regional studies in addition to the Northeast Corridor.

Discussion: Traditional airport development has been carried on in a highly fragmented and localized manner. Capital investment programs have been funded primarily through municipal revenue bonds with Federal support determined on a case-by-case basis. In order to promote marketability of municipal revenue bonds for airport development, the trend has been for the airlines serving the airport to pledge landing fees and special assessments to the support of debt service. Airport operating expenses have not been completely offset by airport revenues in many cases, and additional support is generally required from the municipal government. The short-haul airport development program should be implemented and financed on a national basis rather than on the traditional localized basis. The objective should be to develop a standardized system of airports such that the total short-haul portion of the air transportation system can be operated at minimum cost to the nation.

The willingness of airport operators, municipal governments, and airlines to support the development of a new short-haul airport system will be strongly influenced by the expected demand for the new short-haul service compared to projected overall demand for conventional air transportation service.

A number of Federal government policies and programs will influence the rate of development of short-haul airports. Among these are FAA's airport security program, airport certification, and the head tax and the ADAP ratio. It is important to continue monitoring proposed legislative changes in these areas and to examine the impact of each on the development of short-haul airports.

In addition to examining existing and proposed regulatory and legislative changes, the procedure for investigating alternative methods of airport operation and financing should include examination of historical trends and airport operations and financial structure. Specifically, trends for the following items of airport revenue and expense should be examined:

Revenues	Expenses
Landing fees	Personnel costs
Terminal space rentals	Materials and supplies
Concessions	Equipment
Parking	Taxes, inspections, and other fees
Ground rent	Debt service
Federal and state government reimbursement	Security
	Utilities and insurance
	General overhead

Typically, in the revenue categories, landing fees and parking are the largest revenue generators. Under expenses, debt service is generally the largest single item. However, there is considerable variation in the financial situation from airport to airport. Therefore, a broad survey is needed; one utilizing existing data--generating new data only where required--with the objective of deriving financial and operating profiles for generic classes of airports (such as large, medium, small, and nonhub airports; secondary, reliever, and general-aviation airports). Based on historical data, the existing regulatory environment and pending legislative changes, a number of operating and financing alternatives should be identified and evaluated. When regulatory or legislative changes would be required to make an alternative feasible, these changes should be identified and evaluated.

Performance Period and Milestones: This activity will begin in June, 1973, and extend through June, 1974.

Activity 206: Conduct Airport Facility and Site Inventories

Responsible Organization: FAA

Objective: To provide an up-to-date compendium of potential airport facilities and sites for short-haul airport development in the various metropolitan areas of interest.

Requirement: Site specific information must be in hand as a prerequisite to determining the feasibility of specific facilities and sites for short-haul use. This type of information is required in order to perform various systems analyses and to negotiate with local authorities concerning airport development. The results of this activity are needed as input to Activity 208, Perform Preliminary Airport Planning Studies for the Northeast Corridor. The same results are also needed for other regional studies in addition to the Northeast Corridor.

Discussion: Site specific information should be obtained by visiting each candidate site in each metropolitan area. Information to be acquired includes: (1) estimated ground access time from demand-generating areas; (2) ownership; (3) physical dimensions of site and total owned acreage; (4) surrounding land use, zoning, and approximate cost; (5) topographic data on airport and surrounding land; (6) master plans of surrounding communities with emphasis on planned land use and zoning; (7) runway lengths, headings, widths, lighting, gradients, and bearing strength; (8) taxiway widths, gradients, and bearing strengths; (9) physical condition of existing structures including terminal and hangars; (10) apron bearing strength and dimensions; (11) present capacity limitations, actual number of local, itinerant, and instrument operations, peak-hour activity, and number and type of based aircraft; (12) current air-space utilization; (13) access-egress adequacy and parking facilities; (14) fuel, maintenance, and safety services available; and (15) present community acceptance of airport and attitude concerning need for commercial service.

Performance Period and Milestones: This activity is under way and will be completed in January, 1974.

Activity 207: Collect and Generate Meteorological Data

Responsible Organization: FAA

Objective: To provide a data base on meteorological conditions prevalent at specific sites of interest for short-haul airport development.

Requirement: The prevailing meteorological conditions at sites of interest are a strong determinant in identifying airport configuration and determining operational suitability. The strength and variability of wind direction might dictate a requirement for crosswind runways. The frequency with which certain weather minima are attained is important to determinations concerning the practicality of the site. Unusual turbulence patterns around elevated sites could pose serious operational problems. The results of this activity are needed as input to Activity 208, Perform Preliminary Airport Planning Studies for the Northeast Corridor. The same results are also needed for other regional studies in addition to the Northeast Corridor.

Discussion: Available meteorological records will be surveyed to document the statistical characteristics of wind direction, velocity, and variability at active and inactive airports which are indicated to be of interest for possible short-haul development. In CBD areas, where wind-patterns leeward of large buildings may be highly unpredictable, special investigations may be required to ascertain expected characteristics. The localized turbulence patterns around elevated sites could also present serious problems. To assess both problems, wind-survey apparatus will be set up to investigate these phenomena. Large area, flat-type buildings, characteristic of elevated VTOLports and STOLports, will be used as models for this type of survey work. Variability of weather conditions, particularly ceilings and visibility data, will be collected where it exists. Additional experimental work on CBD weather may be required.

Performance Period and Milestones: This activity is under way and will be completed in January, 1975.

Activity 208: Perform Preliminary Airport Planning Studies

Responsible Organization: FAA

Objective: To develop site-specific planning data for specific airport-development opportunities which appear to have significant merit.

Requirement: As a result of system-analysis studies, contacts with local authorities, and information developed in other areas of activity, specific facilities and/or sites in certain metropolitan areas will appear to be feasible in many respects. For these, it will be of some value to conduct preliminary planning studies which stop short of master-planning-type efforts. This work will permit serious attention to be given to such sites at the community level with adequate information at hand. The results of this activity are needed as input to Activity 106, Metropolitan Area Analyses and Activity 210, Development of Airport Planning and Development Guidelines.

Discussion: As progress is made in other areas of the program, realistic candidate short-haul airport developments will become more identifiable. For these candidates, special planning studies will be conducted. Specific development scenarios will be fashioned. These will include specific site plans identifying the layout and configuration of runways, taxiways, aprons, terminal facilities, and parking and roads. One or more alternatives for providing urban access-egress will be identified. Associated developments for enhancing the airports benefits to the community will be suggested based on community goals and values and the type and extent of development around the site. Estimated development schedules and costs will be prepared. The variety of Federal grant programs which might apply (controlled by FAA, HEW, HUD) will be identified. Preliminary estimates of airport operation and operating costs and revenues will be prepared. Predictions of negative impacts such as noise, pollution, and social disruption will be made. This information can be used by specific communities in developing contingency plans for airport development which best serve the community. Initial emphasis will be given to candidate airport developments in the Northeast Corridor; subsequently, other airports will be studied.

Performance Period and Milestones: This activity will be initiated in April, 1973, and extend through April, 1975. Milestones of interest include:

- June, 1974 - NEC airport planning studies complete
- April, 1975 - non-NEC airport planning studies complete.

Activity 209: Identify Elevated-Airport Aircraft Containment Needs

Responsible Organization: FAA

Objective: To develop the equipment/procedural requirements necessary to assure that aircraft overrunning elevated airports can be safely stopped and contained.

Requirement: A safety question unique to the use of elevated airports concerns the prospect of landing aircraft overrunning the edge of the facility. Assurance that such an incident will not lead to injury on the ground or in the aircraft requires that a practical means be found to stop or contain aircraft under these conditions. Results of this activity are needed as input to Activity 210, Development of Airport Planning and Development Guidelines.

Discussion: Studies will be undertaken to better define the nature of the problem of aircraft overrun of elevated facilities. Overrun factors of interest will include area of overrun, aircraft weights and velocities, aircraft geometry, size, and angles of presentation. A variety of containment mechanisms, both classical and unique, will be defined and studied for applicability. These will include both passive and emergency-activated systems. For the latter class, system-reliability considerations are extremely important. Candidate systems will be selected for prototype development and testing. The results of the work will be used to prescribe recommended containment equipment and related specifications.

Performance Period and Milestones: This activity is presently under way and will extend through December, 1974.

Activity 210: Develop Airport Planning and Development Guidelines

Responsible Organization: FAA

Objective: To determine the requirements for revisions to existing airport design standards, planning and development guidelines, and grant-funding formulas to facilitate the development of airports and introduction of improved short-haul service.

Requirement: It is uncertain whether the present airport standards, planning guidelines, and financial-assistance criteria are adequate or appropriate for the development of short-haul airports. The new requirements which may arise pertain to airport-surface configuration and obstruction-free air space, special noise guidelines, safety measures, and airport planning and financing.

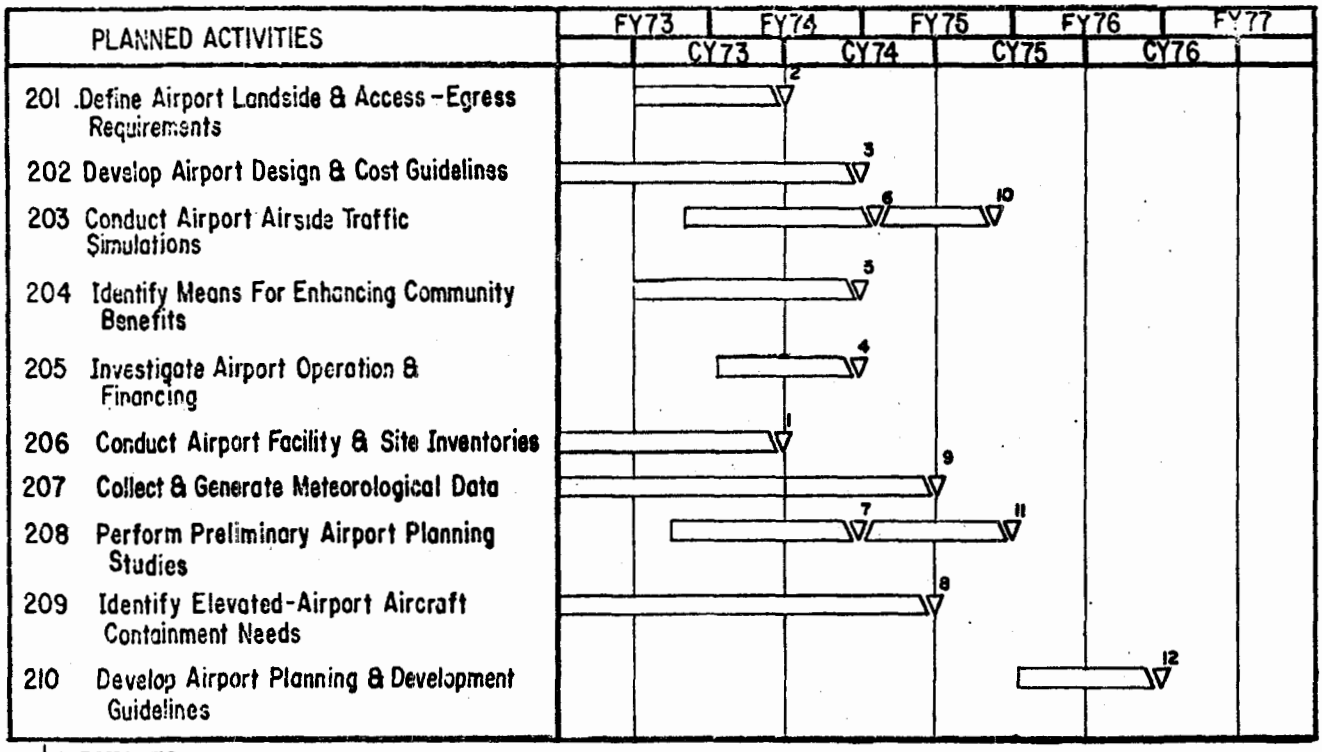
Discussion: The results of earlier airport design studies, preliminary planning studies on specific airports, and coordination activities with various local authorities and community groups will provide a solid base from which generalized short-haul airport planning and development guidelines can be prepared. The airport technical requirements for serving various types and mixes of short-haul, general aviation, and long-haul vehicles will be known. A realisitic appraisal of community financial capabilities and needs will be known. With this information in hand, airport standards can be developed and, if appropriate, a basis may exist for recommending revisions to ADAP funding formulas or guidelines on admissable developments.

Performance Period and Milestone: This activity will be initiated in October, 1975, and extend for an indefinite period. The milestone of greatest interest is

- April, 1976 - Initial guidelines complete.

4.3.5 Milestones and Funding Requirements

Figure 4.7 shows the time durations, and some of the milestones associated with the airport activities. Funding requirements are given in Table 4.3.



MILESTONES-

(1) Inventory Completed
(2) Landside/Access-Egress Requirements Known
(3) Airport Design/Cost Guidelines Developed
(4) Operations/Financing Study Complete
(5) Community Benefits Study Complete
(6) NEC Airport Investigation Complete
(7) NEC Airport Planning Studies Completed
(8) Aircraft Containment Needs Identified
(9) Meteorological Data Available
(10) Non NEC Airport Studies Completed
(11) Non NEC Airport Planning Studies Completed
(12) Initial Guidelines Complete For All Short-Haul Airports

FIGURE 4.7 AIRPORT-SYSTEM-DEVELOPMENT ACTIVITIES AND MILESTONES

TABLE 4.3. AIRPORT FUNDING REQUIREMENTS ($ Millions)

Agency	Fiscal Year					
	1973	1974	1975	1976	1977	1973-77
FAA[a]	0.5	1.1	1.0	0.6	0.3	3.5
FAA[b]	1.1	1.6	0.6	0.4	0.0	3.7
Total	1.6	2.7	1.6	1.0	0.3	7.2

(a) Presently planned.
(b) Additional funding.

4.4 ATC/Navigation Activities

4.4.1 Scope

The ATC/Navigation Development Program is concerned with determining what changes may be required in the existing and planned air traffic control/navigation system and its equipment and procedures, to accommodate the various alternatives for achieving segregated short-haul operations. Where appropriate, changes in the planned system would be made.

The program's activities include various studies, experiments, and flight research for developing an understanding of problems and requirements. The subject matter includes:

- Data acquisition - radar and beacon
- Data transmission - voice and data communications
- Traffic control - en route, en route-terminal transmission, terminal area, landing, and departure
- Navigation - ground based reference systems and avionics
- Airport ATC facilities - lights, landing systems, surface surveillance and control.

The planned work in this program will identify the capabilities of the presently planned ATC/navigation environment to support segregated short-haul traffic operations in an efficient and noninterferring basis with long-haul operations. Special problem areas will be identified as will the practical means, in terms of equipment and procedures, for resolving them. The costs and scheduling of necessary changes in the ATC/navigation system to accommodate segregated short haul will be defined. As appropriate, the existing NAS plans for ATC/navigation development will be altered to facilitate the introduction and operation of improved short-haul air transportation.

The Federal government mandate for the development and operation of the ATC/navigation system is directed to the FAA, which will have the primary responsibility for this program area. Many of the NASA's planned activities for vehicle-flight research will provide useful data in the ATC/navigation area. Accordingly, the NASA will be an important partner to this program.

4.4.2 Statement of Problem

A substantial program already exists for supporting the envisioned future requirements of the operational ATC/navigation system, but without special recognition of the requirements relating to segregated short-haul operations: these requirements are not precisely known. Accordingly, efforts are required to define them.

The important ATC/navigation considerations relate closely to the particular aircraft and airport variations likely to arise in segregating short-haul traffic from long-haul facilities. The aircraft used would differ from present CTOL transports in one or more of the following respects:

- Steeper approach paths
- Lower approach and landing speeds
- Reduced field-length requirements
- Higher maneuverability (turn radius)
- Lower en route altitudes and cruise speeds.

The airports would differ in configuration, type, or quantity:

- CTOL airports reconfigured for segregated short-haul and long-haul operations
- Secondary/feeder airports upgraded for short-haul use, but including the present types of unscheduled traffic
- New suburban and CBD airports, possibly elevated in the latter case.

These different aircraft characteristics and airport variations, when compared to present CTOL operation within the existing ATC/navigation system, suggest possible problem areas that might exist. The following examples suggest the types of problems that could be expected:

- Increased operations of short haul from secondary/feeder airports or new airports might prove difficult because of overlapping air-space requirements with other airports and the present practice of having centralized control of all traffic in a given hub area
- The siting of some airports might present difficult surveillance, communications, and guidance problems, particularly in CBD locations
- The large differentials between aircraft cruise and approach speeds might present unique problems in metering and spacing during en route to terminal area transition

- The inability to achieve close lateral spacing between short- and long-haul aircraft operating into segregated facilities at CTOL airports might defeat the hoped-for gains in airport-airside capacity.

The evolutionary schedule of the alternative concepts by which segregated short-haul operations might be achieved is not known. Therefore, there is a need to determine the kind and phasing of actions needed to support the transportation systems analysis work and to prepare the way for the introduction of such systems.

4.4.3 Approach

Because it is not possible to conclude with reasonable certainty what types of short-haul concepts will evolve, nor in what time frame or areas, the requirements for ATC/navigation system modifications are not known. Therefore, the near-term activity in this area will be aimed at defining such requirements and, concurrently, making those minor or interim improvements needed to facilitate the development of existing short-haul service.

Activities will be selected and pursued to assess unique short-haul characteristics and requirements in the areas of surveillance, navigation, precision approach and landing, ATC air space and procedures, and the ATC/aircraft interface. Concurrently, work pertaining to airport capacity and noise impacts, as governed by aircraft/ATC characteristics, will be conducted to support the Airport and Transportation System Analysis Programs.

The presently planned FAA and NASA activities in the ATC/navigation area are included as part of the plan and supplemented as necessary.

4.4.4 Planned Activities

Work in this area has been divided into six activities, which are described separately below. The interrelationships among these activities are shown in Figure 4.8 and the relationships with other activities in the program are indicated in Section 4.6.1.

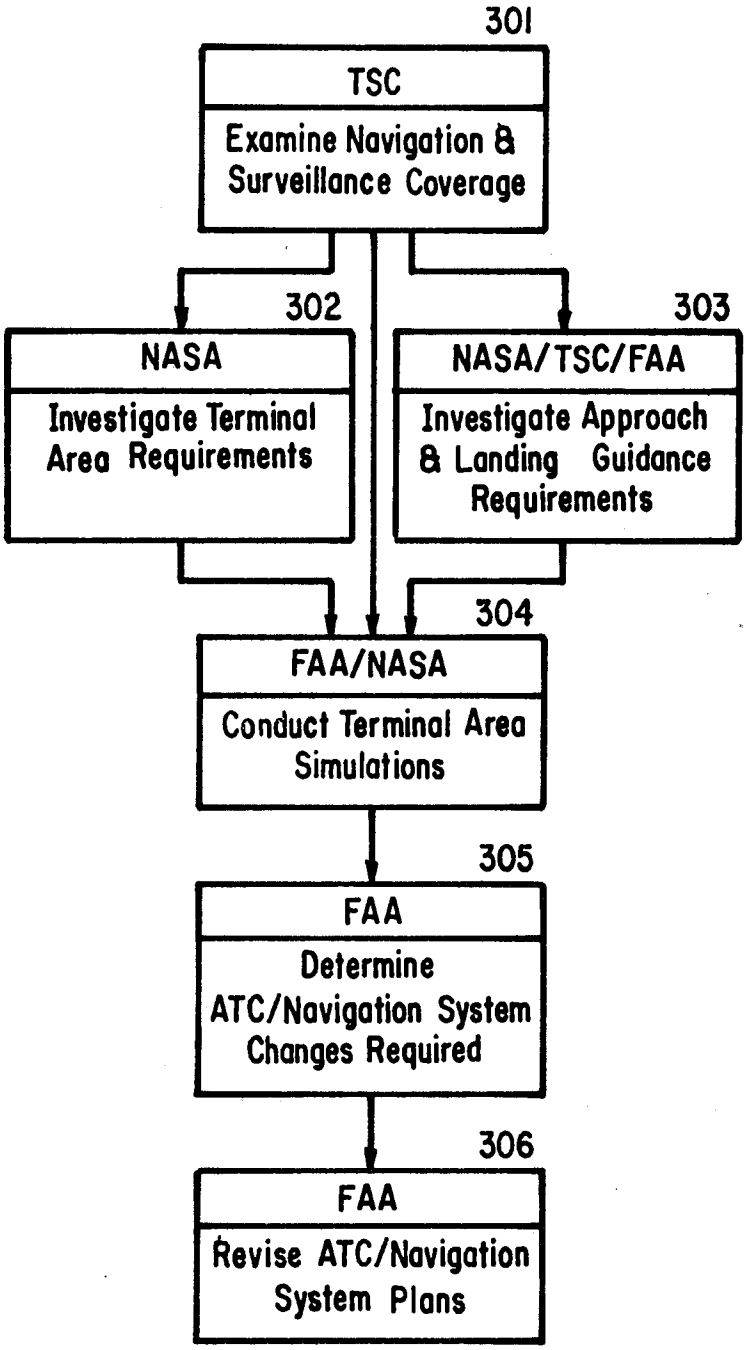


FIGURE 4.8 ATC/NAVIGATION-SYSTEM-DEVELOPMENT ACTIVITIES

Activity 301: Examine Navigation and Surveillance Coverage

Responsible Organization: TSC

Objective: To develop preliminary indications of the adequacy of common and special navigation facilities and primary/secondary radars to provide adequate coverage under operating conditions unique to short haul.

Requirement: Short-haul terminal-area operations may frequently involve situations in which common navigation coverage and radar surveillance are inadequate to provide for the necessary position determination and aircraft-separation requirements. Typical of such situations are the low-altitude operations in proximity to built-up CBD areas or in or near mountainous terrain. Line-of-site navigation signals may not be continuously available; the dependability of alternative navigation systems is uncertain. Similarly, because of the low altitudes and terrain obstacle features, radars may not be able to reliably descriminate the aircrafts position. Preliminary data concerning the adequacy of navigation and surveillance coverage is needed. Results of this study will be required in Activities 302 and 303.

Discussion: A series of selective flight tests will be performed in various areas of the United States to examine a wide range of phenomena and situations relating to navigation and surveillance coverage. Signal continuity and navigation accuracy for VOR/DME and DME/DME navigation modes will be checked at various altitudes around large metropolitan areas, in mountainous terrain, and for low-altitude en route situations in the Northeast Corridor. The efficiency of various filtering techniques to remove inherent errors in VOR signals will be examined. Several tests will be conducted with LORAN C-type signals. The effect of land/sea interface on propagation and possible navigation errors at such interfaces will be studied. The observed effect of aircraft maneuvering on instantaneous LORAN C navigation error will be explored. The effectiveness of radar surveillance in city environments, particularly the ability to discriminate aircraft at low altitude under bad scatter conditions, will be investigated.

A STOL navigation system developed by TSC will be installed aboard a NASA CV-340 aircraft for the purpose of conducting these investigations. This work constitutes one part of the presently planned navigation/guidance project in the STOI operating systems experiments program.

Performance Period and Milestones: This activity is presently under way and will be completed in December, 1972.

Activity 302: Investigate Terminal Area Navigation and Guidance Requirements

Responsible Organization: NASA/FAA

Objective: To develop capability and requirements information relating to the problems of transition between en route navigation aids to final approach guidance, and from departure to en route aids.

Requirement: Taking full advantage of short-haul aircraft attributes requires that the resulting high maneuverability and large cruise-to-approach speed changes be handled safely and without interference to other aircraft operating in the terminal area. Definition of the optimum transition paths, equipment requirements, and operating procedures is a necessary step to achievement of short-haul operation. Information from this activity is required for Activities 106, 114, 115, and 116.

Discussion: This activity will consist of three portions, the first being analytical, the other two flight investigations. The first phase consists of an analysis of terminal area requirements for each of the aircraft/airport combinations being considered in this program. Initially, this analysis would be done for general parameterized aircraft and airport characteristics, but some site-specific investigations may be required to support the analyses of Activities 106, 114, or 116. In each case, the objective would be to determine the type of surveillance, airborne equipment, and the operational concept required to permit the unique characteristics of the aircraft to be utilized, while maintaining adequate safety.

Based on these results, together with those of Phase 1 of Activity 303, which will be running concurrently, estimates will be prepared of airport capacity and noise characteristics, for use in the metropolitan area studies, Activity 106.

In the second phase, the errors resulting from transitioning from common en route navigation aids to a final landing guidance system will be investigated as a function of the types of aids employed, the initial conditions upon entering the terminal area, and the speed reductions employed. These tests will serve to indicate the microwave landing system design requirements as well as other requirements relating to flight procedure, navigation aid employment, etc. These tests will be run with both research and operational pilots.

An additional activity during the period of Phase 2 will be updating of the results of Phase 1, as data become available from other parts of the program.

During the third phase of the program, experiments will be conducted to examine the feasibility of generating and following computer synthesized adaptive flight paths as a means of following a precise time-dependent flight plan under expected congested-air-traffic control situations. Evaluations will also be made of crew work loads, pilot/guidance system interfaces, and advanced displays for manual or semiautomatic flight situations.

Facilities and equipment used will include the NASA Ames simulation facility, NASA augmentor-wing jet STOL aircraft, two NASA STOLAND avionic systems, FAA unmodified Buffalo aircraft, and the FAA MODILS landing guidance system.

The work described is already a planned part of the joint NASA/FAA/TSC STOL operating experiments program.

Performance Period and Milestones: The analytical portion will begin by January, 1973, with completion by August, 1973. The flight portions will extend from April, 1974, through March, 1977, with preliminary definition of requirements by March, 1975, and more complete requirements by March, 1977.

Activity 303: Investigate Approach and Landing Guidance Requirements

Responsible Organization: NASA/TSC/FAA

Objective: To determine the suitability of the microwave-scanning-beam landing-guidance system and other navigation aids to provide the necessary approach and landing-guidance performance for short-haul operation.

Requirement: The suitability of common navigation aids to provide guidance to noninstrumented runways and of the planned microwave-scanning-beam guidance system to provide precision guidance to touchdown remain to be determined. Other uncertainties include the limitations which aircraft characteristics, low-visibility weather conditions, and other factors may impose on approach and landing precision. The identification of navigation and guidance facility requirements and short-haul approach and landing capabilities require the development of extensive data in this area. Results of this activity are required to support Activities 106, 114, and 116.

Discussion: This activity will be organized into three phases, somewhat as Activity 302. The first is analytical, to support Activity 106. The other two involve flight measurements. The first phase will utilize dynamic mathematical simulation to determine the suitability of the different combinations of navigation aids and aircraft for final approach through touchdown. From these results, initial requirements and capacity estimates will be developed.

Phase 2 efforts will consist of analysis, simulation, and flight test investigating a wide range of situations. Approach and landing investigations will use both a research-type scanning-beam-microwave system and common navigation aids such as VOR/DME and TACAN. For the microwave system, the effects of microwave system and aircraft system characteristics on approach and landing performance will be explored. Of particular interest is the sensitivity of performance to scanning-bean-data rate and dwell time. Decision heights as they relate to both landing flare initiation and go-arounds will be examined. For the common navigation aids, inertial and filtering enhancement techniques will be investigated to determine the maximum precision which can be achieved. The minimum altitudes at which such guidance can be safely employed will be identified.

An additional activity during the period of Phase 2 will be updating the results of Phase 1 as additional data become available.

Phase 3 efforts will be a more selective set of tests to refine Phase 1 data. Operational pilots will be used in place of research pilots in some tests to make a more realistic appraisal of day-to-day operational capabilities which might be achieved. Prototype approach and departure paths will be constructed and operational evaluations run. Advanced avionic equipment features will be tested. These will include path-stretching techniques for maintaining precise time/space flight plan and automatic landings. Advanced flight directors and VFR head-up displays will also be evaluated. ATC radar surveillance tests will be performed as a part of Phase 3 tests utilizing operational pilots. In both phases, simulation and flight-test work will be used. The former, to be utilized like specific tests, will maximize the flight test-productivity. Facilities and equipment to be used vary: NASA Ames simulation facility; NASA augmentor-wing jet STOL aircrafts; FAA unmodified Buffalo aircraft; two NASA STOLAND avionic systems; FAA MODILS landing guidance system.

The work described under Phases 2 and 3 is already a planned part of the joint NASA/FAA/TSC STOL operating experiments program.

Performance Period and Milestones: Phase 1 will begin by April, 1973, with termination by April, 1975. Phase 2 will run from January, 1973, through December, 1974, and Phase 3 from January, 1975, through June, 1977.

Activity 304: Conduct Real-Time Terminal-Area ATC Simulation

Responsible Organization: FAA/NASA

Objective: To develop realistic ATC air-space and procedural requirements for the implementation of segregated short-haul operations in busy air-traffic hubs.

Requirement: The handling of joint short-haul/long-haul air traffic on a noninterferring basis with busy air-traffic hubs poses a complex set of routing and procedural questions which cannot practically be answered through analysis or flight test. Real-time simulation is the only reasonable means of defining the attendant problems and the solutions to them. Simulations are needed to support Activity 106 and Activity 305.

Discussion: A three-phase program of terminal area ATC simulation will be conducted. The first phase will deal with simulated operation of STOL aircraft into the New York Terminal area. The second phase will be expanded to cover the remaining Northeast Corridor hubs plus Chicago and other hubs with airports presently under restricted operation. The third phase will deal with the additional hub airports and related terminal areas on a selected basis. The effect of short-haul aircraft characteristics on the air-traffic-control system and the effect of air-traffic-control-system requirements on the efficient operation of short-haul aircraft will be investigated. This will be accomplished by using the NASA-Langley Research Center augmentor-wing flight simulator output in the FAA digital air traffic control simulator at NAFEC.
This effort is a part of the planned joint NASA/FAA/TSC STOL operating experiments program.

Performance Period and Milestones: This activity is presently under way and will continue through the program as needed. Milestones in support of Activity 106 include:

- December, 1972 - simulation of New York area complete
- March, 1974 - simulations of NEC air traffic hubs complete
- January, 1975 - simulations complete for a variety of air traffic hubs.

Activity 305: Determine ATC/Navigation System Changes Required

Responsible Organization: FAA

Objective: To determine the changes required in the existing and planned operating ATC/navigation system in order to accommodate the implementation of segregated short-haul operations.

Requirements: Present operating ATC/navigation system and its planned improvements are not predicated on significant segregated-type short-haul operations. Accommodation of this form of operation may well require facility and procedural alterations. Some changes might be required on a national scale; other requirements may be unique to a particular region and can be handled on a special basis. The timing and costs of such alterations is also unknown. Answers to these questions are needed before necessary decisions concerning short haul can be made. Results are required for Activity 206 and Activity 306.

Discussion: From the results of other defined tasks in the ATC/navigation program, it will be possible to synthesize out the special requirements for introducing various forms of segregated short-haul concepts at various points in the future. The facility and procedural changes will be identified and the schedule and costs of carrying them out determined. A near-term task will be to determine what changes may be required to make helicopter IFR operations feasible. While helicopter IFR is technically achievable, air-space and procedural changes are required to make it economically feasible. Special attention will also be given to the ATC/navigation system changes required in the NEC to introduce advanced short-haul.

Performance Period and Milestones: This activity is under way and will extend on for an indefinite period. Milestones of interest include:

- March, 1974 - helicopter IFR requirements defined
- June, 1975 - NEC ATC/navigation system changes defined.

Activity 306: Revise ATC/Navigation System Development Plans

Responsible Organization: FAA

Objective: To provide the required facilities, equipment, and procedures to facilitate the orderly development of short-haul air transportation.

Requirements: As the necessary changes in the ATC/navigation system required to facilitate short-haul development are identified and approved at the necessary management levels of the program, the requirement exists that they be included in the system's development plan and procured in a timely fashion.

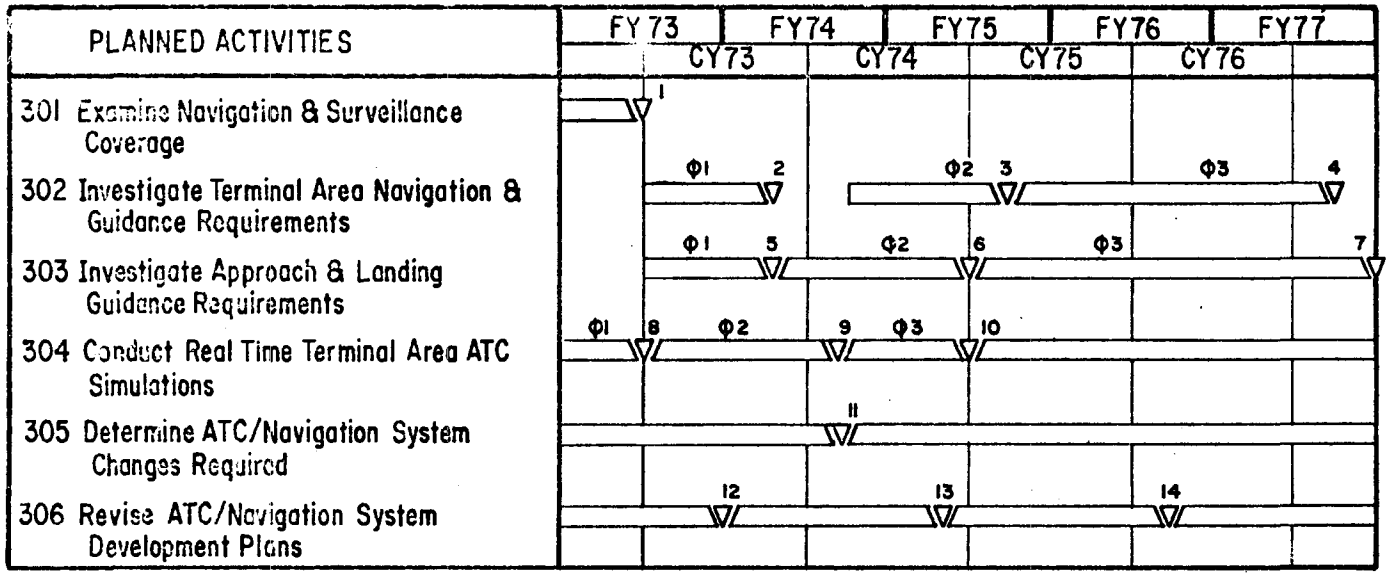
Discussion: The need for an interim microwave landing-guidance system to facilitate the safety and growth of existing forms of segregated short-haul operations has already been identified and approved, and plans made for its procurement. Also, the need to make helicopter IFR operations practical through air-space and procedural changes is anticipated. While they cannot be forecast at this time, other such needs are also anticipated and the necessary facilities, equipment, and procedures will be provided as required.

Performance Period and Milestones: This activity is under way and will continue on an indefinite basis. Milestones of interest include:

- June, 1973 - interim ILS procurement begun
- September, 1974 - helicopter IFR requirements implemented.

4.4.5 Milestones and Funding Requirements

The duration of activities and some of the more significant milestones are indicated in Figure 4.9, while Table 4.4 gives the funding requirements over a 5-year period.



(1) Navigation/Surveillance Coverage Tests Completed
(2,5) Phase I Analytical Studies Completed
(3,6) Phase 2 Flight Programs Completed
(4,7) Final Flight Programs Completed
(8) Simulations Of New York Area Complete
(9) Simulations Of NEC Hubs Complete
(10) Simulations For Activity 106 Complete
(11) Helicopter IFR Requirements Defined
(12) Interim MLS Procurement Begun
(13) Helicopter IFR Requirements Implemented
(14) Changes In ATC/Nav Plans Complete

FIGURE 4.9 AIR-TRAFFIC-CONTROL DEVELOPMENT ACTIVITIES AND MILESTONES

TABLE 4.4. ATC/NAVIGATION FUNDING REQUIREMENTS
($ Millions)

Agency	Fiscal Year					
	1973	1974	1975	1976	1977	1973-77
FAA	1.3	1.8	2.0	1.1	0.6	6.8
NASA	6.6	10.3	8.8	7.7	7.0	40.4
Total	7.9	12.1	10.8	8.8	7.6	47.2

Note: Only E&D/R&T funds shown.

4.5 Aircraft Activities

4.5.1 Scope

Aircraft activities involve the conduct of basic airframe and engine technology work which is supportive of high-lift capability and quiet operation. Also included is the development of appropriate design, certification, and operating standards, with the purpose of identifying and promoting the development of efficient short-haul aircraft by the private sector.

The activities include design studies, simulation, wind-tunnel research, and experimental flight test research. The airframe-technology facets of the work are highly oriented toward the powered-lift and direct-lift aircraft concepts. The engine-technology work, stressing quietness, is oriented toward vehicles in the powered-lift category, but will also benefit other jet-powered vehicles.

The planned work will develop the necessary information base from which feasible short-haul vehicle concepts can be identified, and related standards for design, certification, and operation developed, to permit the private sector to develop useful short-haul aircraft. Examples of the more important types of aircraft/engine technology information requirements include:

- Flight characteristics
- Handling qualities
- Ride qualities
- Operating economics
- Noise characteristics
- Runway requirements
- ATC requirements
- Weather capabilities.

The NASA will have the major responsibility for the advanced aircraft-technology research and will play a prominent role in the aeronautical-research activities required to identify potential directions for the improvement of short-haul air transportation. The FAA will support these research activities from the outset with a view toward the possibility of implementation

into scheduled service at some future point in time, and will focus on the operational aspects of the NASA research. FAA responsibilities include areas such as airworthiness, certification criteria, flight procedures, and ATC interfaces. Coordination between the DOD, NASA, and the FAA will be maintained to assure that applicable military-vehicle-development activities are integrated into the civil-aircraft program. Military developments need to be continually assessed from the point of view of potential civil/military commonality.

Airframe and engine manufacturers, and operators will be involved on a selective basis to the extent that their efforts and plans are a factor in the Federal government's program.

4.5.2 Statement of Problem

The previous work on short-haul air transportation has indicated that there is strong potential merit to vehicle concepts with physical and performance characteristics more suited to terminal-area operations than present CTOL aircraft. Such terminally configured vehicles (TCV) would be capable of quiet operation and would place lower demands on scarce airport real estate and air space. At the same time, they would need to retain certain proven characteristics of existing jet CTOL aircraft to insure maximum passenger acceptance and commercial viability. These characteristics include productivity, operating economy, and ride quality.

Aircraft real estate/air space requirements are closely related to the minimum safe operating speed which can be achieved in the termial area. Lower operating speeds provide for the following useful operational capabilities in the terminal area:

- Better maneuverability due to shorter turn radius
- Steeper approach/departure flight path
- Curved landing approach path
- Reduced landing/take-off field length.

Aircraft with these capabilities not only provide the ability to reduce air-space requirements but steep approach/departure flight

paths also result in significant noise benefits due to the increased distance between the aircraft and the ground at any point along the approach/departure path. Curved approach/departure capability also permits the avoidance of noise-sensitive areas which may be present under a straight-line flight path to and from the runway. On the ground, reduced runway-length requirements offer increased flexibility for operations. Unused real estate at existing CTOL airports, smaller secondary airports, and other potential suburban/CBD sites become candidates for providing additional air transportation service and capacity.

In earlier years, the desired or necessary low speed capability was achieved by appropriately sizing the aircraft wing. This approach, still common in many utility aircraft and small transports, involves considerable sacrifice in the areas of cruise speed, economy, and ride comfort. More recently, technology advances in mechanical high-lift devices have permitted better compromises to be made between desired cruise and terminal-area performance, although this technology has been utilized predominantly for cruise-performance payoffs in all but the more recent designs.

A most promising area of development in recent years has been the emergence of improved technology in the areas of powered-lift and direct-lift schemes. This work, if continued, promises to offer increasing opportunity for the development of vehicles with optimized performance characteristics in all phases of flight. While additional cost and complexity is involved in such concepts, this might very easily be offset by the reduction of costs in other air transportation system elements.

The past research on various types of TCV's can be divided into the following range of vehicle design concepts for illustration purposes as shown in Figure 4-10.

- Reduced take-off and landing (RTOL) by means of passive mechanical high-lift devices

- Short take-off and landing (STOL) by means of low-wing loading or various powered lift arrangements

  - Internally blown augmentor wing
  - Externally blown flap

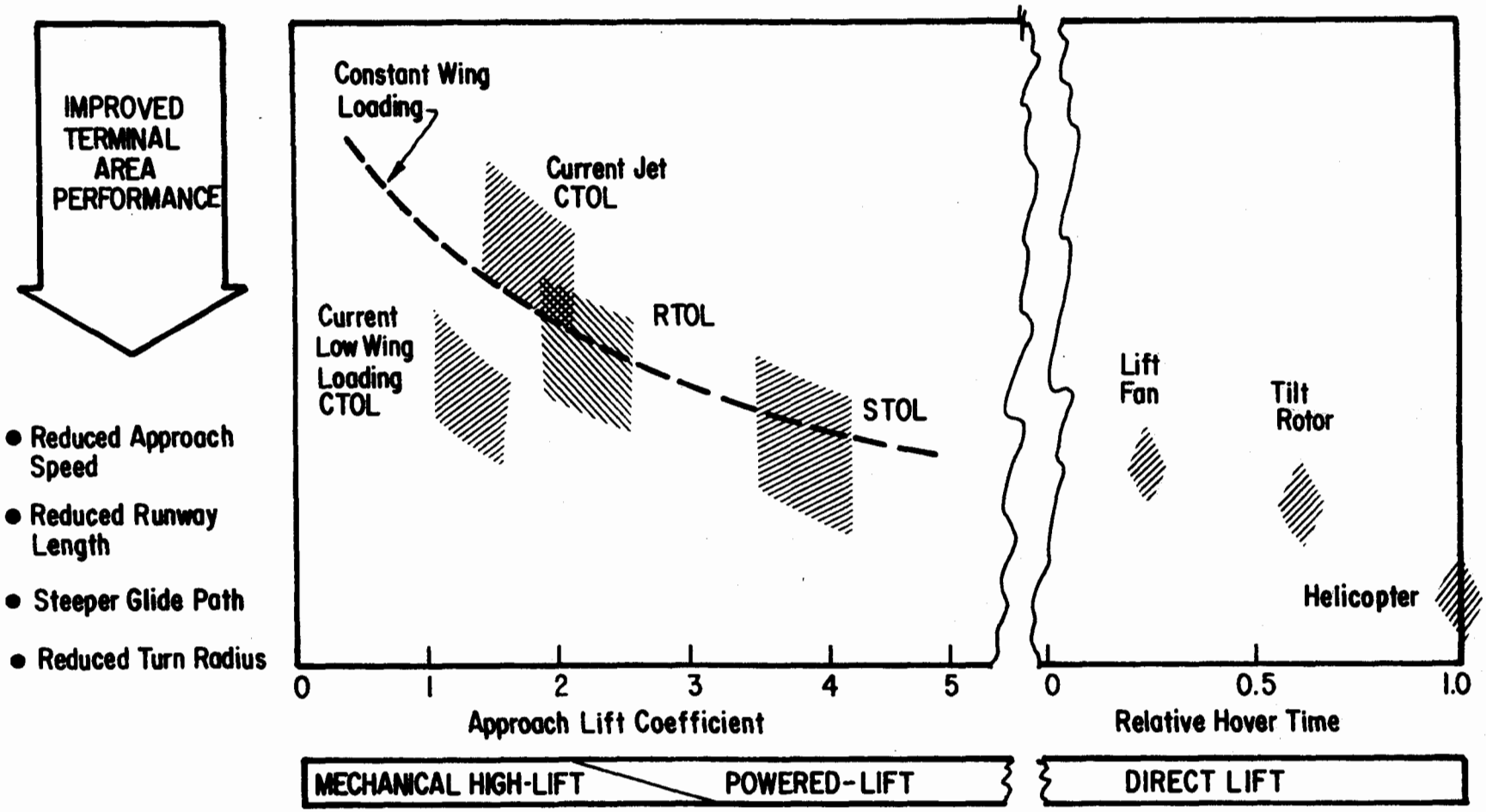


FIGURE 4.10 - TERMINALLY CONFIGURED VEHICLE CONCEPTS AND THEIR RELATED PERFORMANCE MERITS

- Vertical take-off and landing (VTOL) by means of various direct-lift arrangements
  - Lift fan
  - Tilt rotor
  - Helicopter.

It is generally recognized that noise is probably the single most important determinant of airport community acceptance. For this reason, significant noise reduction will be an important parallel concern in the development of improved short-haul vehicles. The most direct way to reduce noise is to suppress the noise at its source. For turboprop and helicopter aircraft, the propeller/rotor is the major noise producer and the technology to reduce propeller noise is well advanced. Turbofan aircraft, on the other hand, are not only the major noise offenders but also present a more difficult and expensive noise-suppression task.

A distinction is made between noise sources internal and external to the engine. Interior noise can be suppressed by acoustically treating the internal-flow passages. External jet noise is more effectively reduced by lowering the engine-exhaust velocities.

Unfortunately, deliberate noise-reduction measures adversely affect aircraft performance, equipment costs, and operating economics. The more dramatic effects include increases in specific fuel consumption, increases in take-off/landing field length, and reduced operating range. Careful design trade-offs between engine and aircraft design variables are required to establish an optimum configuration.

In addition to noise-reduction requirements for the basic powerplant, several aerodynamic noise problems exist for some of the potential TCV concepts. For each, higher thrust levels are required during take-off and landing as compared to those for CTOL in the same weight class. Improvements in noise-reflection characteristics will be required to prevent dilution of the noise benefits associated with the steeper approach/departure flight paths of TCV's.

An appreciation of the technical problems associated with developing TCV's with suitable performance and noise characteristics can be gained by examining the candidate TCV concepts of major interest at the present time.

The RTOL concept embraces new and modified aircraft depending heavily on present mechanical high-lift technology. The primary difference between such vehicles and present CTOL aircraft would be the use of different design tradeoff criteria and, of more importance, the use of higher engine thrust-to-weight ratios to reduce take-off distance (unlike landing distance, take-off distance is heavily dependent on thrust-to-weight ratio). This concept has important implications for engines as regards noise and cruise efficiency.

A more modest approach to achieving STOL capability with larger transports involves retaining the lower-wing-loading features characteristic of present small STOL transports but using the present mechanical high-lift devices common to CTOL transports. The obstacles presented by this approach include marginal ride quality because of the low-wing loading and certain losses in cruise efficiency.

Alternative approaches to achieving STOL transport capability rely on jet-powered-lift concepts. Here, the engine is utilized to increase lift capability by increasing the air-mass flow, through one means or another, to augment the lift of the wing. The internally blown augmentor wing and externally blown flap concepts are among the more prominent being considered. The basic disadvantages involved are potential increases in vehicle cost, complexity, and noise.

Advanced VTOL concepts employing direct lift include such vehicles as advanced helicopters and direct-lift fan and tilt-rotor vehicles. The advantages of such concepts from a terminally configured standpoint are clear. Disadvantages include high noise levels and fuel consumption rates (depending on relative hover time), mechanical complexity, and handling qualities.

Beyond the technical problems in this development area are the selection and timing of technology-development efforts supportive of the evolution of new, improved aircraft for short-haul application. Equally important is the development of aircraft design, certification, and operating criteria and procedures. This information is needed before serious development can be considered by the private sector. Long lead times are involved in bringing aircraft from the conceptual to the operational stage. The Federal government's activities need to be paced to assure the emergence of useful designs on a schedule commensurate with

needed solutions to the growing noise, congestion, and service deterioration problems.

4.5.3 Approach

It is not possible at this time to conclude with reasonable certainty that any one of the vehicle concepts of interest should be excluded from further consideration. Accordingly, the aeronautical and engine-technology work supportive of all the more prominent concepts will be pursued. However, emphasis will be placed on those concepts which appear to offer the best compromise between desirable short-haul features and near-term availability. The near-term emphasis will be on powered-lift concepts with a longer range emphasis on direct-lift concepts.

The aircraft/engine technology research already under way and planned at the NASA is in keeping with the multioption approach being recommended. For near-term planning purposes, it will not be necessary to deviate from the aeronautical research program that NASA has already planned. However, as short-haul program improvement efforts proceed in the transportation-system-analysis, air-traffic-control, and airport program areas, it will be necessary to continually reassess the direction and emphasis of the NASA efforts. New, as yet unforeseen, requirements or limitations that may develop may call for a reorientation of emphasis or alterations in direction.

The present FAA planned activities relating to aircraft certification and noise standards are appropriate and will be continued. Additional emphasis in this area will be placed on examining the suitability of existing CTOL certification criteria and noise standards to proposed RTOL developments, and acceleration of the effort to generate firm certification criteria for STOL concepts. This latter item is highly dependent, however, on progress in the NASA technology program.

4.5.4 Planned Activities

Work in this area has been divided into four activities, which are described separately below. The interrelationships among the activities are indicated in Figure 4.11 Relations to other activities in the program are shown in Section 4.6.1.

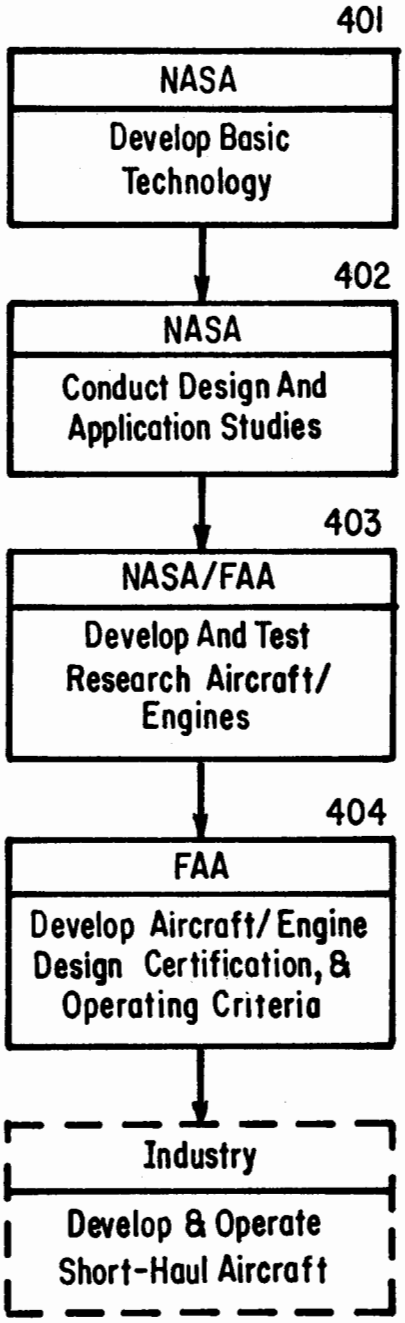


FIGURE 4.11 VEHICLE-DEVELOPMENT ACTIVITIES

Activity 401: Develop Basic Technology for Powered-Lift/ Direct-Lift Concepts

Responsible Organization: NASA

Objective: To develop an improved understanding of overall vehicle-performance requirements and to advance the basic technology required to develop and test research aircraft/engines which match these requirements.

Requirement: The need has already been established for new short-haul aircraft with performance characteristics that require less airport real estate and terminal-area air space than conventionally designed aircraft while at the same time maintaining good cruise performance capability. Additionally, quiet and economical operation are viewed as premium attributes. Far more is required than the application of different design-tradeoff criteria. Advancements in the technological data base are required in areas such as handling qualities, ride qualities, aerodynamic noise, and engine noise.

The results of Activity 401 are needed as inputs to Activity 402 which involves Design Studies of powered-lift STOL aircraft/engine concepts, advanced helicopter concepts, and lift fan/tilt rotor concepts.

Discussion: Basic aeronautical research and technology activities will be pursued which support the development of concepts based upon powered-lift and direct-lift arrangements. These will include studies, experiments, and simulation in such areas as aerodynamics, propulsion, structures, noise, flight control systems, and operating environment.

In support of all concepts, research work will be undertaken on the human response to noise and vehicle-ride quality. Also, research on atmospheric disturbances unique to short-haul operations will be examined.

In support of powered-lift technology, configuration research is already under way to provide technology to advance-aircraft aerodymamics, including improved performance, stability, and control and reduced aerodynamic noise. This is fundamental applied technology work and depends on the extensive use of wind-tunnel, acoustic-chamber, and static-rig facilities.

Basic research and technology programs on advanced direct-lift concepts, such as lift-fan and tilt-rotor aircraft, will be undertaken. Large-scale wind-tunnel tests of lift-fan models of various arrangements of lift fans on the fuselage and wings have been under way to define the V/STOL performance, static stability, and control requirements in and out of ground effect. Simulation studies directed at the potential proof-of-concept aircraft are also under way.

The propulsion needs of the lift-fan program include establishing a technology base for lift-fan engines, and providing propulsion support to the aircraft studies as required. The engine-technology program will be directed at the investigation of problems associated with the engine components, integration of the engine components, engine-installation effect, and engine-noise generation. Lift-engine configurations being considered include remote-drive fans, driven by either turbojet or turbofan gas generators, and intergral-drive fans.

Joint NASA/Army/Air Force full-scale tilt-rotor experimental investigations are under way. Tests of a full-scale flight-worthy semi-articulated tilt-rotor in the NASA-Ames 40- by 80-foot wind tunnel have successfully demonstrated the dynamic and performance characteristics of this design. A full-scale hingeless tilt rotor is currently being fabricated for similar tests. The full-scale program includes the fabrication and test of a foldable tilt rotor of the semiarticulated type.

A continuation of the NASA/Army/Onera tilt-rotor performance program provides for additional Hover Tests in the Ames 40- by 80-foot wind tunnel and further high-mach-number cruise-performance investigations in the Onera Modane 26-foot wind tunnel. A theoretical description of the rotor, rotor/wing, and aircraft dynamics will be developed and the stability, control, and vibration characteristics of the aircraft will be studied.

Performance Period and Milestones: Continued efforts in this area are anticipated. Important milestones are as follows:

- January, 1973 - ride-quality and noise-tolerance criteria available for powered-lift concepts
- June, 1974 - ride-quality and noise-tolerance criteria available for advanced-helicopter concepts
- May, 1975 - ride-quality and noise-tolerance criteria available for lift fan/tilt rotor concepts.

Activity 402: Conduct Design and Application Studies

Responsible Organization: NASA

Objective: To develop an increasingly reliable indication of the combinations of short-haul vehicle characteristics which are achievable and to identify those technology advances which can best improve vehicle capabilities.

Requirement: Assessments of the state of aircraft-related technology does not provide a full understanding of what that technology can provide in the way of specific vehicle capability. The application of design methodology is required to identify what joint attributes are achievable. Where such capabilities are found wanting, design sensitivity analysis is needed to indicate which technology developments would prove most beneficial.

The results of Activity 402 are needed as inputs to two distinctly different types of activity. From an engineering point of view, the findings obtained during Activity 402 are needed as input to Activity 403 which involves the detailed design and fabrication of Test Research Vehicles and Engines for the powered lift QUESTOL, QCSEE, advanced helicopter, and direct-lift tilt rotor/lift fan concepts, respectively.

From the point of view of Federal policy decision making, the results of Activity 402 are also needed during Activity 117, which involves the formulation of national recommendations for short-haul air transportation improvements.

Discussion: At the present time, there are two studies under way in the short-haul vehicle design and applications area. Studies of quiet turbofan-powered STOL aircraft are being conducted under contract by two airframe manufacturers. In support of these, two engine manufacturers are under contract to provide design data on STOL aircraft turbofan engines. These studies will provide a much better view of the ability to develop short-haul STOL vehicles with suitable performance characteristics.

A similar set of studies, directed first at advanced helicopters, and subsequently at lift-fan and tilt-rotor aircraft, should be undertaken.

Performance Period and Milestones: The planned efforts extend from the present through May, 1975. Important milestones are as follows:

- January, 1973 - Quiet STOL aircraft/engine design studies complete
- June, 1974 - advanced-helicopter design studies complete
- May, 1975 - lift-fan and tilt-rotor design studies complete.

Activity 403: Develop and Test Research Aircraft/Engines

Responsible Organization: NASA/FAA

Objective: To validate the predicted performance of potentially viable vehicle/subsystem concepts, and to identify unusual characteristics which may be the basis for operating limitations and/or additional investigation.

Requirement: The development and flight test of research vehicles is a necessary step in the process of increasing the confidence level in vehicle performance and characteristics data. This confidence in predictability of vehicle characteristics is important to the stimulation of private-sector developments and the development of valid vehicle design, certification, and operations criteria. The latter requirement is particularly true for designs whose departure from conventional designs are more than modest.

In the near term, the results from Activity 403 for the Modified C-8 Buffalo, QUESTOL, and QCSEE powered-lift concepts are needed as input to Activity 404 which involves development of aircraft/engine design certification and operating criteria. Later, as yet unscheduled, Activity 403 flight tests on advanced helicopter, lift fan, and tilt rotor research vehicles will be required to complete Activity 404 efforts for all of the aircraft concepts under consideration.

Discussion: Several aircraft/engine research articles will be developed and flight tested to provide basic-characteristics data and operational data required to establish commercial feasibility. Near-term efforts will involve aircraft/engine articles related to powered-lift concepts. Midterm and longer range efforts will relate to direct-lift concepts.

The modified De Havilland Buffalo C-8 research vehicle, an augmentor-wing STOL aircraft, will be tested periodically over the next several years for aerodynamic research purposes (it will also be used for ATC/Navigation development). Under the heading of aircraft performance, ride, and handling qualities, data will be obtained on operational

procedures, operational limitations, unsafe and undesirable flight characteristics, and high-work-load situations. Flight-control procedures and vehicle operational performance will also be evaluated.

Two quiet experimental STOL (QUESTOL) research vehicles will be designed, fabricated, and flight tested to provide advanced information on propulsive-lift technology and design criteria. Design-trade-off studies are currently under way to select a particular powered-lift concept: the present candidates include the augmentor wing, internally blown flap, and externally blown flap. Flight tests of the modified Buffalo will provide valuable design data for the QUESTOL aircraft.

A quiet, clean STOL experimental engine (QCSEE) program will develop and establish criteria for turbofan engines incorporating advance noise reduction techniques needed to meet the expected stringent noise and pollution levels required for future short-haul aircraft. The resulting engine development will provide an engine for flight testing.

Rotor test-vehicle studies will provide for an advanced rotor-research capability, including a flight vehicle to be used in generating data on realistic rotor-aerodynamic and dynamic analysis developments. The test vehicle will have a performance capability in excess of present helicopters, additional lift, and propulsive-force capabilities above those of a rotor alone, a computerized flight-control system, and a unique research-instrumentation capability.

A lift-fan research aircraft will be developed to advance knowledge of the practicality of this advanced VTOL concept. Contracts have been awarded to three firms to define a practical commercial design, establish a preliminary design of a minimum size proof-of-concept research aircraft, provide a program plan for its development, and define the necessary research and development program for its development.

Following the appropriate technology-development activities, a tilt-rotor proof-of-concept flight research aircraft will be developed and tested. Competitive study contracts will be awarded to define practical commercial/military designs, establish a preliminary design of

a minimum size proof-of-concept research aircraft, and provide a program plan for the tilt-rotor research aircraft development.

Performance Period and Milestones: The planned activities extend from the present to well past June, 1977. Important milestones are as follows:

- June, 1972 - Modified Buffalo C-8 delivered
- March, 1973 - Initial modified C-8 flight tests complete
- January, 1975 - QUESTOL aircraft and QCSEE engines available
- June, 1975 - Advanced-helicopter research vehicle available
- March, 1976 - Modified C-8 aircraft and QCSEE engine tests complete
- June, 1977 - Lift-fan and tilt-rotor research vehicles available.

Activity 404: Develop Aircraft/Engine Design, Certification, and Operating Criteria

Responsible Organization: FAA

Objective: To develop appropriate design, certification, and operating criteria which will facilitate the timely development and implementation of short-haul aircraft.

Requirements: While it cannot be argued that the development of design and certification criteria must lead commercial aircraft development by a large time margin, concurrent standards development is needed on a schedule which does not delay design, manufacture, and introduction into scheduled service.

In the near term, both aircraft- and engine-certification standards are needed by potential manufacturers for the one or more powered-lift concepts which prove feasible. Potential operators of such equipment will also have a stong interest in the standards which are adopted. In either event, the FAA, itself, also needs the applicable standards to anticipate air-traffic-control accommodations that may become necessary.

Over the longer term, the same kinds of standards are needed for the same reasons for the more advanced short-haul vehicle concepts which prove to be feasible.

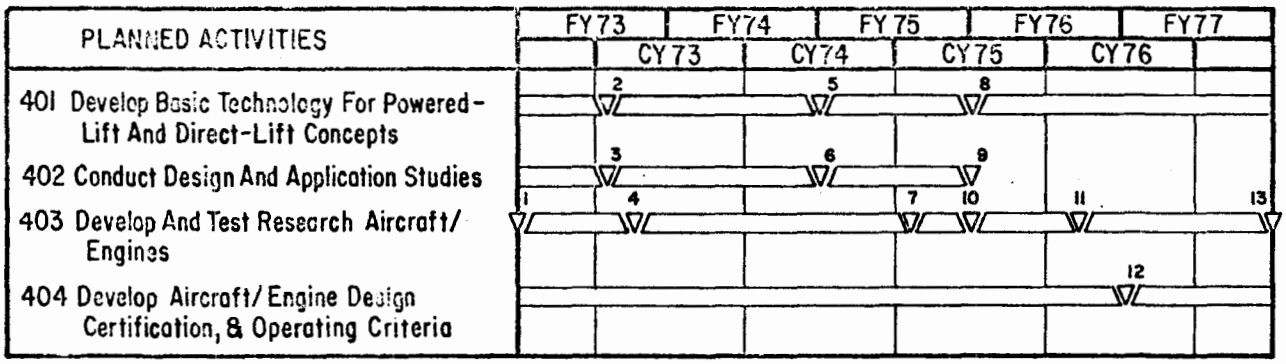
Discussion: The several flight-vehicle research programs will provide much of the data required for this activity. These data will be supplemented by special studies pertaining to vehicle flight characteristics, flight performance and operation, and noise. Present standards are believed adequate, or nearly so, to certificate RTOL designs that might be forthcoming from industry. The first requirements for new standards will likely be presented by powered-lift concepts. Tentative standards for this class of aircraft have already been developed and can be modified as may be dictated by new information, and finalized at the appropriate time. New standards for advanced helicopters and other advanced VTOL designs would follow as required.

Performance Period and Milestones: The planned activities are expected to run more-or-less continuously. Important milestones are as follows:

- September, 1976 - Powered-lift design and certification criteria finalized
- September, 1976 - Powered-lift engine-noise standards finalized.

4.5.5 Milstones and Funding Requirements

Figure 4.12 shows the time duration of the activities, together with some of the milestones mentioned in the activity descriptions. Table 4.5 gives the funding requirements for the Vehicle Development Activities over the 5-year period.



MILESTONES

(1) Modified Buffalo C-8 Delivered
(2) Powered Lift Ride Quality & Noise Tolerance Criteria Available
(3) Quiet STOL Aircraft/Engine Design Studies Complete
(4) Initial Modified C-8 Flight Tests Complete
(5) Helicopter Ride Quality & Noise Tolerance Criteria Available
(6) Advanced Helicopter Design Studies Available
(7) QUESTOL Aircraft & QCSEE Engines Available
(8) Lift Fan/Tilt Rotor Ride Quality & Noise Tolerance Criteria Available
(9) Lift-Fan & Tilt-Rotor Design Studies Complete
(10) Advanced Helicopter Research Vehicle Available
(11) Modified C-8 Aircraft & QCSEE Engine Tests Complete
(12) Powered Lift Aircraft/Engine Design & Certification Criteria Finalized
(13) Lift-Fan & Tilt-Rotor Research Vehicles Available

FIGURE 4.12 VEHICLE-DEVELOPMENT ACTIVITIES AND MILESTONES

TABLE 4.5. VEHICLE FUNDING REQUIREMENTS ($ Millions)

Agency	Fiscal Year 1973	1974	1975	1976	1977	1973-77
FAA	0.6	1.7	2.4	1.8	1.0	7.5
NASA	58.9	95.8	72.3	68.7	49.9	345.6
Total	59.5	97.5	74.7	70.5	50.9	353.1

4.6 Program Summary

4.6.1 Time Sequencing and Interrelationships Among Activities

In the activity descriptions of the preceding subsections, some indications have been given of the time span of each activity, and of the interconnections among them. Here, as these questions are considered for all four of the activity areas, the constraining time considerations become clearer.

The principal mechanism for this discussion is Figure 4.13. In this figure, all 39 of the individual activities are shown, some include multiple phases. The beginning and ending times for each activity are given, and the time-constraining interrelationships are indicated by the arrows. In many cases, earlier activities feed a number of later activities, but only the feeds which have scheduling implications are shown in the figure. The numbers inside the small square boxes are the numbers of the activity associated with the nearby arrow. Arrows without activity numbers usually require zero time and resources, and are used simply to indicate sequencing. The isolated numbers appearing by some arrows are the estimated time durations of the activities, in months.

Activities which will be under way on or before January 1973 are all given a start date of January 1973. If the activity has been planned in detail, and is completely consistent with this plan, the start is designated with the symbol ⊛. If it is under way, but some redirection or additional planning is required, the start date is designated by a simple asterisk.

The major analysis efforts are shown through the center of the figure, Activities 104, 105, 106, 117, and 118. In the upper left are a group of activities relating to implementation, in the upper center are the airport activities, and in the lower left, the ATC/Navigation activities. The aircraft activities are in the lower right portion of the figure.

The high degree of paralleling of analysis tasks, brought about by the Northeast Corridor date is apparent in this figure. Airport, ATC, and implementation studies are all running concurrently with the early phases of

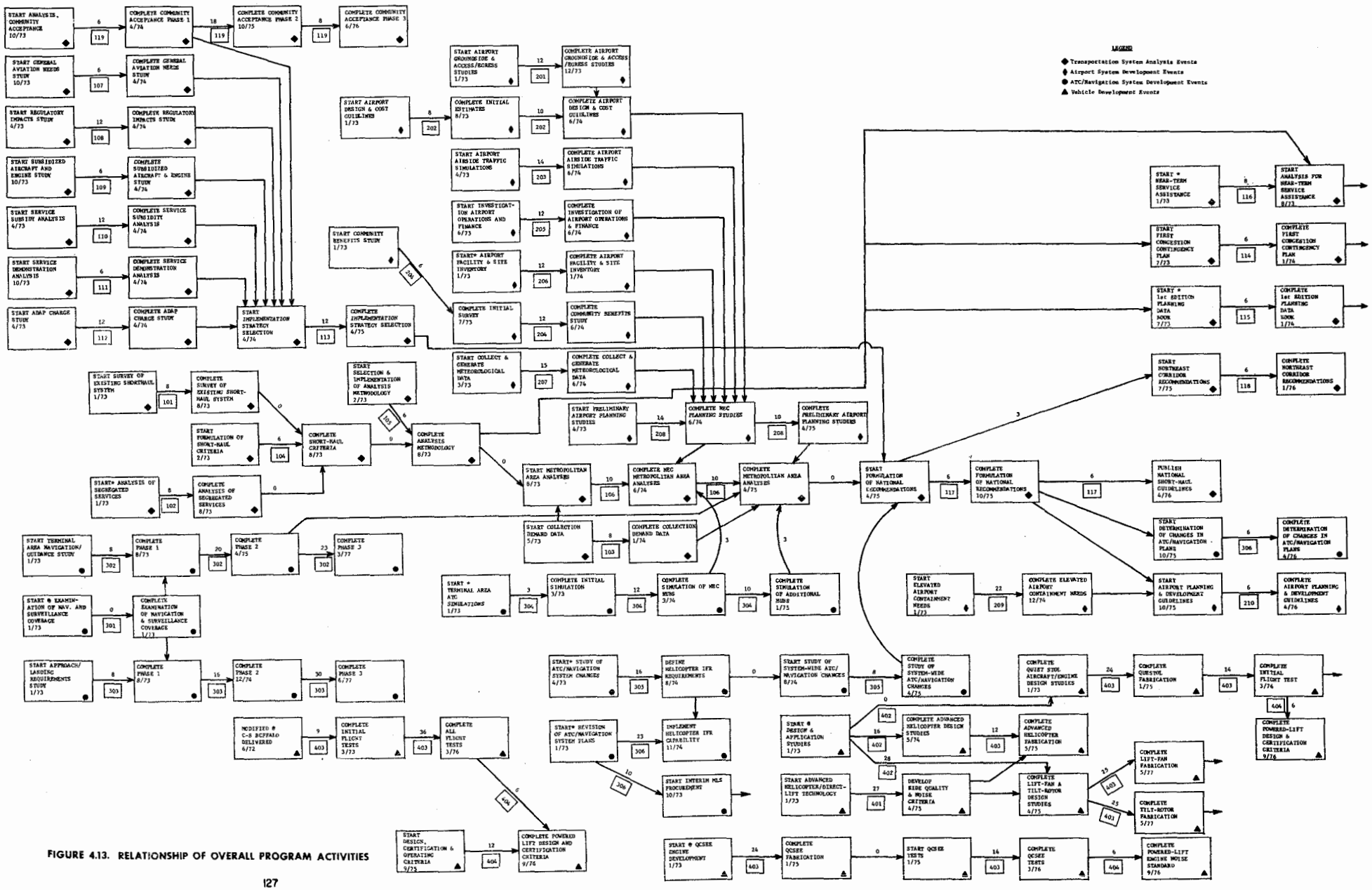


FIGURE 4.13. RELATIONSHIP OF OVERALL PROGRAM ACTIVITIES

the metropolitan area analyses. At least for airport and ATC, it might be preferable to have more task completions prior to initiation of the area analyses. It may also be seen that a number of the longer-lead-time flight programs will not be able to contribute to the recommendations. For example, the final phases of Activities 302 and 303, the advanced-vehicle tests and the quiet-engine tests of Activity 403, all come too late to contribute fully to the formulation of national recommendations.

4.6.2 Funding Summary

In Table 4.6, the funding requirements for the four activity areas are shown together with the totals for the two agencies. The amounts shown are consistent with previously planned funding levels, except for Airport Activities, for which the figures given here are somewhat higher.

4.7 Program Management and Coordination

The Short-Haul Air Transportation Program presents particularly complex problems in the areas of management and coordination. This complexity arises from several sources. The subject area involves many non-technical as well as technical factors. The responsibility for development, operation, and regulation of various system elements is spread over a large number of organizations, Federal and non-Federal, thereby involving many decision makers. Finally, the program involves a large number of concurrent activities which require timely coordination.

The management approach developed will bring the full talents of government and industry to bear on the problem and will permit all of the positions and issues of the participants to be aired and factored into the program. Because this program does not mark the beginning of short-haul-oriented activity, many of the necessary management and co-ordinative mechanisms were already in place. Accordingly, the approach described here makes use of them and adds others as appropriate.

The initial plan, presented in this document, sets forth the elements and resources necessary to formalize and implement the program. As the program proceeds, the management and coordination mechanisms must provide for

TABLE 4.6. PROGRAM FUNDING SUMMARY FY1973-1977
($ Millions)

Activity Area	Agency	Fiscal Year 1973	1974	1975	1976	1977	1973-77
Transportation Systems Analysis Activities	FAA	0.915	1.767	1.615	1.460	1.420	7.177
	NASA	0.970	0.920	0.890	0.860	0.700	4.340
	CAB	0.235	0.368	0.245	0.110	0.050	1.008
Airport Activities	FAA	1.600	2.700	1.600	1.000	0.300	7.200
ATC/Navigation Activities	FAA	1.300	1.800	2.000	1.100	0.600	6.800
	NASA	6.600	10.300	8.800	7.700	7.000	40.400
Aircraft Activities	FAA	0.600	1.700	2.400	1.800	1.000	7.500
	NASA	58.900	95.800	72.300	68.700	49.900	345.600
Agency Totals	FAA	4.415	7.967	7.615	5.360	3.320	28.677
	NASA	66.470	107.020	81.990	77.260	57.600	390.340
	CAB	0.235	0.368	0.245	0.110	0.050	1.008
Grand Total		71.120	115.355	89.850	82.730	60.970	420.025

several important functions, as follows:

- Technical management of the many activities planned
- Planning, coordination, and integration of the concurrent activities
- Coordination with involved participants from local and state government and the private sector
- Resolution of technical and funding priorities
- Timely action on major issues and policy questions.

The management and coordination approach responsive to these requirements is described in three parts:

- Short-haul management structure
- Supplementary coordination mechanisms
- Coordination with nonFederal participants.

4.7.1 Short-Haul Management Structure

Figure 4.14 shows the short-haul management structure which provides for three different levels of management functions. The uppermost level consists of the heads of the three Federal organizations most directly relating to the air transportation mission: DOT/FAA, CAB, and NASA. Fundamental guidance to the program will come from this level. As substantive and more reliable information is generated on various development options for short haul, their benefits, and the required levels of Federal commitment, it is anticipated that major issues or policy questions will arise. These will have to be resolved at this higher level in the program.

Higher level coordination and policy matters will also be the subject of interactions between DOT/FAA, CAB, NASA, and other branches, departments, and agencies. These other organizations include the Congress, OMB, NASC, DOD/DDR&E, EPA, HUD, and other administrations within the Department of Transportation.

As the program progresses, an increasingly important function will include the monitoring of activities, setting of technical and funding priorities, and, as required, reprogramming of activities. This function is primarily applicable to the activities involving the expenditure of

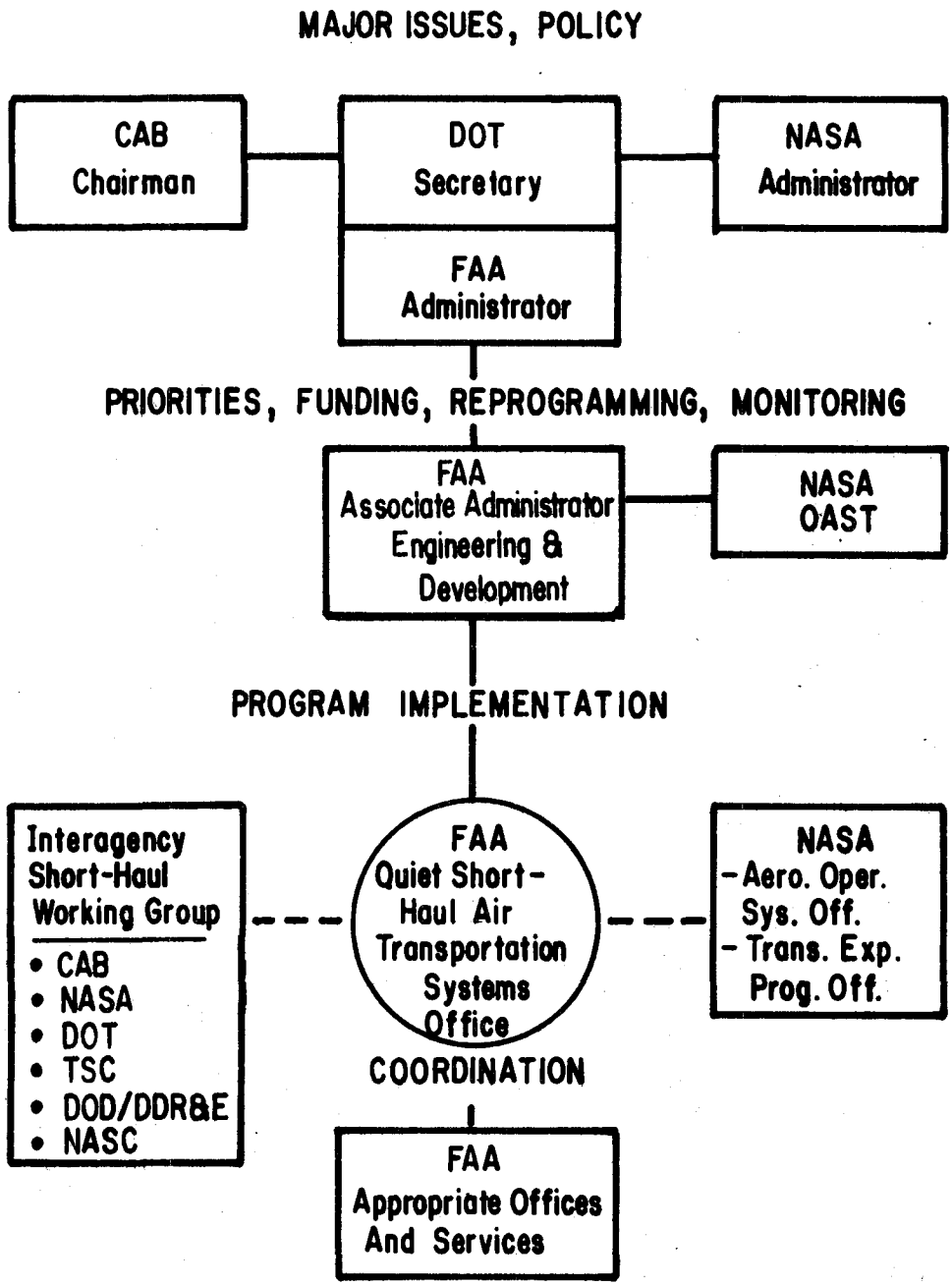


FIGURE 4.14-SHORT-HAUL MANAGEMENT STRUCTURE

engineering and development funds (FAA), and research and technology funds (NASA). Within FAA, this responsibility falls to the Associate Administrator for Engineering and Development and is carried out by the Office of Systems Engineering Management. In the NASA, the cognizant organization is the Office of Aeronautics and Space Technology.

Program implementation will be achieved by various offices, services, divisions, and bureaus within the FAA, NASA, and CAB. The FAA's Quiet Short Haul Air Transportation Systems Office will serve as a systems management/integration and coordination role.

The Aeronautical Operating Systems Office and Transport Experiments Program Office, both in NASA/OAST, have overall responsibility for the short-haul-oriented research and technology activities. The bulk of these programs will be carried out at the NASA Research Centers (Ames, Edwards, Langley, and Lewis).

The CAB is continuously involved with important investigations and hearings which significantly impact the short-haul air transportation area. They will provide appropriate information on user needs, patronage, fares, and other issues of importance to the program. The Bureau of Operating Rights and the Office of Plans constitute the two principal organizations involved.

The FAA activities which directly or indirectly relate to short-haul air transportation are conducted across the entire organization and will necessitate coordination. The Office of Policy and Plans, Office of Aviation Economics, Systems Research and Development Service, Airports Service, Air Traffic Service, and Flight Standards Service are the principal groups involved.

Broader interagency coordination than just FAA, NASA, and CAB is required at the program-implementation level. This is particularly important in connection with the Transportation Systems Analysis area of the program. To provide this coordination, an Interagency Short-Haul Working Group has been formed with the FAA QSATS Office providing the leadership. This Group includes appropriate individuals from DOT/OST, TSC, DOD/DDR&E, and NASC, as well as FAA, NASA, and CAB. As the program proceeds, this Group's role will be refined and strengthened.

4.7.2 Supplementary Coordination Mechanisms

Other coordinative mechanisms already in existence constitute important additional means of providing for the necessary interagency coordination at all three levels of the program management structure. They are as follows:

- Major issues and policy
  - Joint DOT/NASA CARD Implementation Office
  - CARD Review Group
- Priorities, funding, reprogramming, monitoring
  - Joint FAA/NASA Coordinating Committee
- Program Implementation
  - Joint FAA/NASA STOL Operating Experiments Steering Group
  - Air Force/NASA STOL Aircraft Coordinating Council.

In response to the CARD Policy Study, a Joint DOT/NASA CARD Implementation Office was created in 1971 to develop an implementation plan for the Policy recommendations. While concerned with all aspects of air transportation, high- and low-density short-haul system improvements are given special attention. Extensive effort has already been devoted to developing a comprehensive implementation plan, and results are scheduled for publication before the end of 1972.

A CARD Review Group, comprised of members from NASC, DOT, and NASA, has also been formed at the Assistant Secretary level. This group meets annually and will serve as a policy and program formulation review and focusing mechanism. The present members of this Group are the DOT Assistant Secretary for Systems Development and Technology, the NASA Associate Administrator for Aeronautics and Space Technology, and the NASC Executive Secretary.

The Joint FAA/NASA Coordinating Committee was formed to better coordinate the aviation activities of the two organizations. The formal committee meets quarterly and is presently composed of eight top-level officials from each agency. The FAA co-chairman is the Associate Administrator for Engineering and Development. He is joined by the FAA Directors of Flight Standards Service, Office of Aviation Medicine, Systems Research and Development Service, Office of Systems Engineering Management, the QSATS Office, the Aircraft and Noise Abatement Division of

SRDS, and the Office of Aviation Policy and Plans. The NASA cochairman is the OART Deputy Associate Administrator for Programs. He is joined by the Assistant Administrator for DOD and Interagency Affairs, and the NASA Directors of the Aerodynamics and Vehicle Systems Division, the Guidance, Control and Information Systems Division, the Aeronautical Life Sciences Division, the Aeronautical Operating Systems Office, the Transport Experimental Programs Office, and the Communications Programs Office.

The Joint FAA/NASA STOL Operating Experiments Steering Group was formed to deal with various aspects of the operation and certification of V/STOL systems. For example, the FAA and NASA recently purchased a STOL flying test bed, fitted with a complex avionics system. NASA personnel will concentrate on vehicle, engine, and avionics technology. The FAA will provide total systems analysis and guidance, including the development of landing, navigation, and air-traffic-control techniques and equipment.

The NASA is also working with the Air Force on prototype STOL aircraft/engine concepts through the Air Force/NASA STOL Aircraft Coordinating Council. This council is cochaired by the Air Force Assistant Secretary for R&D and the NASA Associate Administrator for Aeronautics and Space Technology. The Executive Secretary for NASC will also participate as a member of the Coordinating Council. The NASA wants to assure there will be maximum integration and commonality between the Air Force Advanced Medium STOL Transport (AMST), and the technology work contributing to development of civil powered-lift aircraft.

4.7.3 Coordination With Non-Federal Participants

Non-Federal organizations with direct involvement in air transportation are viewed as important participants in the program. They share important responsibilities with the Federal government for the development, operation, and regulation of parts of the air transportation system. The participants include:

- Local and State Government
  - municipal governments and planning agencies
  - quasigovernmental transportation bodies
  - state departments of aviation and/or transportation
  - airport operators

- Private Industry
  - airframe and engine manufacturers
  - trunk, local service, and commuter airlines
- Trade/User Groups
  - AIA
  - AOCI
  - AOPA
  - ATA
  - IATA
  - NATC.

Many of the above have continuing relationships with the DOT/FAA, CAB, and NASA, and are regularly consulted concerning the various activities which are a part of this program. Coordination over and above this will be required, however, if such organizations are to be made a part of planning activities such as goal setting, strategy development, evaluation criteria development, coordinated action, and program assessment.

A formalized process for coordinating with these groups is not defined as part of this plan. It is given the highest priority early in the program, however. For the present, continued selective coordination, as required, is planned.

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6.0 GLOSSARY OF TERMS

ADAP	Airport Development Aid Program
ADF	Automatic Direction Finder
AGL	Above Ground Level
AGTC	Airport Ground Traffic Control
AIA	Aerospace Industries Assosiation
AMST	Advanced Medium STOL Transport
AOCI	Airport Operators Council International
AOPA	Aircraft Owners and Pilots Association
APC	Area Positive Control
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radio Beacon System
CARD	Civil Aviation Research and Development
CBD	Central Business District
CFCF	Central Flow Control Facility
CTOL	Conventional Takeoff and Landing
DABS	Discrete Address Beacon System
DME	Distance Measuring Equipment
EPNL	Effective Perceived Noise Level
FAR	Federal Aviation Regulation
FDEP	Flight Data Entry and Printout Equipment
FL	Flight Level (= 100 ft MSL)

6.0 GLOSSARY OF TERMS
(Continued)

IATA	International Air Transport Association
IFR	Instrument Flight Rules
ILS	Instrument Landing System
MLS	Microwave Landing System
MODILS	Modular ILS
NAFEC	National Aviation Facilities Experimental Center
NAS	National Airspace System
NASP	National Airport System Plan
NATC	National Aviation Trades Council
NEC	Northeast Corridor
NECX	Northeast Corridor Extended
NEF	Noise Exposure Forecast
OART	Office of Advanced Research and Technology
OAST	Office of Aeronautics and Space Technology
O-D	Origin-Destination
PANCAP	Practical Annual Capacity
QCSEE	Quiet Clean STOL Experimental Engine
QSTOL, QUESTOL	Quiet STOL
RTOL	Reduced Takeoff and Landing
STOL	Short Takeoff and Landing
STOLAND	STOL Landing Avionics

6.0 GLOSSARY OF TERMS
(Continued)

TACAN	Tactical Air Navigation
TCA	Terminal Control Area
TCV	Terminally Configured Vehicles
TRACAB	Terminal Radar Approach, Tower Cab Control
TRACON	Terminal Radar Approach Control Facility
TRSA	Terminal Radar Service Area
TSC	Transportation Systems Center
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rules
VOR	Very High Frequency Omnirange Station
VORTAC	Colocated VOR and TACAN
VTOL	Vertical Takeoff and Landing