

NASA-CR-165,887

NASA Contractor Report 165887

NASA-CR-165887
19830010430

**A Reappraisal of Transport Aircraft Needs 1985-2000:
Perceptions of Airline Management in a Changing Economic,
Regulatory, and Technological Environment**

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Contract NAG 1-180
March 1982

NASA

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23665

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by

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Pursuant to NASA Langley Research Center

Grant NAG 1-180

TC431

N83-18701#

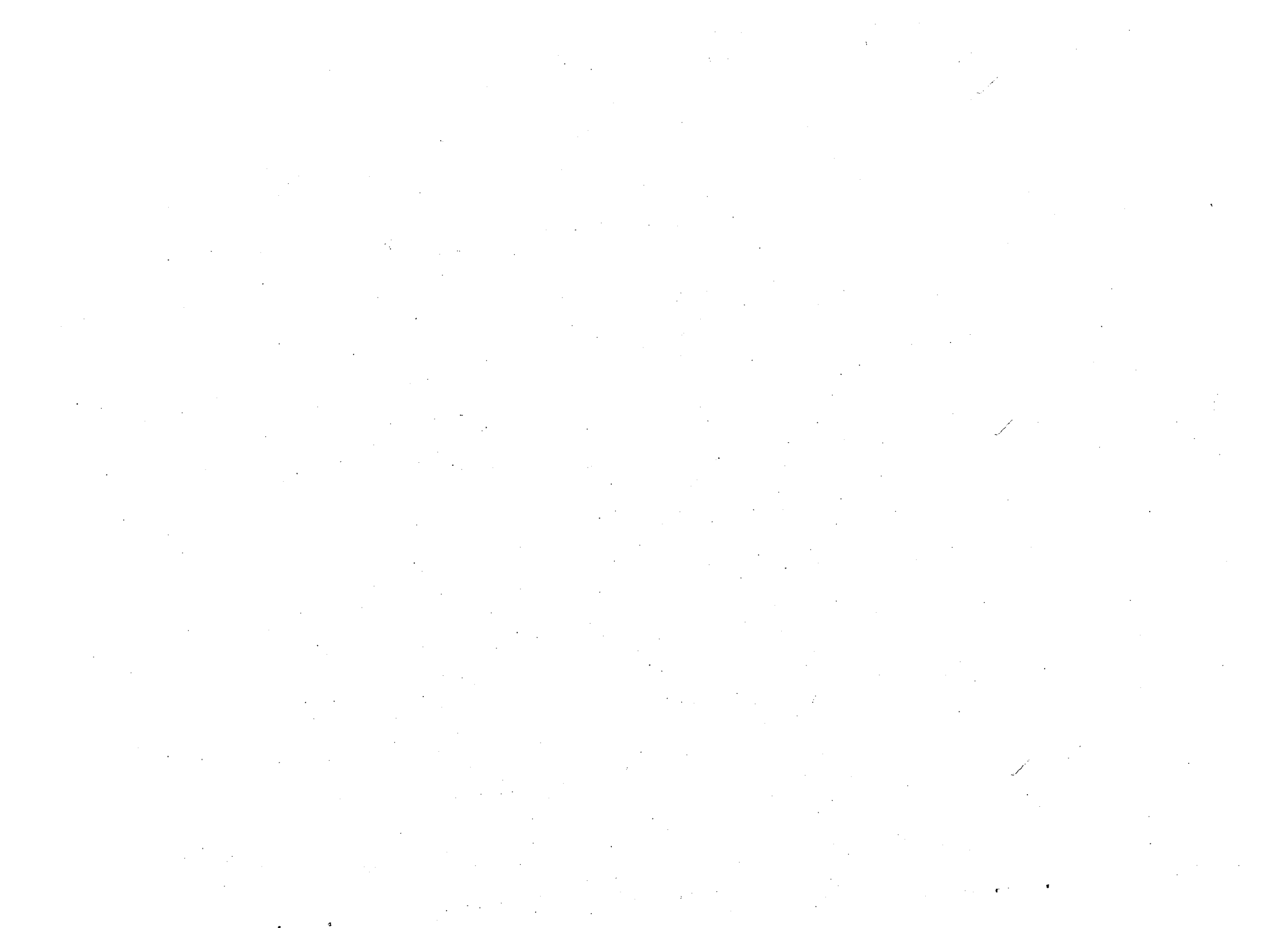


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FOREWORD

This study which deals with the future equipment needs of the airlines is the third in a series of research projects conducted by the Transportation Center of Northwestern University for the National Aeronautics and Space Administration (NASA). The first, published in 1979, Factors Affecting the Retirement of Commercial Transport Aircraft (NASA CR-152308), indicated that retirements in the current era have not been caused by equipment aging and physical fatigue but rather by technological obsolescence resulting from dramatically rising fuel prices which pointed to the need to focus technology on fuel efficiency, and from increasingly successful pressures by environmentalists toward minimizing or even eliminating the use of certain types of transport aircraft because of their noise characteristics. Fortunately, the development of high-bypass engines, first adopted on long-range wide-body aircraft, represented substantial improvement in both fuel efficiency and noise emissions. The study closed by pointing to the advisability of accelerated research to hasten the application of this technology to smaller capacity and shorter range aircraft.

Indications that air traffic in Europe and in the Pacific Basin was subject to increasing constraints because of aircraft noise regulations led NASA to commission the second study, a two-volume report entitled Transport Jet Aircraft Noise Abatement in Foreign Countries: Growth, Structure, Impact, Vol. I: Europe and Vol. II: Pacific Basin. This report (NASA CR-152,356 and 152,357), published in 1980, focused on the existing noise regulations as well as the future outlook. It concluded that noise regulations were becoming more pervasive and more onerous in a number of European and Pacific Basin states than in the U.S. Foreign carriers and their governments evidenced some dissatisfaction with the progress made by U.S. aircraft manufacturers in addressing the need for replacing medium to small transport aircraft with quiet, fuel-efficient planes.

This third study complements the other two and adds the factors of deregulation, inflation, and new technology to the calculus of decisions dealing with equipment needs for 1985-2000. Focus is on the perceptions of the executives who will be making the equipment decisions.

A note of explanation is necessary concerning the apparent lack of standardization in terminology in categorizing the airlines into types of carriers. On January 1, 1981, the CAB discontinued the terminology of trunks, local service, and commuters -- a terminology based upon the type of service rendered -- in favor of categories based upon gross revenues received. Under the new classification there are majors (revenues of \$1 billion or more), nationals (\$75 million to \$1 billion), large regionals (\$10 million to \$75 million), and small regionals (revenues less than \$10 million).

Financial analysts and the airlines themselves are not too happy with the new terminology; a few cling to the former classification, some have adopted the new, and still others use a mixture of both. This report employs whichever term is appropriate in the context. Thus, the historical material employs the classifications of trunks, local service, and commuters -- terms in common usage at the time.

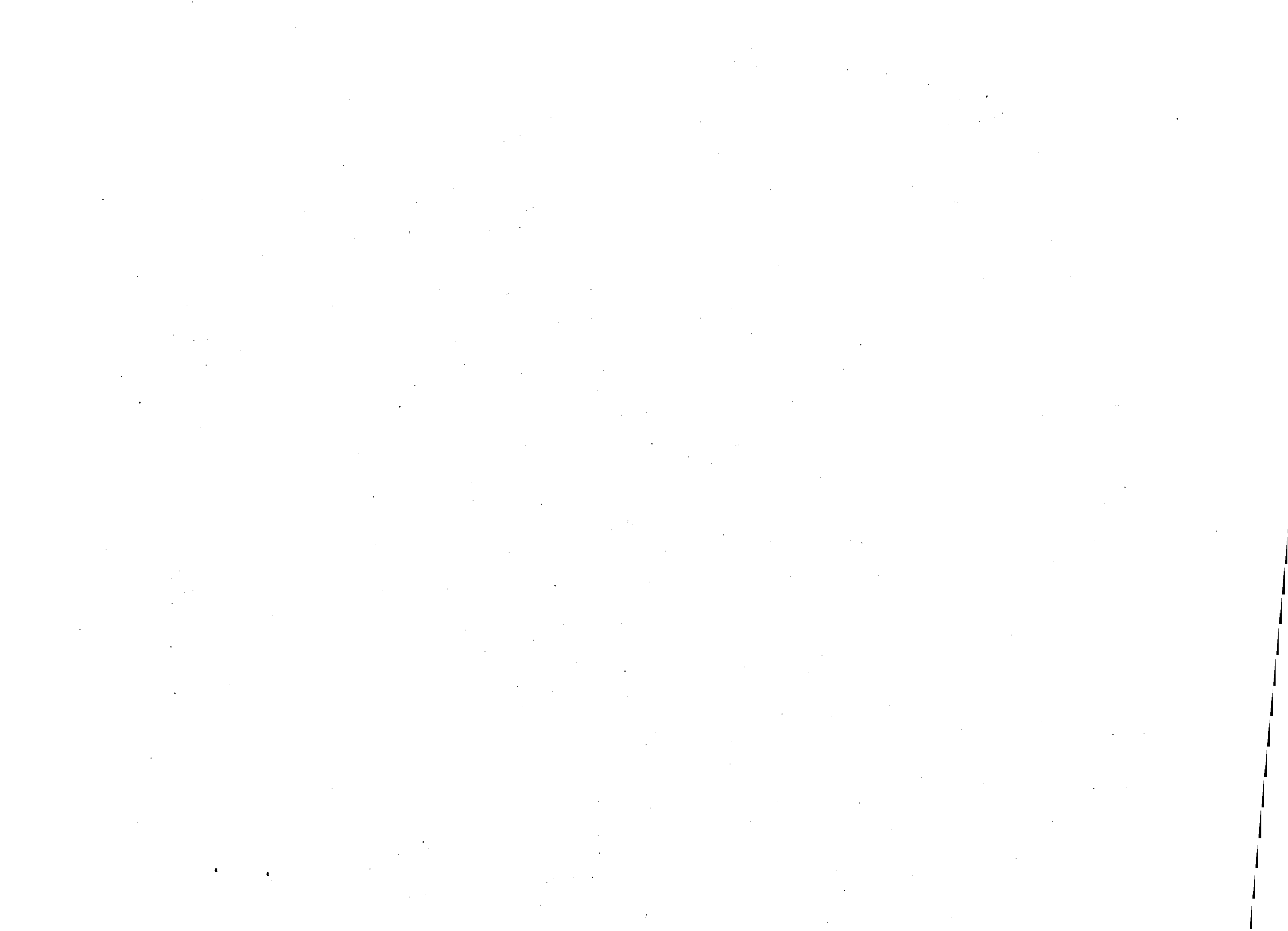
Evanston, Illinois
January, 1982

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ACKNOWLEDGEMENTS

Many airline executives and their staffs, by extensive and candid personal interviews, made this report possible. Their names, too numerous to mention here, may be found in Appendix B. Special thanks is owed to Ernard B. Graves, the technical officer of NASA, assigned to the study, for his support and patience as the difficulties of coordinating meetings all over the United States during travel problems occasioned by the PATCO strike forced extension of the original deadline. And, finally my heartfelt thanks to my wife, Jerry, who cheerfully gave up a summer vacation in Switzerland and kept the homefires burning during my frequent absences pursuing this work.

Frank A. Spencer



Chapter 1

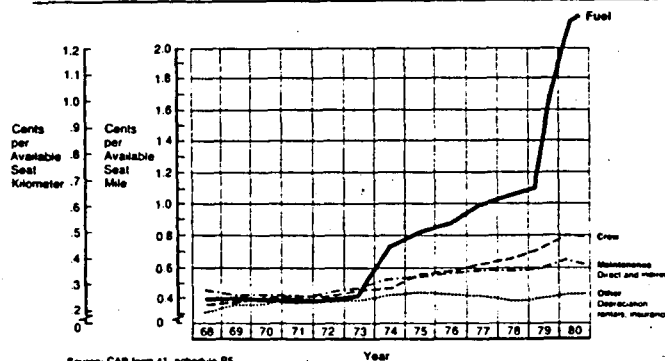
INTRODUCTION

Dramatic changes in the economic, political, regulatory and technological environment in which the airlines operate have taken place in the 1970s and are continuing.¹ Rapid escalation of fuel costs relative to other costs (graphically depicted on Chart 1-1), fluctuating concerns over fuel availability, more stringent environmental regulations stemming from complaints about noise and particulate emissions, and a changed economic environment resulting from inflation and deregulation have required airline managements to re-examine carefully their needs for aircraft in the years ahead.

Chart 1-1

Influence of Fuel Price

Direct Operating Cost Elements (Current Dollars)



Source: CAB form 41, schedule P5

Source: Boeing Commercial Airplane Co.

Prior to 1973, when fuel was 11 cents a gallon, airframe engineers and powerplant designers were not concerned with fuel consumption; nor were they as concerned with jet aircraft noise emissions as the

¹ The controllers' strike beginning in August 1981 is the most recent example of a change which might have long run effects.

environmentalists have now forced them to be. Similarly the airlines, then under a regulatory system which provided a measure of protection against entry by other carriers, found it necessary to compete in frequency of service and to provide more and more costly amenities.

In the 1960s, high growth rates of traffic stemming from a post-war population which was experiencing increases in disposable income and leisure time caused aircraft designers to build larger and longer range aircraft, including the B-747, which were deployed over route segments as short as 32 minutes flying time and as long as 13 hours irrespective of the efficiency involved. In the rush to increase capacity some airlines even purchased aircraft without having identified the routes on which they would be flown. It was the common belief of management that if too large an aircraft was purchased the carrier would either grow into it or easily sell it.

In the middle 1960s, with traffic increasing at the robust rate of over 15 percent per year and with certain overwater distances too great for nonstop operation, aircraft manufacturers concentrated on developing a new generation of wide-body high-capacity aircraft (B-747, DC-10, L-1011 and Airbus). The peak efficiencies of these planes were in the longer ranges. Introduction of these wide-bodies in the early 1970s began in a recession and continued in the subsequent inflationary period during which fuel costs increased by 900 percent.

Influenced by the historical record of traffic growth and the "bigger is better and cheaper per seat mile" syndrome, aircraft manufacturers have been slow to develop medium- to short-haul aircraft of moderate capacities. Until recently aircraft manufacturers were not being pushed

hard toward new-technology planes of more modest size and by small-medium-sized airlines because their managements had visions of growth which would enable them to emulate the trunks. However, new elements have now developed to change the environment in which airline managements must operate so that management of an airline is "a whole new ball game."

1.1 The New Environment Facing Management -- Developments of the 70s

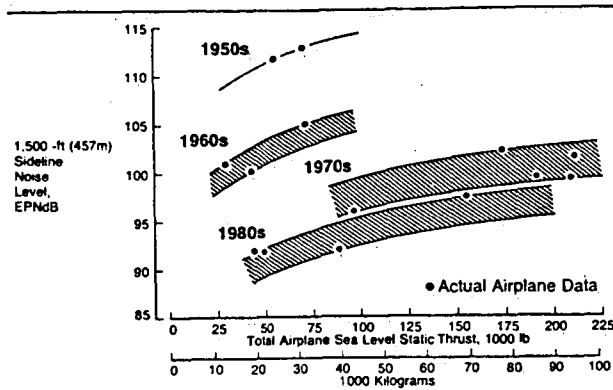
Six important developments of the 1970s now face management:

- (1) a 900 percent increase in fuel price which renders many airline aircraft either economically obsolete or requires fares sufficiently high to curtail demand;
- (2) a general rate of inflation which results in less disposable income being available for travel, thus reducing future growth expectations. Inflation has also raised ownership costs of new aircraft to the extent that the economies of the new technology are offset;
- (3) a growing trend toward a more competitive industry -- formalized into law by the Airline Deregulation Act of 1978 and characterized by significant changes in airline route structure;
- (4) legal and social pressures for the replacement of existing aircraft by quieter aircraft which are now available (chart 1-2);
- (5) public rejection of large wide-body service when it competes with higher frequency, lower-capacity, standard-body planes; and
- (6) the possibility of a technological advance which would make a propfan with its significant fuel savings viable, poses complications on long-term equipment decisions.

These elements combine to force managements to reassess their strategy not only as to routes and types of business, but particularly as to the type and size of aircraft employed. Under the previous regulated environment in which there were varying degrees of protection from entry by competing carriers so that routes had a franchise value, the CAB set rates on the basis of industry costs. Thus, fares had to be high enough to protect the inefficient carriers. This is no longer the

Chart 1-2

Progress in Noise Reduction Technology



Source: Boeing Commercial Airplane Co.

case. Efficient low-cost carriers, like Delta and Northwest, as well as new specialized carriers, like SWA, PSA, New York Air, and People, have the capability of establishing rates which will not be profitable for high-cost competing carriers. Thus, it may prove impossible for a carrier with a three-engine, three-man cockpit crew plane of the wrong size operating over non-optimal stage lengths to survive against a new-technology, twin-engine, two-pilot, properly-sized aircraft.

Immediately prior to the introduction of jet aircraft, when energy costs were not a significant factor in aircraft equipment decision making, a limited number of Lockheed Electra turboprop aircraft were introduced. An unfortunate design defect led to accidents and the aircraft's eventual phase out. Moreover, the public's rapid acceptance of jets doomed extensive use of this turboprop. When jets were introduced, airlines were happy to avoid the complexities and problems with the turboprop propeller and its drive and gearbox mechanisms. Recently, however, high energy costs plus the fact that NASA studies indicate very

substantial fuel savings and the ability to fly at speeds close to jet Mach numbers for advanced technology turboprops, now called "prop-fans," suggest that there may be substantial economies for short- and mid-range turboprop aircraft over pure jets, providing the public and the airlines are willing to accept them. Thus, the present attitude toward turboprops or prop-fans by those who would have to commit for them is a subject worthy of examination.

The proper size for future air transports is critical to profitability. Is the age of empire building with larger aircraft and larger airline networks over? Or, will additional competition, coupled with a behavior pattern of the public showing preference for frequency of service with fewer amenities over large aircraft with low frequencies, result in a demand for aircraft no larger than the present planes? This study presents the current thinking of those charged with making equipment purchase decisions or with making the recommendations to those who do make the decisions.

1.2 Research Procedure

The purchase of aircraft can be the most important capital expense made by a company and should involve long-range planning including top officials of a company. It is perhaps significant that the more successful airlines turned out to be those most attentive to strategic planning. In general, long-range planning for aircraft has not been the strong suit of airline management.

Because aircraft equipment decisions have historically been made by the top executive or a few top executives, albeit purportedly by the board of directors, the research alternatives of a survey of the

literature dealing with equipment choice processes or an analysis of responses to questionnaires was discarded in favor of personal interviews with either the chief executive or his designated representatives. Each company executive to be interviewed was supplied in advance with questions which would serve as the basis for further discussion. The basic question list is found in Appendix A. A representative list of persons interviewed is found in Appendix B. In the case of several large carriers, the chairman of the board and CEO were the major participants in the interview.

One to six individuals of each of the following 24 airlines were interviewed at company headquarters. Individual interviews averaged one hour and twenty minutes.

- | | |
|-------------------------|------------------------|
| 1. AirCal | 13. Golden West |
| 2. Air Florida | 14. Midstate Airlines |
| 3. Air New England | 15. Midway Airlines |
| 4. Air Wisconsin | 16. Northwest Airlines |
| 5. American Airlines | 17. Piedmont Aviation |
| 6. Britt Airways | 18. PSA |
| 7. Continental Airlines | 19. Republic Airlines |
| 8. Delta Airlines | 20. Southwest Airlines |
| 9. Eastern Airlines | 21. TWA |
| 10. Federal Express | 22. United Airlines |
| 11. Flying Tigers | 23. USAir |
| 12. Frontier Airlines | 24. Western Airlines |

Because of the extensive management restructuring underway at Braniff and Pan American -- a restructuring which will undoubtedly change future plans of the companies, these companies were not included. Ozark's president suggested his carrier be omitted since the company was still recovering from a strike and had not yet formulated a game plan for the future. Originally this study was to be limited to trunk and regional carriers, thus omitting the smaller certificated and commuter

airlines. Later NASA asked that some coverage be given to these categories. As a result, AirCal, Air New England, Golden West, Air Wisconsin, Midstate and Britt were added.

Chapter 2

HOW EIGHT MAJOR (FORMER TRUNK) AIRLINES PERCEIVE THEIR FUTURE ROLES

2.1 Alternatives Available

Faced with deregulation, inflation, rising fuel costs, noise problems and financial constraints, various alternatives are open to airline managements. A carrier's equipment needs for 1985-2000 are dependent upon the role it sees for itself in the transportation system. A carrier may attempt to follow the course of history in which almost every carrier worked toward expanding its operations to become a coast-to-coast or even an international carrier. Commuters may strive to expand into local service or national carriers, and nationals to transcontinental majors. A large airline may structure itself to be, in effect, all three types of airlines, with its smaller operations feeding into the large. In an attempt to protect traffic on its linear routes, a carrier may choose to expand the hub-and-spoke concept. Additionally, a large carrier, after reviewing what it can do most profitably, may discontinue its quest for size and decrease its fleet to concentrate on the routes best suited to its present equipment, or it may adopt a new strategic plan and restructure its route network to take advantage of the economics of a new type of plane not yet in its hangers.

Since deregulation, the former local service airlines have generally been more profitable than the former trunks. Options of the local service lines include: (a) maintaining the status quo and concentrating on fine-tuning their operations; or (b) attempting to attack the weaker major airlines in the hope that the superior efficiency of their operations

will cause the major airlines to withdraw and the local service lines will then become majors.

Options for the commuters are more limited -- they must remain relatively small or attempt to break out of the commuter mold to progress to larger certificated operations. As the remainder of the chapter shows, when the question of future role was asked of the officials interviewed, there were a wide range of responses covering all these options. However, if a generalization can be made, it is that there is greater recognition (than in the past) that competition may force inefficient airlines out of business and that there is, therefore, a high priority on a "lean" company structure and great attention on redeploying assets where operations are not meeting a desired standard of profitability. Finally, the cost of aircraft -- present and potential aircraft -- are being scrutinized as never before. Capital costs, financing costs, costs per seat mile, per revenue passenger mile, per aircraft mile, per aircraft hour, seat miles per gallon, and maintenance costs per revenue hour, are all closely examined to determine which aircraft is best for the strategic plan.

2.2 Questions to be Raised

American, Continental, Delta, Eastern, Northwest, Republic, TWA, United, and USAir are the nine major airlines interviewed. Each carrier was asked:

"Given the changes of the 1970s and 1980s how does your airline see its future role in the air transport system?"

- a. "What is the size and type of aircraft this role requires?"
- b. "What stage lengths will be involved?"

- c. "Will it be necessary to readjust the airline's route network to fit the economics of the current fleet?"
- d. "Or is it planned to obtain a completely new plane optimal for the airline's new or existing strategic plan?"

2.3 American Airlines

This major transcontinental carrier, with a past history of a low return on total assets, stated that financial constraints dictated some of its answers. Additionally, it pointed out that deregulation has permitted and encouraged new "instant" or "upstart" low-cost operators to enter some point-to-point markets. Aside from the advantage of low startup costs by buying or leasing low-cost used airplanes and operating them with low-cost, non-union, low-seniority personnel, these carriers offer spartan service without interlining. The net effect will be to drive American and other "full service" carriers from some of these markets. American has already dropped several such markets -- markets in which the carrier for a long time has had a major presence.

The company foresees its role as a medium- to long-haul carrier fed through an expanding hub-and-spoke concept. It believes that other airlines facing a similar situation will adopt the same strategy. Point-to-point operations will survive where they feed the longer routes.

What type of aircraft does the company need for future operations with this scenario? For its long-haul domestic passenger and possible new passenger interational operations, it needs and has B-747-100s of about 400-passenger capacity and DC-10-10s with about 296 seats. Thus, except for the possible need for used DC-10-30s for a projected route too long for the DC-10-10, the long-haul stage lengths are covered. Given American's financial situation, it has no plans for replacing or

re-engining these aircraft before they are 18-20 years old and consideration is being given to extending their life further.

Table 2-1
American Airlines Fleet, August 1981

<u>Owned</u>	<u>Leased</u>	<u>On Order</u>	<u>Type</u>	<u>Seats</u>	<u>Cargo Aircraft Payload</u>
55	1		B-727-100	108	
55	70		B-727-200	144	
29			B-707-300*		
1	7		B-747-100	396	
6			B-747F		215,000 lbs.
		15	B-757	190	
		30	B-767	204	
5			CV-440	44	
28	6		Dc-10-10	296	

* All are now permanently grounded and being sold.

Table 2-1 lists American's fleet in August 1981. Noise regulations would have forced the grounding of the B-707s in several years, but the escalating fuel prices made their use uneconomical in 1981 thus forcing the company to take them all out of service. For similar reasons American is phasing out as quickly as possible the B-727-100s and some of the older B-727-200s. Obsolescence of these planes and the present absence of suitable replacements set in motion the company's search for new-technology aircraft or for a major modification to its newer B-727-200 series in order to be competitive in the 1985-2000 period.

With the new 204- and 190-passenger B-767 and B-757 aircraft on order for use up to the year 2000, the carrier's equipment concern is how to meet the short- to medium-haul market given its hub-and-spoke strategy. It cannot be competitive for long with its B-727-100s and B-727-200s. Options available are: (a) feed the hub out and back with

an efficient two-man crew B-737-200 fleet which it does not have;
(b) employ one piece of equipment which would be less efficient on the short-haul but would have long-haul capability. For example, assuming the B-727-200, there would be a ten passenger advantage per trip.

At present the main concern of American for the 1985-2000 period is which aircraft can efficiently handle its shorter hauls and still provide frequency of service -- a factor deemed to be of great importance. Also of concern is how this purchase can be financed. Current analysis leads the company to believe that much as it needs a quiet, fuel-efficient, new-technology, twin-engine aircraft of about 150-passenger capacity, there is no way such an aircraft, which has not yet been designed, could presently be financed. Further, there is the conviction that with the exception of highly profitable Delta, no other airline could handle the financing of a new-technology aircraft. Therefore, American reasons that unless a major modification of most of its three-engine B-727-200 series² into a fuel-efficient twin-engine aircraft at a price less than one-third of that of a new-technology aircraft can be effected, the company must decrease in size and number of aircraft operated.³

To be more specific in answering the question on its future role, American sees a smaller but more profitable role for itself than it has had in the past. It will fight to preserve its long-haul routes and withdraw from point-to-point routes which do not provide profitable feed. With system stage lengths now averaging 900 miles in 1980 and 850 in 1981, and with stage lengths of its short- to medium-range obsolescent fleet

² Because of some construction differences, none of the B-727-100s and B-727-200s produced before 1974 can be re-engined.

³ By October 1981 the company already had reduced its fleet by 35 aircraft.

averaging 600 miles, the company feels that because of the effect of its hub-and-spoke program it will experience a further decrease in stage lengths. The net result of the foregoing dictates an emphasis on the purchase of smaller planes than in the past. Recent additions of seating in the B-727-200 series to 144 with consideration being given to a further addition have, in effect, made it a 150-passenger plane. Thus, if the plane's economics can be improved to approach those of new-technology aircraft at one-third the price, this is the way the company feels it will be forced to go.

In recent months both United and Delta announced forwarding to manufacturers specifications for a twin-engine 150-passenger plane. American was asked which of these two proposals it favored. In answering "neither," it explained that Delta's "specs" focused on a specialized aircraft optimized around a 400 mile stage length with a range of 1400 miles -- both figures being below those desired by American. Additionally, since the plane would require a completely new engine which had not yet been designed, the plane was, perhaps, a 1988 to 1990 airplane -- much too late for American's needs. While the United proposal was more to its liking, American concluded that it just could not afford to look at new aircraft beyond the B-767s and B-757s ordered.

To compete with the "upstart" or "instant" airlines over such routes as American wishes to protect, the company is adding still more seats in a single-class service to its three-engined planes.

2.4 TWA

TWA, an old established major line with both international and domestic operations, has not fared well financially over the past decade.

As in the case of American, TWA's "druthers" are offset by capital constraints. In 1980, although it still lost money, the company reacted more quickly and successfully to recessionary influences than did some other carriers. As a result, in 1981 its financial fortunes began to improve. In looking to the 1985-2000 period, TWA does not see a change from its present role which tends to emphasize its international operations. The company thinks its present fleet is well suited to its route structure so that there is no need to change either the equipment or routes. Of course, its economically obsolete B-707 fleet is a drain on its competitive ability, as is its B-727-100 fleet. TWA's October 1981 fleet is presented in Table 2-2 below.

Table 2-2
TWA Aircraft Fleet, October 1981

<u>Number</u>	<u>On Order</u>	<u>Type</u>	<u>Seats</u>
34		B-727-100	101/116
56		B-727-200	135/144
61*		B-707	141/151 (184 single class)
30	5	L-1011	274
18		B-747	380
	10	B-767	200

* Including 12 grounded.

Approximately seventy-five to eighty percent of the carrier's operation is in three types of service: (1) transatlantic; (2) transcontinental; and (3) hub-and-spoke. These are the operations which dictate the carrier's equipment needs. TWA has little short-haul, high-density service. Since one-half of the business is very long-haul i.e., between 2,500 and 5,000 miles, the company has a fleet of wide-body, twin-aisle

B-747s and L-1011s which it feels are well suited to the purpose. For the future, TWA is investigating the possibility of re-engining the L-1011 with more efficient Rolls Royce or GE engines for use as early as 1984 (GE) or 1985 (Rolls). As was the case with American, no plans are in progress for replacing or re-engining the B-747s. However, some are being modified to comply with noise regulations.

The balance of TWA's operations utilize about 90 B-727s, two-thirds of which are the 200-series, and about 56 active B-707s. An additional 19 B-707s are permanently grounded. Since the B-707s are uneconomic and are running afoul of the noise regulations, they are a burden and will be phased out by 1984 or sooner. Thus, the company needs replacements for this type of plane. It has on order some 200-passenger B-767s which are considerably too large to replace the B-727s. Indeed, financial pressures may delay delivery of the B-767.

Because of the costs of operating the three-engine, three-man cockpit crew B-727, TWA expressed the desire for a twin-engine, two-man crew airplane carrying 150 passengers at Mach .75 to .80. It was expressly stated that the 175- to 186-passenger B-757 was too large to be considered. The mission requirement for the 150-passenger plane is a multiple one involving stage lengths ranging from 250 to 1,800 miles, with optimization around 900 miles.

Unlike the Delta requirement, which focuses on a short stage length for optimization, TWA desires a more flexible aircraft which may start off on short stage lengths and then carry these passengers to feed the longer 1500-mile segment. The carrier's cost objective is to meet the B-757's seat mile costs but with a 20 percent lower airplane mile cost.

Although the United proposal was favored over Delta's, TWA felt that its capital constraints would prevent it purchasing the craft even if the plane were designed and offered for sale.

In discussing the merits and likelihood of re-engining the B-727-200, TWA expressed negative views. Although the re-engining cost might be only one-third that of a new-technology plane, the \$14 million per aircraft estimated price was considered a lot to pay for modifying a ten-year old plane which would still embody much old technology. Also, and particularly if the balance problem⁴ should make it necessary to add a "plug" with more passenger capacity, the resulting modification would bring the plane into competition in size and price with Boeing's new 757. The foregoing factors suggested to TWA that even if a number of carriers preferred the re-engining, Boeing probably would not go ahead.

One of the TWA officials expressed a view not voiced elsewhere that, given the financing problems, the industry could well get along for some years with evolutionary incremental engine and airframe modifications to the B-727-200 to increase its efficiency so that a new-technology plane could be put off.

2.5 United Airlines

United, with a fleet of over 300 transports consisting of about ten aircraft types from two major manufacturers, is one of the largest carriers in the world and has established dominance or significant presence in many choice markets. In the past its routes have involved a variety of stage lengths from very short to very long. As a result of deregulation,

⁴ The weight of the new heavy PW2037 engines so far to the rear is said to require a counterbalance weight of "nonproductive" lead in the nose.

increased competition has adversely affected profitability on many of its routes. Some such routes, particularly those of 150 miles or less (uneconomical for its jets) have been dropped. While United officials were more reluctant than those of some other airlines to describe in detail the carrier's future role, its equipment plans, its route restructuring, and its public utterances suggest the company's direction.

Table 2-3
United Airlines Aircraft Fleet, October 1981

Number		On Order	Type	Passengers	Maximum Cargo
Owned	Leased				
9	9		B-747	374-413*	
20	16	1	DC-10-10	254	
24	6		DC-8-61	190-238**	
14	0		DC-8-F	0	93,000 lbs.
60	16		B-727-200A	132-141***	
25	3		B-727-200	126-132+	
48	13		B-727-100	96	
49	0		B-737	103-125++	
	39		B-767	197	

* All are being converted to 413 passengers

** 238 is coach class

*** All being converted to 141 passengers

+ All being converted to 132 passengers

++ All being converted to 125 passengers

Long in favor of deregulation because it permits a company to restructure its routes with changing competitive conditions and changing aircraft technology, United sees itself not only maintaining a preeminent position in long- and medium-haul markets but eventually successfully competing with what are now the new-entry, low-cost, short-haul carriers. Thus, United will be competitive over almost all stage lengths. To accomplish this result the company realizes that the long-sought goal of standardization on one, two, or even three separate aircraft types will

be modified. This is not to say that an aircraft type will have a very limited stage length mission; in fact the company's idea for its short-to medium-haul aircraft replacement involves stage lengths from 300 to 1850 miles with an average of about 800. However, a given fleet type may contain subfleets, such as a number of planes with high-density single-class seating and no galleys, others with limited galleys, and still others with a full mixed class.

The main thrust of United's equipment program is economy of operation -- in crew complement, in fuel efficiency, and in maintenance cost. While it is well situated with efficient wide-bodies for its long-haul, dense-traffic routes, and has ordered 200-passenger B-767s for the medium-to long-haul less heavily traveled routes, the company needs by 1985 to 1988 a highly efficient replacement for its lower capacity aircraft involved in shorter and thinner routes, i.e., the B-727 and B-737 whose current capacities are reaching 145 in the B-727 and 125 in the B-737. After looking at the B-737-300, at the proposed re-engining of the B-727, and at the DC-9-80, the company decided that for the long term it was best to reject them in favor of a "clean sheet" new-technology plane carrying 150 passengers. As a result, general specifications for this aircraft were sent to aircraft manufacturers.

While other companies would like to program seat capacities in relatively even increments, such as 25, United has announced it sees no place in its strategy for a 175-passenger plane. It sees long life ahead for its B-737s configured to 125 seats.

There are some who would question whether a 150-passenger plane is the smallest new-technology plane an airline which plans to compete on

thin, short routes should have. However, unlike many carriers, United is showing strong interest in turboprop and prop-fan developments. It is this type of propulsion which shows signs of being a significant advance in the short-haul field.

Summary: United sees itself using its considerable financial resources to continue expanding in all phases of its operation. This will involve short, medium, and long stage lengths. It has been necessary to readjust the carrier's route network to fit the economics of United's current fleet. As some planes become uneconomic, the routes over which they flew are abandoned. To effectuate the company's strategic plan for the 1985-2000 period, management has determined not to purchase a 175-passenger new-technology plane but, instead, to press for a high-technology 150-passenger transport with considerable flexibility in mission capability.

2.6 Northwest Airlines

Table 2-4
Northwest Airlines Fleet, March 1981

<u>Number</u>	<u>Type</u>	<u>Passengers</u>	<u>Maximum Cargo</u>
14	B-727-100	93-100	
52	B-727-200	128	
22	DC-10-40	236	
24	B-747	363	
5	B-747F	0	261,000 lbs.

This transcontinental airline with international operations has been markedly different from other major carriers in its equipment policies, financial policies, marketing policies and the degree of labor strife. Northwest's attention to low operating cost on an available seat mile basis is legendary. As a result, it has been able to operate

profitably at lower load factors than other carriers and develop an enviable debt/equity ratio. In the past, its policy of replacing components in the fleet rather than repairing them has resulted in such well maintained aircraft that they have brought premium prices in the used aircraft market. The funds so accrued have been used to buy more up-to-date equipment or upgrade existing equipment.

The company sees itself as well poised for the future to continue in its past role but with further expansion of international operations. Northwest has three kinds of routes: (1) long- and very long-haul international routes; the very long are served by B-747s or by DC-10-40s which the company required as a condition of purchase to have the same engine as the B-747s. The extra power of the engines and their commonality with the B-747 is efficient and economical. (2) There are also long-haul domestic transcontinental routes, easily handled by the DC-10-40s; and (3) there are domestic short-haul routes for which the company has a fleet of B-727-200s and a small number of B-727-100s.

Since the company believes it has a reasonably up-to-date fleet which can be operated profitably at lower load factors than many of its competitors, it thinks its future role requires the same size and type of aircraft. The stage lengths will be about the same. Deregulation has enabled the company to drop some short, uneconomic routes which freed aircraft for more profitable deployment. It was pointed out that whereas many companies are approaching the limits of providing for growth by adding more seats instead of aircraft and consequently are faced with tremendous capital costs to add capacity through aircraft increments, Northwest can in some instances "just sit" and let the load factors build

in planes which already are attractive because they have greater seat pitch than that of their competition. For other aircraft, seating is being increased (from 128 to 142 in the case of the B-727-200) -- a very modest expense compared with adding aircraft at 20 to 40 million dollars each.

Given the high cost of money and the earnings records of most of the major airlines, Northwest was not optimistic about the early arrival of new-technology aircraft. Inflation has increased the price of commercial aircraft so that it is difficult for new technology to pay off the investment. For example, the company estimates a B-757 delivered in the first quarter of 1985 would cost \$46.6 million, or \$282,000 per seat. Yearly depreciation (15 year depreciation and 10 percent residual) would be \$2.8 million or \$1,000 per hour. Compare this with the current delivery price on a B-727-200 of \$15 million, or about \$110,000 per seat in mixed class. A DC-9-80 at \$19 million is still only \$137,000 per seat.

Engine fuel efficiency has been counted on as the main financial offset provided by new technology, with noise control a welcome addition. However, many of the rosy pictures of a financial payoff were based upon assumptions of much more rapid escalation of fuel prices than has been the case. A 30 percent saving at \$1.00 a gallon is 30 cents a gallon, but a 30 percent savings at \$4.00 a gallon -- and some predictions did reach that figure -- is \$1.20, a much bigger payoff.

As Northwest pointed out, past financial difficulties have left all but two majors with insufficient internal resources; thus, reliance on the capital market must be resorted to for equipment replacement or growth. High interest rates add to costs and therefore to economies that

new technology must furnish. In the past some offset came for the value of current in service planes which brought not only much more than their book value when sold, but often more than their original cost. Now, however, the very planes most in need of replacement are falling in value, and in some cases are worth little more than scrap.

As a result of the foregoing factors, Northwest expects to see more companies "slipping their orders" for the new-technology aircraft now in production and moving still further in the future any thoughts of purchasing new-technology aircraft to replace the B-727 and some DC-9 series.

Northwest thinks it has been the realization that financing of another new-technology aircraft is out of the question which has generated interest by some airlines in the 727RE (re-engine). An expenditure of \$14 million (current estimated re-engining cost) on a \$5 to \$10 million airplane to give it at least 10 or more years of life might be financially possible for certain airlines, whereas \$30 to \$40 million expenditure per plane would not be.

Summary: Northwest sees no substantial change in its role in the industry. While it recognizes the desirability of eventually replacing its B-727 fleet with a more efficient twin-engine craft, it is currently attacking the unit cost problem by converting its 128-passenger B-727s to 142-passenger planes. Competitors already have 144 in mixed class and are talking 149. Thus, Northwest feels that its fleet of B-727s is pretty well insulated from economic obsolescence until the 1990s. Since many of its B-727s are written down to a low value it can use them to fend off attacks by the new "instant airlines."

2.7 Delta Airlines

For many years Delta consistently has been the most profitable of the major airlines. Reams have been written to explain Delta's success and the entire litany need not be repeated. However, one should briefly note the company's location in the growing southeast; its unusually successful prosecution of route applications before the CAB when other lines were unsuccessful; its paternalistic management under the legendary C.E. Wollman whose treatment of employees inspired loyalty and dedication and avoided the prohibitions against cross-utilization of personnel which so often accompany unionism; its dedication to long range planning which early discovered the merits of the hub-and spoke system; and its adoption of equipment acquisition policies directed toward keeping its fleet efficient, young, and closely matched to the mission to be performed. In any event, plans being made by a company which has experienced such consistent success as Delta are worthy of note.⁵

Delta's future role appears to be that of using its massive financial resources to obtain the most modern and efficient fleet in order to be the lowest cost full-service operator. Such a fleet will enable the company to make the most of opportunities provided by deregulation.

To reach this goal Delta has become convinced that a fundamental change be made in its equipment acquisition philosophy from one of commonality and simplicity to one of specialization involving multiple types. As late as 1972, after the merger with Northeast Airlines, Delta

⁵ Further details on its aircraft equipment policies are found in Julian May, "Aircraft Evaluation and Selection" ATRIF, Atlantic City, May 27, 1981 and Mr. May's address of August 11, 1981, AIAA, Dayton OH, bearing the title "Design of the 80s."

had 12 different equipment types. Believing that the economics of commonality more than offset the over-design and off-optimum operation, Delta consciously sought to reduce to three equipment types. However, by the time the fleet was reduced to four types, the dramatic rise in fuel prices plus the anticipated future increases put the first priority on fuel efficiency. Delta also noted large gaps between the capacities of its various aircraft. This situation sometimes compromised Delta's ability to shift to a larger aircraft and maintain desired frequency without adversely affecting load factors and profitability. The current fleet-mix is tabulated in Table 2-5.

Table 2-5
Delta Fleet, April 1981

<u>Number</u>	<u>Type</u>	<u>Capacity</u>	<u>Average Stage length</u>	<u>Capacity Difference From Next Lower</u>
35	DC-9-32	88	343	
128	B-727-200	137	520	49
13	DC-8-61	198	525	61
35	L-1011	293	989	95

Note: In October 1981, in order to increase the seat miles per gallon and to decrease the cost per seat mile, Delta initiated a program of adding seats: 9 in each L-1011, 14 in each DC-8-61, and 11 in each B-727.

Actually Delta had planned (for capacity, noise, and fuel economy reasons) in the early 1970s to purchase a new 200-seat aircraft. However, inflation and fuel price controls made it uneconomic to produce such an aircraft. Accordingly, to take care of its expanding needs Delta felt it necessary to purchase more than 100 B-727s, even though they had been designed in the early 1960s. By 1978 fuel prices, manufacturing costs, and technology combined to permit the ordering of 42 Boeing 202-seat B-767 aircraft to cover long-haul domestic routes not justifying

the use of the 293-passenger L-1011. The financial obligation was \$1.6 billion. In 1979, by contracting for the re-engining with CFM-56 engines of its 195-passenger DC-8-61 which was running afoul first of noise rules and second with fuel expense problems, Delta extended the life of the aircraft at a fraction of the cost of new aircraft.

In 1980, the company continued to pursue its quest for a smaller new-technology aircraft with lower airplane mile costs. Because of its interest in fuel economy, Delta was willing to wait a year for the certification of the PW2037 high-bypass engine with still greater fuel savings. Thus, the \$1.5 billion November 1980 order for 60 Boeing 757 aircraft of 187-passenger capacity. Although carrying only 15 passengers less than the B-767, the B-757 was aimed at a shorter mission.

Ever since 1976 Delta has been looking for replacements for its 150 medium- to short-range narrow-body aircraft but could not interest the manufacturers in designing such aircraft. Now, however, with a large fleet of narrow-bodies deteriorating in profitability, and with two-thirds of its trips being 450 miles or less in length, Delta sees a chance for a tremendous improvement in profitability if it can secure a new-technology plane optimized around these shorter trip lengths. As C.J. May, Delta's vice president of engineering put it, "We can no longer enjoy the luxury of using an aircraft designed with transcontinental range for trips of less than one hour. We must optimize the aircraft for the operation, even if it means a large variety of aircraft in the stable." The perceptions of competitors on the merits of this view are discussed in Chapter 8.

Summary: Delta's plans for the future appear to contemplate continuing its policy of steadily developing its hub-and-spoke system so as to become the dominant and most profitable (in terms of gross profits) carrier in the industry. One factor in the implementation of the plan is an aggressive equipment policy of acquiring and maintaining a young, efficient fleet of various types -- all tailored to specific missions. With 42 Boeing 757s and 60 Boeing 757s on order supplementing its L-1011 wide-bodies and re-engined DC-8-62s, the company is well on its way to its goal. However, two-thirds of its trips are in stage lengths of 450 miles or less and are being covered by early 1960 technology Douglas DC-9s and the Boeing B-727s which are marginal under noise regulations and fuel-inefficient relative to new-technology aircraft. To close this technology and capacity gap, Delta has issued specifications to manufacturers for a new 150-passenger aircraft with performance optimized for short-haul operations. As later sections will show, because of financial constraints on both the manufacturers and other airlines and because other airlines at present tend to favor the longer-haul stage lengths in the United Airlines specifications, the likelihood that Delta will be successful in having its specifications fulfilled in a timely fashion has been seriously questioned.

2.8 Eastern Airlines

Eastern Airlines, a major competitor of Delta, is the last of the major transcontinental carriers to be discussed. Lack of earnings over a period of years has placed the carrier in a weak financial posture. Nevertheless, Eastern has striven to modernize its fleet, and with the

help of imaginative financing by the banks, the airframe, and the engine manufacturers, two sizes of wide-bodies (A300 and L-1011) now appear in its fleet. Additionally, some Boeing 757s are on order.

Eastern sees its future role as being one of the surviving major carriers when competition has run its course under deregulation. To accomplish this feat the company sees the need to remain competitive, particularly with Delta, by replacing or re-engining its less efficient planes.

Table 2-6
Eastern Airlines Fleet, July 1981

<u>On Hand</u>		<u>On Order</u>	
<u>Type</u>	<u>Seating</u>	<u>Type</u>	<u>Seating</u>
DC-9-30	97	B-757	185
DC-9-50	129		
B-727-100	118		
B-727-200	149		
A300	240		
L-1011	293		

Table 2-6 indicates a conscious policy of acquiring differently sized aircraft with seating varying by increments of approximately 20 percent. Eastern's B-757 purchase was to fill the void between the 149-passenger B-727-200 and the 240-passenger A300. Since Eastern plans to continue its present type of network, the size and types of equipment will remain the same. Stage lengths now vary from 100 miles to trans-continental. Other than fine tuning, the airline sees no need to re-adjust its structure to fit the economics of its fleet.

Although Eastern recognizes the need for replacing or modifying its B-727 and DC-9 fleet, the fact that it has exhausted its borrowing capacity drastically limits its new equipment plans. While the airline examines with interest the United and Delta proposals for a new 150-

passenger plane, realistically it knows there is currently no financing possibility. Some in the company question whether a 150-passenger plane (the "magic number" now so frequently mentioned) is too big to be the smallest plane in the fleets of major carriers. They see the need for a 90- to 100-passenger transport for their company and for various smaller carriers. One executive argues that to maintain frequency of service -- and frequency is now considered "the name of the game" -- that the next new plane should be designed for 130 passengers because: (1) deregulation increases the number of competing carriers thereby reducing the size of aircraft required; (2) traffic growth has presently stopped and is unlikely to return to levels justifying larger aircraft; and (3) since history indicates that airplanes always increase in capacity during the design stage, a design for 130 would very likely reach 150 by the time the production began.

Since financing a new airplane is out of the question, some in Eastern lean to a re-engined B-727 "if the numbers on fuel consumption and capital cost come out right." Most of its B-727-200 planes fall into the re-enginable category, and they already carry 149 passengers.

Summary: Eastern seeks to retain its role as one of the large surviving major carriers with short-haul, medium-haul, and long-haul routes across the U.S. and into some foreign destinations. Despite inheriting an unsatisfactory financial condition, the current management, by imaginative and innovative financing, now has some large efficient aircraft on its roster. Also some B-757s have been ordered. Eastern recognizes a growing need to replace its smaller capacity DC-9 and B-727 fleets which now seat 97 and 149 passengers respectively.

Since Eastern felt the Delta proposal involved a completely new engine which, because of its specialized nature would not be built, the company did not fear that Delta's superior financial resources could be used to acquire a specialized very efficient aircraft which Eastern would be in no position to purchase. However, Eastern's own financial position also precluded real current interest in the B-727 re-engine project. It knows future equipment purchases must await a period of improved profit margins and lower interest rates before the financial community will consider it a worthy credit risk. Given the financial position of the aircraft manufacturers, who have participated in what little aircraft financing has been done, manufacturers' financing is not available on a large scale.

2.9 Western Airlines

Western, one of the oldest airlines in the United States, serves primarily leisure markets and thus it is vulnerable to changes in economic conditions. Originally confined to the West Coast with relatively short hauls, over the past two decades it has expanded to include the destinations of Hawaii, Alaska, Mexico, and more recently, London. Deregulation subjected Western to extensive competition forcing it to eliminate or reduce service in some markets. Efforts to merge with Continental, a merger previously denied under earlier legislation, were on the road to success until February 1981 when Texas International began its takeover attempts of Continental. The Western-Continental merger then failed.

Western's equipment picture improved as it disposed of its fuel-inefficient Boeing 727s and 707s and some of its B-737s which at the time were required to carry an extra pilot as a result of a "me too" labor agreement tied to United. Although its long-haul routes were in reasonable shape with ten DC-10-10s (the longer range of some of the new routes tend to exceed the economical range of the aircraft with a heavy payload so that the DC-10-30 would be more economical) -- and one DC-10-30, its key problems are the 47 B-727-200s, currently configured with 133 seats (160 when all coach), and the 12 B-737-200s, configured with 113 seats. Western's July 1981 fleet and aircraft on order are shown in Table 2-7.

Table 2-7
Western Airlines Fleet, July 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>	<u>On Order</u>
12	B-737-200	113	6 B-767 for 1983-1984 delivery
44	B-727-200	133	
1	DC-10-30	260	
10	DC-10-10	270	
3	B-727-200	160 (coach)	

In a move contrary to the industry trend of increasing aircraft seating to achieve lower seat mile costs, Western, late in 1981 began reconfiguring its B-727s from 133 seats to 124, and its B-737s from 113 to 103. By advertising a roomier airplane, the company hoped to differentiate its product as being superior in comfort to that of its competitors. Whether other carriers with excess capacity will follow suit and thus nullify Western's advantage will depend upon the public's reaction to Western's revised seating.

Western sees its future role as being strong in a North-South direction from Anchorage to Mexico featuring major connecting complexes at Salt Lake City, San Francisco, Los Angeles and Denver. Its long-haul continental routes will be aided by the arrival (1984) of B-767s assuming deliveries are not postponed or orders cancelled for financial reasons. However, a look at Western's stage lengths indicates that over one-half of them are 500 miles or less, and the heavily traveled Las Vegas shuttle is but 235 miles in length. Accordingly, to handle its future short- to medium-hauls Western desires a twin-engine, two-pilot, 150-passenger plane with high fuel efficiency and with noise emissions equal to or lower than those on any other transport. Also prominent in the specifications is a flexibility requirement which would enable the aircraft to handle economically stage lengths from 250 to 1500 miles.

Fortunately for Western, the new-technology 150-passenger plane is not yet available. For one thing, given the impact of deregulation and the recession, a 150-passenger plane would be too large. The recent addition of B-727-200s as replacements for the B-737 is causing the dropping of some routes because they cannot support the larger B-727. Secondly, the carrier would be unable to finance the purchase. It is these factors which have caused Western to feel it wise to become actively interested in the viability of the B-727 re-engining program. A \$12-14 million expenditure per aircraft, particularly with such a young fleet as the carrier has,⁶ presently seems more realistic of accomplishment than \$40 to \$50 million per aircraft five to seven years hence for a completely new aircraft.

⁶ According to Western's annual report, the average age in September 1980 was 6.35 years, said to be the youngest of any U.S. trunk line.

Summary: Western's future needs center around replacing its B-727 and B-737 fleet. Because of additional competition and the deteriorating economics of the aforementioned planes, the airline has already had to do some readjusting of its route network to fit the economics of the current fleet. According to Western, the ideal solution to its long run needs would be a 150-passenger, fuel-efficient, quiet aircraft whose economics would be good for stage lengths from 250-1500 miles.

Western noted that one of the adverse effects of deregulation was that the additional competition made it very difficult to fill wide-bodies such as the DC-10. Hopefully the lower-capacity B-767 will alleviate that problem. Nor is it easy to fill the smaller 133-seat B-727. At one point the idea was expressed that really nothing bigger than the current B-727 was needed for the future short- to medium-haul plane.

2.10 Continental Airlines

Continental is the last of the old line trunk airlines to be discussed. In an earlier expansionist era, Continental added extensively to a route structure primarily linear in nature and emphasizing Denver and Denver-West. After years of efforts the company was successful in acquiring transpacific routes to Hawaii, New Zealand, Australia, Fiji, Samoa and Tokyo by way of some small Pacific islands. American Airlines had previously dropped the South Pacific routes for reasons of unprofitability. A look at the company's route map shows routes radiating from Denver to both coasts, Alaska, and to a number of points in Mexico.

To service this extensive route system the company operates a fleet of DC-10s and B-727s, with the current complement listed in Table 2-8.

Table 2-8
Continental Airlines Fleet, July 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>
2	DC-10-30	247 (mixed class)
11	DC-10-10	247 (mixed class)
45	B-727-200	137
<u>15</u>	B-727-100	102
73		

The years since deregulation have not been kind to Continental. Losses were sustained in 1979 and 1980. Because of competition the company has not been able to raise fares to offset the increase in fuel costs. Continental's fleet is similar in size and composition to that of Western and has some of the same problems. Continental's DC-10s have proven to be too large. The company's B-727 aircraft are becoming increasingly fuel-inefficient and may eventually be at a competitive, if not legal, disadvantage by reason of their noise emissions.⁷

Early in 1980, A.L. Feldman, who had been president of the very successful Frontier, and some of his staff were brought in to turn around the company's fortunes. Western saw a new role for itself, namely, strengthening its domestic system by increasing the traffic feed through Denver, Houston and El Paso. This was to be accomplished by concentrating on a hub-and-spoke system. President Feldman was suddenly met with a takeover attempt by Texas International. His sudden death in 1981 resulted in another president being brought in, Mr. George Warde,

⁷ Although under the Reagan administration noise regulations are not being pushed at the federal level with the vigor of the former administration, the pressure has merely been transferred to other forums: state, municipal, and airport authorities and the courts. Some airports are being accused of formulating their regulations so as to force the purchase of Douglas DC-9-Super 80s or other quiet craft at the expense of older Douglas and Boeing Aircraft. California airports such as Orange County and San Diego are currently in the news in this regard.

who had former airline experience as president of American Airlines. What changes will take place in Continental's future strategy now that Texas International's stock purchase has been approved is not clear.

At the time of the interviews, Continental planned to continue the broadening of its hub-and-spoke operations. For the near term its fleet is not ideal but options are few. A number of the DC-10s are larger than optimum for the traffic on the routes to which they are assigned. Efforts to dispose of DC-10s have found only a soft market. Even the B-727 fleet leaves something to be desired. Continental's domestic stage length categories are: one-third between 600 and 800 miles; one-third between 800 and 1200 miles; and the final third between 1200 and 1800 miles. In the B-727-200 fleet only the nine aircraft equipped with JT8D-15 engines will handle the critical mission of Denver-East Coast on a hot day. The JT8D-17 engine is really needed, but the twin-engine, two-pilot B-737 with JT8D-17A engines is said to be economically preferable. As with most of the carriers referred to, Continental's ability to readjust its fleet is limited by financial circumstances.

Although currently faced with excess seating capacity, Continental believes that by the 1985-2000 period traffic growth will not only support its existing fleet but will justify replacement of the B-727s (now 102 or 137 seats) with a 150-passenger, twin-engine, fuel-efficient, quiet airplane. While it is expected that examination of the hub-and-spoke system will lead to an increase in the number of less than 500 mile trip segments and thus a decrease in the average stage length, Continental prefers a plane with a wide range of mission capability to an optimized short-haul aircraft.

Given the possibility that financial constraints of the manufacturers or airlines might preclude the arrival of a new-technology plane in the time frame needed, Continental, like other financially constrained airlines, was receptive to the concept of re-engining the B-727. However, it favored adding a "plug" to increase the seating over "carrying around several thousand pounds of lead in the nose for balance." In any event, one prime requirement, according to the company, is performance out of Denver combined with range to the East Coast.

Summary: Continental's future role is to remain a major trunk line covering very long-haul international routes plus an extensive domestic network featuring feed by a hub-and-spoke system. Two to three types of equipment will be needed. Since it already has fuel-efficient wide-bodies, Continental sees as its greatest need replacements for its B-727s which have three engines and a three-pilot crew while competitors may have two-engine, two-pilot crews. Stage lengths are expected to decrease somewhat. Continental has found it necessary to readjust some of its route network because of the economics of the current fleet. While the current B-727 capacity is adequate for several years, future air travel growth will, Continental believes, justify concentrating on a new 150-passenger plane for the 1985-2000 period.

Chapter 3

HOW THE TWO NEW MAJOR AIRLINES SEE THEIR FUTURE ROLE

The ability of local service airlines (now called regionals) to grow at a greater rate than the trunks arose first, from their success in persuading the CAB that additional segments were needed "for route strengthening purposes," secondly, from taking advantage of opportunities afforded under deregulation to enter routes of their choice and, finally, from a greater ability than the trunks to merge with other airlines relatively free from rejection on antitrust grounds. Two of these carriers, currently known as USAir and Republic, have by various expansion tactics now passed the \$1 billion revenue mark and are "majors" under the present CAB classification system.

3.1 USAir

USAir began operations in 1937 as All American Aviation, a very small carrier engaged in experimental air mail pickup operations. By merger, two other local service carriers, namely Lake Central in 1968 and Mohawk in 1972, were acquired. By this time the name had been changed to Allegheny. In 1979, further geographic expansion and the company's major airline status was reflected by the name change to USAir. By 1981 its route network radiated out of Pittsburgh to various points on the East coast, as far west as Phoenix and Tucson, into Texas and Florida, and across U.S. borders into the Canadian points of Montreal and Toronto. In the main, the route segments are of the short- to medium-haul type averaging less than 500 miles in length.

Table 3-1

USAir Fleet, October 1981

<u>Number</u>	<u>Type</u>	<u>Seating</u>
55	DC-9-30	110 single class
11	B-727-100	122 single class
5	B-727-200	142 - 14 first class/128 coach
27	BAC-1-11	79 single class

The company's operating fleet is listed in Table 3-1. Additionally, on order are 15 B-737-200s seating 120 and 10 B-737-300s seating 138, both single class. The latter will not be delivered until 1983 and 1984.

USAir's role, which in large measure determines its aircraft acquisition policies, is based upon conscious decisions made about the time of deregulation to concentrate on routes or markets of less than 1500 miles utilizing twin-engine, two-crew aircraft of less than 150-passenger capacity and feature frequency of service. These decisions reflect the fact that in the United States two-thirds of air travel is less than 1,000 miles from origin to destination (O&D). Since most of the stage lengths in this thousand miles or less category are skewed to less than 500 miles, the company's equipment plans will focus on acquiring planes which are very efficient over this length. On the other hand, not wishing to put all its eggs in the short-haul basket, USAir hedged its bets for some longer-haul services by purchasing 11 three-engine B-727-100s and five B-727-200s. These will take care of its operation up to nearly 2,000 miles. Although the company would prefer newer-technology two-man crew, twin-engine aircraft for this purpose, it does not expect them to be available until after 1985. Thus, the role of the B-727-200s, and particularly the 100s, is an interim one. USAir management strongly wishes to resist temptation of purchasing larger aircraft

such as the B-757, attractive because of its low seat mile costs, for fear of losing the advantage of frequency of service.

USAir's unusual success in the last few years -- with a 1980 net income of over \$60 million, its rate of return on investment exceeded that of all certificated carriers except Southwest Airlines -- indicated a need for additional twin-engine, quiet, short-haul, fuel-efficient aircraft with seating capacities in the 110- to 135-passenger range in order to maintain its role. Specifications for such aircraft were announced by Edwin I. Colodny, chairman and president, at the Lloyd's of London Press International Civil Aviation Conference No. 2, in April 1980. Lack of a quick favorable response from aircraft manufacturers combined with significant fuel and noise improvements to current models of aircraft caused the company to re-evaluate derivatives for use well into the late 80s and early 90s. The result was an order for 120-passenger B-737-200s and 138-passenger B-737-300s. Delivery of the latter does not begin until 1984.

Perhaps the most telling way of highlighting USAir's role in the 1985-2000 period and of indicating how it intends to maintain that role is to quote and paraphrase from Mr. Colodny's well-publicized "Ten Commandments" speech given before the Third International Civil Aviation Conference in Paris, June 4, 1981:

- I. THOU SHALT NOT TAKE THE NAME OF DEREGULATION IN VAIN
By the above he means: Do not overdo the opportunity to expand. USAir's credo is "controlled growth."
- II. THOU SHALT PLAN BASED ON CONSERVATIVE PROJECTIONS OF TRAVEL GROWTH
Beware of ten-year geometric progressions.

- III. THOU SHALT KEEP AN EFFICIENT FLEET
Plane mile costs are as important as seat mile costs.
Frequency is more important than wide-body comfort.
- IV. THOU SHALT NOT COVET OTHER AIRLINES
Under deregulation there is little need for mergers. Mergers bring problems; one of the most significant is integration of the labor forces.
- V. HONOR THY INVESTOR AND THY LENDER
Without capital the industry cannot flourish. This means an essential need for profit, a reasonable debt/equity ratio without overleveraging and willingness to raise capital when the market "window" is open.

Summary: USAir's future role is in the short- to medium-haul market requiring efficient equipment for trips of less than 500 miles, as well as some aircraft for a limited number of long-haul routes out of hubs. USAir believes its network is well tailored to fit the economics of the current fleet. Recognizing that portions of this fleet are fuel-inefficient and noisy, USAir sees a requirement for aircraft in the 150-passenger and less class, preferably down in the 110- to 130-passenger category. The preference for smaller sized aircraft stems from their conviction that the frequency of service necessary to attract passengers cannot be maintained under deregulation if large aircraft with their higher plane mile costs are used.

3.2 Republic Airlines

The very rapid expansion of Republic Airlines, its philosophy, and its use of the merger technique proscribed in Edwin Colodny's commandments stand in contrast to USAir ideas and actions. Some of Republic's 1980 loss of \$25 million can be attributed to merger problems.

A few years ago Republic was a small one-state airline and recently it has grown to be the number seven airline in passengers carried.

Beginning as Wisconsin Central Airlines in 1948, the company grew as a subsidized local service carrier to become North Central Airlines in 1952. It prospered under the "route strengthening" philosophy of the CAB as well as from substituting high-frequency service with smaller planes for the low frequency service provided by some larger lines.

When deregulation came, North Central quickly and aggressively expanded, particularly via the merger mechanism. In 1979, when the company merged with Southern Airways -- a 14-state local service carrier which had begun operations in 1979 -- the name Republic Airlines was adopted. A year later, 1980, Hughes Airwest -- a western based local service airline with 47 planes was acquired, again via merger. As a result, Republic now serves 200 cities and has a route network which stretches along both coasts, across the U.S., and from Canada to the Caribbean. This extensive expansion partially explains a tripling of revenues in 15 months. The losses incurred while digesting the change of the carrier's role from a regional to a transcontinental major constrain its ability to finance new-technology aircraft with their very high capital costs.

With the caveat that fleets are rarely static -- particularly when airlines are in transition because of changing economic, technological, or regulatory conditions -- Republic's 1981 fleet is distributed as shown in Table 3-2.

Prior to deregulation Republic saw itself as a regional carrier concentrating on bringing people from small cities to large hubs where major carriers took them to further destinations (essentially a feeder operation). With the onset of deregulation, Republic decided to change

Table 3-2

<u>Republic Fleet, June 1981</u>		
<u>Number</u>	<u>Type</u>	<u>Seats</u>
28	DC-9-50	130
59	DC-9-30	96/102/107
37	DC-9-10	80/85
16	CV-580	48
15	B-727-200	141/145
2	DC-9-80	147 (12 yet to be delivered)

its role so as to become a large, major airline. The quickest way to do this was to acquire via mergers "going concerns" which already had facilities and personnel in place at desirable hub points. Given the new ease of entry, it then would be easy to establish routes between the hubs and carry the traffic it formerly gave away. Another purpose of its new role was to attract passengers away from the major airlines by using satellite airports such as, San Jose and Ontario. Accordingly, Republic believes it will obtain long-haul traffic.

To fulfill its plan for an extensive service over short- to medium-haul and long-haul routes the company will need (1) planes carrying from 100 to not more than 150 passengers for the short haul; and (2) a limited number of 200- to 250-passenger planes to compete on the long haul. Among the short- to medium-haul planes the low-capacity, fuel-hungry, DC-9-10 will be the first to be replaced because they cost as much to operate as other DC-9s but have fewer seats. For its short- to medium-haul aircraft the stage lengths will be from 200 to 1,000 miles but will average between 400 and 500 miles.

Now Republic is well satisfied with its route network and does not plan to alter it to fit the fleet. In fact, management thinks the current fleet is a "good fit." Although it has some aspirations in the

long-haul market, Republic says it does not in any way intend to abandon short-haul operations for a concentration on long-haul.

There are two main reasons why Republic does not plan to acquire a new-technology plane optimized around its strategic plan. First, the 150-passenger plane so often talked about is 150 in mixed-class configuration. Republic is primarily a one-class operator, so that for it the 150-passenger plane would become a 180- or 190-passenger craft -- far too large for thin routes. Second, at an estimated \$40 million each, the price for the plane would be far above the company's financial ability.

For the future, Republic sees its best approach to be the acquisition of derivative aircraft, which it believes will be almost as desirable as new-technology planes but at a much more attractive cost. Accordingly, the first step was the purchase, for delivery beginning in 1981, of 14 of the fuel-efficient, quiet, DC-9-80s, configured to 147-passenger capacity. It is interesting to note that when USAir and Republic evaluated the DC-9-80 and the B-737-300, each came up with a different answer. Republic chose the DC-9-80 because it contained a new engine and an improved wing. Additionally Republic already had a large fleet of Douglas planes with which it was well satisfied. Finally there was a reluctance to wait until 1984 for the Boeing aircraft when deliveries of the Douglas plane could begin in 1981.

3.3 Summary and Conclusion

Two carriers, USAir and Republic, both with a history as short-haul local and regional carriers, have by quite different means -- and with different philosophies -- grown into the category of major airlines.

One, USAir, has taken a more conservative approach and sees itself primarily as an operator of a hub-and-spoke system for routes characterized as short- or medium-haul, with 500 miles and less being predominant. Nevertheless, it has not been completely able to resist the temptation to enter some long-haul vacation markets such as Phoenix and Tucson and to acquire some three-engine, three-man crew B-727s to service them. It has a firmer long-term preference for new-technology aircraft than Republic and was willing to wait several years for delivery of the B-737-300 -- a plane which, according to USAir's engineering and marketing staff, was better for its operation than the DC-9-80. Thus far USAir's "controlled expansion" has been profitable and the company is not tightly constrained for capital should new equipment appear.

After deregulation Republic Airlines very quickly discarded its one-region role for the development, largely via the merger mechanism, of an extremely large network enveloping both coasts, the interior of the U.S., and international neighbors to the north and south. Because of the economic downturn and the PATCO strike, the company's operations have recently been unprofitable. If Republic is unable to digest the mergers, its ability to finance equipment will be compromised.

Both companies are well satisfied with their route structure and the fleets they now have. Also, when it comes to aircraft needs in the next generation of aircraft, the companies' philosophies are quite similar. Both emphasize the need for frequency of service to attract passengers and both believe that competition arising from deregulation dictates caution on sizing aircraft. For the major portion of their operations they indicate a 150-passenger plane would be the maximum size

considered, but as a matter of preference they want new planes in the 100- (for thin routes), 130-, and 150-passenger capacity. Each carrier repeated several times the importance of low airplane mile costs. Finally, both airlines thought it would be some time before they would have enough power, at least individually, to influence significantly specifications for the next generation of short- to medium-haul aircraft.

Chapter 4

THE CHANGING ROLE OF SIX MEDIUM SIZE CARRIERS

As has been suggested previously, deregulation has introduced instability into the classification of airlines so that in some cases distinctions have been blurred and in other cases airlines are rapidly moving from one category to another. Chapters 2 and 3 dealt with the old line trunks, plus USAir and Republic which have recently passed into the trunk or "major" category. This chapter includes results of interviews with the managements of six medium size airlines, all but one of which -- Air Florida -- have more modest goals than those of the major airlines. Generally these are medium sized, single-class service airlines who engage in short- to medium-haul operations. Although originally organized as feeder airlines, in recent years they have engaged increasingly in point-to-point service and have encouraged commuter airlines to act as feeders for them. Four of the six airlines emphasize twin-engine aircraft with high-density seating and, by being able to charge higher rates per mile than the majors, these four airlines have been financially successful during periods in which most majors have been having difficulty. The six carriers treated are:

Frontier
Piedmont
Air Wisconsin
AirCal
Air Florida
Air New England

4.1 Frontier Airlines

Frontier began in 1950 as the outgrowth of a merger of three small

feeder lines: Monarch Airlines, Challenger Airlines, and Arizona Airways. The carrier is characterized as a hub-and-spoke system. Its main hub is Denver from which routes radiate in all directions, in some cases as far west as the west coast and as far east as Detroit and Atlanta. Its current fleet is listed in Table 4-1.

Table 4-1
Frontier Fleet, July 1981

<u>Number</u>	<u>Type</u>	<u>Seating</u>
49	B-737-200	106
16	CV-580	50
3 (on order)	DC-9-80	147

Notwithstanding the short-haul nature of its operations -- 44 percent of its stage lengths are less than 300 miles, another 37 percent in the 300-600 mile bracket -- and notwithstanding that most of its routes are classified as thin-density routes, Frontier in 1980 ranked third in profitability behind USAir and Southwest Airlines. The carrier was an early supporter of deregulation because of the control it gave management over the company's own destiny, including the ability to dispose of subsidy routes. As airplane economics change, Frontier adjusts its route network. Since deregulation the carrier has added 25 desirable cities while disposing of 27 "loser" cities.

For the future, management intends to build on its present hub-and-spoke system and perhaps add one or two more hubs. Also it will (and is) moving gradually into some longer-haul operations -- a move which has equipment implications. Hot-day, long-haul operations with full loads out of its high altitude Denver hub require high-performance airplanes. Fortunately, the B-737-200 with the new higher thrust JT8D-17A engines

satisfy this need. The expansion will be the controlled-type, keeping in mind a quotation often repeated by the company's President G.L. Ryland, "Remember, 'Being big didn't save the dinosaur.'" Expansion will be aimed at the nation's prime growth regions. Some lengthening of the current average stage length of 373 miles is anticipated.

In looking at the equipment picture, the CV-580 fleet, because of age and high operating costs, will soon be retired or replaced. Since the company finds no suitable replacements for this 50-place airplane, some of the cities it serves are being deleted. If a better 75-seat plane were available, Frontier would stay in those markets. Thus, to a certain extent, Frontier is restructuring its routes to fit its fleet. For most of the route structure the B-737-200, with its low cost per aircraft mile and with its modest size, is ideal for the near term. By 1985 the company would like to be selecting two or three types of aircraft carrying 75-100, 100-130, and 150 passengers, of course with low airplane mile costs and lower cost per ASM than current equipment.

Since the tendency will continue to be to add routes in the longer ranges, Frontier wants a portion of its future planes to have 1,500-1,600 nautical mile capacity as well as performance out of Denver on a hot day. Presently ten of the company's B-737-200s have the more powerful JT8D-17A engines which just about meet this future requirement. In choosing between Delta's and United's proposed new-technology aircraft, Frontier leans toward the United-type transport.

Ever since the jet era began, environmentalists have promoted with increasing success noise regulations covering aircraft emissions as well as curfews and daily schedule limitations. The latter might themselves

be tailored to aircraft noise emissions. One of the most restrictive airports is Orange County, California -- an airport which Frontier wishes to serve. Early in 1981 Frontier placed an order for three of the 147-passenger DC-9-80s primarily for their low noise emissions (they meet stage 3). Reference to Table 4-1 shows that until the DC-9-80 order the carrier's active fan-jet fleet was limited to small 106-passenger planes from Boeing. Thus, a secondary reason for the DC-9 purchase was to increase capacity for use on more heavily traveled routes. The change in vendor was not a question of a company leaving a supplier for reasons of dissatisfaction, but because of non-availability of the desired type of plane from the traditional source. Frontier could not follow its strategic plan if it waited until 1984 for delivery of the Boeing product, the B-737-300.

Although the current B-737-200, because of its small size and low plane mile costs, has the advantage of being able to enter a market sooner and build up frequency of service quicker than a larger plane, Frontier feels it must monitor carefully each new-technology aircraft so that it does not get caught with obsolescent aircraft in the 1985-2000 period.

Summary: Currently, Frontier has a fuel-efficient, low-operating-cost fleet of 106-passenger B-737-200 aircraft which is a good fit for a route system featuring stage lengths of 400 miles. The airline's success in managing its business, as well as its future plans, suggest that growth will be accompanied by new, longer routes so that its re-equipment plans will require as many as three types of planes. One, a 75- to 100-seat plane for short-haul and thin routes; two, a 100- to

130-seat aircraft for the major portion of its medium-haul routes; and three, a 150-seat plane with the flexibility necessary to serve routes as long as 1,600 nautical miles. New-technology aircraft will be closely examined for the "bottom line" as well as for the prime elements of fuel economy and low noise emissions.

4.2 Piedmont Aviation

Piedmont, located at Winston-Salem, North Carolina, is a somewhat smaller carrier than Frontier, but has some similarities with the latter. It has successfully concentrated on single-class twin-engine service with B-737-200s using a two-pilot crew, but has begun to find them short on capacity for its web of short-haul routes in the southeast. In 1980, a recessionary period, its profits reached an all time high, following Frontier in the list of profitable airlines.

Piedmont, like Frontier, has been a staunch supporter of deregulation, attributing part of its success to using the opportunities afforded by deregulation to add and subtract routes as needed, to adjust fares more freely, and to its "bypass strategy." The latter saves passengers time by bypassing major hubs for direct point-to-point flights. Based on two and a half years of successful growth under deregulation, Piedmont plans on a 20 percent annual growth factor over the next few years. Such a growth factor implies significant equipment changes in the 1985-2000 period. Piedmont's fleet in July 1981 is shown in Table 4-2.

Piedmont views itself as a feeder system feeding itself and others. In looking at its future needs, Piedmont believes it cannot continue the luxury and simplicity of a single plane fleet. Historically, its

Table 4-2

Piedmont Aviation Fleet, July 1981

<u>Number</u>	<u>Type</u>	<u>Engine</u>	<u>Seats</u>
40	B-737-200	dash 9	112
6	B-727-100		117
2	B-727-200		150
6	B-727-200		150 (on order)
20	B-737-200	dash 15	112 (on order)

short-haul characteristic resulted in 200-300 mile stage lengths. But longer lengths are now showing up. As late as the annual report of 1980, dated February 1981, Piedmont planned a complete two-engine, two-pilot B-737 fleet by 1983. Yet by spring, additional 150-seat, three-engine, three-pilot B-727-200s were ordered. The company found that the combination of the added seating capacity and the higher yield of its single-class service, resulted in profitable operations. Plane mile costs were "terrible but with the loads carried the seat mile costs were good." Further growth has given birth to consideration of placing 160 seats in the B-727-200s.

Currently the YS-11 stage lengths average only 115 and they will be completely phased out by the start of 1982. Stage lengths on some B-727s are now 800 miles. A large portion of B-737 trips are in the 300 mile stage length category. The company, therefore, hopes for a plane with excellent economics at 800 miles and with good economics at 300 miles.

Although the present fleet is operating profitably, the aircraft employed are reaching the limit of their capacities, and hence productivity. Piedmont's planners, based on growth projections, believe that in the 1985-2000 period the airline will require two types of planes which it does not now operate. One will be a 150-passenger, twin-engine,

two-pilot, quiet, fuel-efficient transport for its shorter operations, the second, a 150- to 180-passenger aircraft similarly configured but with a flexible range.

Summary: High yielding single-class fares combined with high load factors and the economies of a twin-engine, two-pilot crew airplane have been profitable for Piedmont. Unanticipated growth and longer haul operations have forced Piedmont to purchase three-pilot, three-engine airplanes as an interim measure until the next generation of new-technology aircraft arrives. The company, like others of the regional group, does not feel it has the expertise to design replacement aircraft nor the clout to influence design, but hopes that those that do will provide two sizes, namely, a 130-passenger and one 20 to 40 passengers larger, which will enable Piedmont to upgrade its fleet in the 1985-2000 period. From a preliminary perusal of the Delta and United specifications, Piedmont favors United's because of its focus on economy of operation at the 800 mile range.

4.3 Air Wisconsin

Thus far this report has involved airlines established in the 1930s under the restrictive CAB interpretations as to entry and exit. We now shift to some of the newer carriers. Their small sizes give them the feeling that they have little input in equipment matters but must "take what is on the shelf." They hope, however, that collectively there are enough of them to interest manufacturers in their specific needs.

Air Wisconsin, whose headquarters is in Appleton Wisconsin, was established in 1965 to serve the paper industry people with business in

Chicago. Blessed with astute management, the company expanded and prospered. Deregulation was a boon to the company because its small planes were able to fill in and increase frequency where major carriers dropped out. Curiously, although it carries the name Air Wisconsin, Appleton is the only Wisconsin city it serves. Only 12 other cities: one in Minnesota, one in Illinois, four in Indiana, two in Michigan, three in Ohio, and one in Pennsylvania are on its routes. Air Wisconsin's fleet at present and on order is shown in Table 4-3.

Table 4-3
Air Wisconsin Fleet, August 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>
13	SW Metro	16
6	DH-7	50 (4 additional by April 1982)
3	BAe-146	100 (first delivery 1983)

Using this 19-plane fleet, in which 46 percent of the available seat miles were flown with the DH-7, the company earned a net profit of \$4.2 million on revenues of \$35.7 million, a 12 percent margin. By way of comparison, a number of the majors have been hoping for a 5 percent margin.

Air Wisconsin's equipment needs in the 1985-2000 period reflect its conviction that its role is high frequency service in short-haul operations -- operations in which it has been successful and in which it intends to stay. Basically its success has been partially due to its policy of avoiding competition where possible which enables it to charge high fares. While trunk line fares yield carriers about 12 cents a mile, Air Wisconsin's fares yield about 38 cents a mile, three times the yield of major airlines.

The company sees for itself a bigger role in the future than it now has. Since deregulation large carriers have been abandoning their unprofitable routes which have usually been served by planes too large for the traffic. Air Wisconsin's success in replacing United's low-frequency service in short-haul markets in Michigan and Indiana suggest that the process will be repeated in the future. Already the 16-passenger Metros are becoming too small and are being phased out.

For its expanded role in the 1985-2000 period, Air Wisconsin sees the need for two or three types of planes. Since the current average stage length is but 133 statute miles, and the future maximum stage length is conceived to be 250 miles, focus must be on efficient short-haul aircraft. The company sees a clear need for a 36-passenger, a 50-passenger, and a 100-passenger plane. While there are some 36-seat aircraft being offered for sale, none of them is considered completely satisfactory so Air Wisconsin is continuing to look. Options which it has on the 36-passenger DH-8 may not be exercised.

Its experience with the DH-7 leads Air Wisconsin to believe that the aircraft will be a workhorse for the company for a number of years. The company's recent order for the four-engine, 100-passenger BAe 146, though surprising to those who cannot believe that there is economy in four engines over two, was made only after a long evaluation of the product. Air Wisconsin is convinced that this aircraft will be economical down to a 150 mile stage length. The carrier believes that by obtaining new aircraft, though capital-expensive, it can fend-off the "instant" airlines who believe they can compete by using cheap cast-off aircraft.

Finally, the arrival of the 100-passenger BAe-146 will cause the airline to readjust its route network to enter more large cities and engage in longer haul operations. Since the carrier calculates the break even load factor to be in the thirties, it does not fear entering these markets.

Summary: Air Wisconsin intends to stay in the short-haul market and continue, where possible, to avoid competition in order to maintain high yields. Unless a 36-passenger plane can be found, phasing out the Metros means that future markets will be limited to those which will support the 50-passenger DH-7 or 100-passenger BAe-146.

4.4 AirCal

AirCal is another relatively new carrier. It began operations as Air California in 1967 with two Lockheed Electras to serve the Orange County-San Francisco market. Orange County is the company's headquarters and major base. This intrastate operation avoided the necessity of obtaining a certificate from the CAB. Until deregulation, however, AirCal was rather tightly regulated by the State of California Public Utility Commission. Since deregulation, AirCal has used the opportunities afforded under the law to branch out into nearby states. This well-managed company earned \$10 million on operating revenues of \$159 million in 1980, a recessionary period. Its July 1981 fleet is tabulated in Table 4-4.

AirCal has a clearly defined role for itself in the future. It is to continue to be a single-class, full service, no frill airline to provide for the basic transportation needs of selected cities in California,

Table 4-4
AirCal Fleet, July 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>
14	B-737-200	119
2	B-737-100	119
2	DC-9-80	160 (2 more for October 1981 delivery and 5 beginning in 1982)

Utah, Nevada, Washington, Arizona, and Oregon. Frequent but simple (no meals, except an occasional snack-pack), on time, quality service on segments of one to one and one-half hours flying time will continue to be its selling point. Relatively high-density seating and higher than average yields (currently 15 cents a mile compared with about 12 for the trunks) is expected to keep the company profitable and ease equipment acquisition problems.

The aircraft which AirCal wants to implement this role are 120 and 150 seats in capacity, with two engines, two pilots and fuel-efficient powerplants. Finally, the aircraft must be extremely quiet to comply with environmental regulations which are most strict at Orange County. AirCal's continuing acquisition of DC-9-80s with their quiet, fuel-efficient JT8D-209 and -217 engines fulfill part of this requirement almost to the year 2000. The B-737-100 and -200 series, however, are another story. While currently the B-737s are satisfactory, they were acquired used from PSA, and are older technology, and are high in cycles -- some have 60,000 landings and takeoffs.

AirCal feels that its first replacement task will be that of the B-737 fleet with 120- to 130-seat new aircraft. Currently the price of the B-737-300 has not looked attractive when carried down to bottom line after deducting interest charges and depreciation. The new BAe-146

at 100 passengers is considered too small, and the B-757 at over 220 passengers in single-class is too large. As long as fuel prices do not increase faster than inflation, interest rates remain high, and as long as used aircraft meeting the company's immediate needs sell for about \$5 million in comparison with a price of over \$20 million for a new aircraft, AirCal does not feel pressed to buy new. Environmental pressures could possibly speed up its timetable.

Summary: AirCal plans to continue its role of serving a limited western region area with frequent, single-class, quality service. Short-haul service -- 300-400 miles in one-to-one and one-half hours -- will be its mode of operation. By taking delivery on a fleet of 160-seat DC-9-80s it has solved for a number of years its environmental, fuel efficiency, and high capacity problem. While management recognizes that it faces replacing B-737 aircraft unless they go through a major modification program which is highly unlikely, it sees nothing very attractive on the market. AirCal emphasized that under current conditions financing could cost more than technological advances could save. Thus only some special circumstance, such as environmental rules, could dictate a purchase.

4.5 Air Florida

Prior to 1978 Air Florida was an intrastate airline initially utilizing B-707s and Lockheed Electras. The company began its rapid growth and route expansion with the onset of deregulation and now flew to Houston, Dallas-Ft.Worth, Washington, D.C., New York, Toledo, Chicago, as well as international operations to Central American, the Caribbean,

and several points in Europe. Any plot of where the company flies and the content of its fleet is subject to quick change. Its October 1981 fleet is listed in Table 4-5.

Table 4-5
Air Florida Fleet, October 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>
5	B-727-200	170
2	DC-9-15	85
3	B-737-100	107
23	B-737-200	125-128
3	DC-10-30	380 single class 41/288 in mixed class

Notwithstanding extremely rapid expansion -- revenue growth from \$8 million in the year before deregulation to \$161 million in 1980 -- Air Florida has been profitable and in 1980 earned \$5.7 million. It attributes some of its success to cost control -- its offices are among the most spartan in the industry -- the ability because of its small size to react quickly and to its focus on low fares made possible by high-density single-class seating. A policy of going into a market with charters the first year, expanding by scheduled service with bulk contracts the second year, and then full schedules the third year has been successful.

Although the company is opportunistic and pragmatic, it does see a specific role for itself and has some definite ideas about its equipment needs. In the short term the company's needs vary with aircraft price. Although the B-727-100s are considered obsolete, Air Florida conceived of circumstances -- such as low cost coupled with favorable contract provisions for future aircraft from Boeing -- which would make them an

interesting possibility. Indeed, to the surprise of some, Air Florida did purchase new from Boeing five three-engine, three-pilot B-727-200s under arrangements it considered to be profitable.

To fulfill its future role, Air Florida thinks it needs three types of planes. First, for its Miami to Europe routes it requires a 300- to 400-passenger wide-body, with 10 to 11 hours or 5,500 to 6,000 mile range. The second type is a 100- to 130-passenger, two-pilot, twin-engine aircraft with a range of 1,800-2,000 miles and short and rough field capability. This requirement for some years can be satisfied with the high gross weight version of the B-737 with dash 17 engines. Ultimately, a plane of the same size and range but better economics is desired. According to the company's computations the price of fuel would have to escalate considerably to justify purchasing the B-737-300 series.

The third type desired is a plane slightly smaller than the B-757 which would carry about 190-200 passengers in an all coach configuration. However, because of the small probability that such a plane would be built, Air Florida took advantage of a package deal with Boeing to order three B-757s for delivery several years in the future. Air Florida also indicated an interest in the B-727RE "if the price is right."

Summary: For the 1985-2000 period, Air Florida sees itself reasonably well suited for two of its three types of operation. For the third type it sees the need for a new-technology plane carrying 190-200 passengers in dense seating coach configuration with a range of up to 1,800 or 2,000 miles. Air Florida considers itself a gnat in the equipment

picture and therefore feels it will be purchasing off the shelf or used rather than participating in the determination of any design parameters.

4.6 Air New England

Air New England, a Boston based carrier, was difficult to classify. It had outgrown the commuter stage but was hardly large enough to fit into another classification. The company's recent financial difficulties were such that its name will soon be only a memory. This is a far cry from its early promise. Air New England was organized in 1970 and quickly became one of the largest and most successful of 200 commuter airlines. In 1972 the carrier filled a void in New England when Delta took over Northwest Airlines and then was able to drop service to many New England towns because of the size of their airports in relation to the size of Delta's planes. At the time of the interview, routes extended west to Albany, Rochester, and Cleveland and from there to Baltimore.

By 1974 Air New England already served New York, Boston, New Bedford, Hyannis, Nantucket, Martha's Vineyard, Lebanon, Lewistown, Portland, etc. When it applied for certification as a scheduled interstate carrier under the Civil Aeronautics Act, it made a serious misjudgment on the additional costs involved. Subsequently, instead of operating at a profit without government aid, the company found it necessary to ask the CAB for larger and larger subsidies. Although not all routes were subsidized, subsidy payments have risen every year up to 1980.

Under deregulation one type of subsidy, i.e., section 406, is to be phased out. Recession, competition by new, low-cost carriers under

deregulation, and instability of management have placed the company in a precarious financial position. Its fleet in October 1981 is shown in Table 4-6.

Table 4-6

<u>Air New England Fleet, October 1981</u>			
<u>Number</u>	<u>Type</u>	<u>Seats</u>	<u>Use</u>
4	FH-227	44-48	Subsidized routes
10	DH-6	19	Subsidized routes
4	CV-580	50	Non-subsidized routes

Given its route structure and the traffic generated, Air New England was not satisfied with its fleet composition shown in the above table. There is over a 100 percent spread between the seating capacity of the DH-6 and either the CV-580 or the FH-227. Air New England felt it would be much better off with a 30- to 36-passenger plane, such as the CASA or Embraer Brasilia, but without funds nothing could be done.

During the interview it became clear that Air New England was uncertain whether it had a future at all. Because of the loss of subsidy under deregulation, and because of additional competition from "upstart" airlines with artificially low costs, Air New England had to restructure some of its routes to fit the economics of its existing fleet. This could not be done successfully and at the end of October 1981 the company ceased operations.

Summary: Air New England, after an auspicious beginning, underestimated the cost of operating as a certificated airline in the congested short-haul, high-cost New England area. Compounding its problems were a reduction of subsidy; additional competition from new carriers started with inexpensive airplanes and staffed by entry level, low cost

personnel; poor economic conditions; and the PATCO strike (Boston is one of the 22 restricted airports). Air New England was privately held and without a large infusion of capital it was doomed. Therefore, any discussion of needs for the 1985-2000 period is moot.

Chapter 5

ROLE PERCEPTIONS OF THREE SPECIALIZED CARRIERS

Previous chapters have dealt first with the future role seen for themselves by the former large trunk lines and by two new additions which are now lumped into the trunk or "major" category; and second, with the role seen for themselves by six medium-sized carriers. In general, it was found that the medium-size carriers were more limited in their objectives; had almost all their operations in single-class, short-to medium-haul service; were able to maintain higher yields per revenue passenger mile; and emphasized the importance of low aircraft mile costs in their equipment plans. Despite a desire to retain the economies of a two-pilot, twin-engine aircraft, several airlines, because of lack of range or adequate seating capacity in their twin-engine craft, were forced to introduce three-engine, three-man crew B-727s on some of their routes. This occurred after management had calculated that with the denser seating and higher yield, aircraft which were unprofitable for other carriers became profitable for them.

This chapter outlines roles seen by two airlines which began as intrastate operators to evade the obstacles of CAB certifications but now under deregulation have expanded into interstate operations -- Southwest Airlines (SWA), and Pacific Southwest Airlines (PSA) -- and by one of the new high-density, low fare, single-class airlines made possible by the free entry system under deregulation, i.e., Midway Airlines.

5.1 Southwest Airlines

The genesis of Dallas-based Southwest Airlines (SWA) in 1967 was the idea that the difficulties, if not the impossibility, of obtaining a certificate of convenience and necessity under the CAB could be avoided by forming an intrastate airline in Texas as Pacific Southwest Airlines had done in California. Despite the limited service provided by the two existing CAB competitors -- Braniff and Texas International -- these competitors raised numerous legal objections in the state courts the processing of which almost bankrupted SWA. Southwest, however, ultimately won these legal battles. Braniff and Texas International, nevertheless, kept up the attack only to be sued and eventually found guilty and fined for trying to stop Southwest in an illegal fashion.

Operations of SWA literally "got off the ground" in 1971 with three new B-737 airplanes obtained from Boeing at the bargain price of \$4 million each. Colorful Lamar Muse, a man with previous airline experience, became president. Muse sought out high-quality, experienced airline talent -- available because of the recessionary period -- to conduct the operation in a highly efficient manner. Through the years the company has been successful to the point that its margin of profit is often a multiple of that earned by any of the trunk carriers, including Delta and Northwest. Aside from its excellent choice of suitable equipment, part of SWA's success has been due to operating from airports close to the city in Houston and Dallas. After many legal battles, Southwest Airlines was permitted to operate out of Love Field in Dallas while competitors were required to operate from the more distant Dallas-Ft. Worth Airport (DFW). SWA had never signed an agreement as had all others to

move to DFW; in fact, it had not been organized when the other carriers signed.

Southwest's operations are based on a mass transit concept of short-haul, high-frequency service, featuring low fares at peak times, and still lower fares at off-peak times. Since deregulation, a limited number of interstate points have been added. Until recently, stewardesses dressed in "hot pants" as well as slogans built around the word "love" were hallmarks of SWA.⁸ Among other features not common on other airlines are: ten-minute stops, quick ticketing at cash registers, no interlining, and no meals. Generally speaking, the employees are not unionized and are cross utilized. Southwest actually attempts to compete with the automobile. "Keep it simple" is a motto often repeated by company executives. In line with the "keep it simple" concept, and because of the excellent fit of B-737s to the SWA route network, the company decided early on the use of a one-type fleet of twin-engine, two-pilot B-737s.

Table 5-1

Southwest Airlines 1981 Fleet and Aircraft on Order

Number Oct '81	Type	Seats	1981 (Dec)	1982	1983	1984	1985
25	B-737-200	118	27	6	3*	4	
0	B-737-300	142	0	0	0	2	8*

*Plus Options for 3 B-737-200s and 30 B-737-300s

In viewing the future -- 1985-2000 -- SWA believes it is well prepared for continued success. Table 5-1 lists planes on order and on

⁸ Stewardesses now have the option of wrap-around skirts. Recently a court ordered Southwest to grant application of qualified males to become flight attendants.

option in October 1981 but it does not reflect the fluidity of the situation. Increases in the number of B-737-300s on order to 40 are currently under consideration as well as further acquisitions of the 200 series. Part of the company's strategy is to keep its transports young and efficient -- currently the average age is 28 months -- so that they will command a good price as used aircraft. According to Southwest, the advent of deregulation made the utilization of efficient aircraft a requirement for survival.

Company officials were very clear about the carrier's future role which is to continue its present role of providing low-cost, high-frequency, short-haul, mass transportation which may compete with the automobile. This role requires the same type aircraft but possibly a little larger than that used in the 70s. Southwest has no aspirations to become a trunk line or to engage in long-haul operations.⁹ Management viewed with skepticism proposals for a new 150-passenger mixed-class aircraft, pointing out, as did Air Florida and other single-class carriers, that 150-passenger mixed-class aircraft are equivalent to 180-passenger planes in single-class service. This latter size represents too large a capacity jump to accommodate traffic and still provide frequency of service.

Building another model of the B-757 but reduced in size, or reducing the size of some other plane, would not be appropriate because, according

⁹ In a surprising move early in November 1981, the president of Southwest, Howard Putnam, left to become president of Braniff. His successor, Herbert Kelleher, who was and continues to be chairman of the board has announced plans for expansion into other states than contemplated by the former president. However, it is not believed that these plans presage a move to a major change in the type of operations.

to SWA, much unneeded weight stays with the airplane in the reduction process. Additionally, large planes are designed for longer stage lengths than the 276 mile stage length average now characteristic of Southwest's routes. Finally, the company pointed out that since noise was one of the reasons for developing the Dallas-Ft. Worth Airport and moving airlines from Love Field, it is imperative for SWA to purchase the quietest new-technology planes possible. One of the appeals -- besides its fuel economy -- of the recently ordered B-737-300 was the assurance that it would shrink the Ldn 65 noise contours to an area 70 percent less than that of the B-737-200, and 50 percent less than that of the quiet DC-9-80.

Summary: Southwest Airlines has a very clear idea of its future role in the industry. It plans to continue to operate -- as it has so successfully in the past -- a mass transit, auto-competitive, short-haul service, employing twin-engine, two-pilot aircraft with high-density seating and attractive flight attendants. Further, the operation will be characterized by low-fare, high-frequency service involving such "keep it simple" features as quick ticketing, no interlining, no meals, and simple "no gimmick" fares.

The company has no desire to expand to a full-service airline so that its equipment needs for the years 1985-2000 are substantially the same as today except for a more intense emphasis on low cost (both per seat mile and per aircraft mile), extended seat miles per gallon, and a vast improvement in noise emissions. Growth will require slightly larger aircraft than the present 118-seat B-737-200.

Management sees the B-737-300 as meeting future fuel economy and noise requirements. By 1990 most of the B-737-200s are expected to be replaced by the larger, more efficient B-737-300s. Unlike the case with most other carriers, financing is not expected to be a problem. As the company president put it, "If you make money, you have no trouble raising money." He also saw no reason for readjusting Southwest's route network to fit its current fleet or planned acquisitions. Although the B-737-300 is the closest to a new-technology plane SWA will need, the company did emphasize that it does now, and will in the future, closely monitor new aircraft offerings to see if anything better is designed.

In short, Southwest feels it has its equipment needs well covered until the year 2000.

5.2 Pacific Southwest Airlines

Pacific Southwest Airlines (PSA), with headquarters in San Diego, is another airline which entered the business as a single-class, high-frequency, low-cost, intrastate carrier to avoid rejection by the CAB of an interstate application. Although the company was successful for a while, regulation by the California State Public Utility Commission later proved as onerous as that of the CAB. Thus PSA became a staunch advocate of deregulation which later enabled it to expand to Arizona, Nevada, cities within California, and into Mexico. W.R. Shimp, chairman of PSA, recently stated, "I doubt that PSA would have survived without deregulation." The company's routes are still predominantly between cities of western California with a heavy concentration of traffic along the high-density Los Angeles-San Francisco corridor. Its revenues are

running about \$400 million a year. Passenger yield in 1980 was 13.6¢ and average stage length was 348 miles.

PSA's 1981 aircraft fleet, listed in Table 5-2, has already been heavily influenced by deregulation, fuel prices, and noise regulations.

Table 5-2
PSA Fleet, October 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>	<u>On Order</u>
15	B-727-200	165*	
3	B-727-100	128	
6	DC-9-80	153	20

*Being converted to 175

Fuel prices, in particular, have forced changes in the route structure and PSA feels its future role will involve longer stage lengths than its current 50 minute average. Stage lengths, such as San Diego-Los Angeles, are inefficient for its present fleet and are being dropped. These segments are being replaced by expansion into the Pacific Northwest with Seattle being an objective.

As previously indicated, California residents have been increasingly successful in obtaining compensation for unwanted noise and in restricting the operation of noisy aircraft. Thus, one of the major reasons for purchasing the DC-9-80 was that it reduced the noise footprint of the B-727-200 by 80 percent.¹⁰ For the next few years, the 153-seat DC-9-80 is considered to be the ideal size. While most of the B-727s will be disposed of as soon as market conditions will permit, a few will be retained where there is a special need.

¹⁰ PSA Annual Report, 1980, p. 7.

Since PSA already has 153- and 175-passenger planes, ideal for the present, it believes that by 1985-1990 a slightly larger plane (200-215 passengers) containing more new technology will be needed. At the present time the Boeing 757, configured to 214 passengers in single-class service, is favored by the company. The \$1 billion investment required for 26 DC-9-80s and 14 B-757s is two and a half times the total assets and four times the value of the current flight equipment shown on the company's 1980 balance sheet.

Summary: PSA has found that deregulation, higher fuel prices, and noise regulations have had a dramatic effect on fleet composition and on the company's role in the future transport system. To offset increasing fuel costs, additional seats are being added to the less fuel-efficient B-727-200s. Noise regulations at Orange County and San Diego, plus noise-sensitivity elsewhere, were predominant factors in the purchase of a large fleet of DC-9-80s. The improved fuel efficiency of the aircraft was also a significant factor.

PSA envisages a larger departure from its initial transport role than does Southwest which is satisfied with its "keep it simple," one type of aircraft approach. PSA has found it necessary to make more adjustments to its routes than has SWA in order to counter changed economic and competitive conditions. For the future 1985-2000 period, PSA sees the need for a more economical plane in the 200- to 215-passenger single-class category, and has publicly indicated that the B-757 meets its anticipated requirements. Because of the adverse effects of (a) their pilots' strike in 1980; (b) the particularly "soft" travel market in 1981; and (c) problems associated with the PATCO strike,

the financial position of the company will not warrant for some time a firm commitment to such a major future obligation.

5.3 Midway Airlines

Midway Airlines (MDW) is one of the new (often called "instant") airlines which are a direct product of the deregulation movement. The company, based at Chicago's Midway Airport, flew its first flight on November 1, 1979. With Chicago as a hub, its spokes go to Omaha, Kansas City, St. Louis, Washington, Philadelphia, New York, and Minneapolis. In essence, it attempts to use in the Midwest the principles so well employed in Texas by Southwest Airlines. Successful in its first year, Midway features short- to medium-haul, high-frequency service, using two-tier, unrestricted low fares to attract traffic. To make these low fares possible, MDW has established simplified service consisting of single-class service, no meals, high speed ticketing and reservations procedures in one type of airplane -- the DC-9.

Table 5-3
Midway Airlines Fleet, October 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>	<u>Unit Cost (mil.)</u>	<u>Misc.</u>
9	DC-9-15	86	\$3.25	Exempt from noise regulations
8	DC-9-31	115	\$5.4	ex seats

As was the case at Southwest Airlines, the airline began operations under the leadership of experienced executives from other airlines who were interested in the challenge of starting a new airline. To hold costs down, Midway Airlines planned to purchase used twin-engine, two-pilot crew aircraft. This meant a small model which had the advantage

service, over a hub-and-spoke system on routes of less than 1,000 miles in length. It believes this role can be filled best by a twin-engine, two-pilot, 150-passenger, single-class, fuel-efficient airplane. Environmental rules, as well as more modern aircraft, will render the company's early aircraft obsolete. Sometime during the 1985-2000 period Midway expects to reach a peak of 30 to 40 aircraft -- all in the 150-passenger category. Because of its relative small size and specialized type of operation, Midway Airlines feels that it will have little or no input into the aircraft design process, but rather will be a purchaser of "off the shelf" airplanes. It would prefer, however, to buy low-cost used aircraft if they become available.

Chapter 6

ROLE PERCEPTIONS OF A CARGO CARRIER AND A SMALL PACKAGE CARRIER

In previous chapters the report has dealt with old, established major trunk lines, six medium sized carriers (including newer carriers), and three specialized one-class service airlines. This chapter considers two cargo carriers one of which limits its service to small packages weighing 70 pounds or less.

6.1 The Flying Tiger Line

The predecessor of the Flying Tiger Line ("Flying Tigers") was organized in 1945 by World War II pilots, hence the name. The present Flying Tigers company, a subsidiary of Tiger International, is a certified carrier primarily engaged in common carriage of cargo over a route system serving cities in the United States, Asia, and Europe. The scope of its operations was considerably broadened by its merger in October, 1980, with Seaboard World Airlines, another cargo carrier. As a result of this merger, the Flying Tiger company is the largest air cargo carrier in the free world as measured by revenue cargo ton miles. In addition to its cargo operations, it conducts passenger operations for the military under a MAC contract. Limited charter and scheduled passenger service with B-747-200s and DC-8s are performed through its Metro International subsidiary. Currently it suffers from overcapacity and for this reason is parking several DC-8s in the desert.

Before examining the Flying Tigers' future role, let us look at its present fleet listed in Table 6-1.

Table 6-1
Flying Tigers Fleet, July 1981

<u>Number</u>	<u>Type</u>	<u>Cargo Capacity</u>	<u>Comments</u>
7	DC-8-61	90,000 lbs.	Leased, not being re-engined
19	DC-8-63	105,000 lbs.	14 being re-engined
2	DC-8-63	252 passengers	
4	B-747-100	215,000 lbs.	
14	B-747-200	240,000 lbs.	

John E. Flynn, executive vice president, indicated that cargo traffic should continue to grow and Tigers' decision to coordinate its air cargo operations with its rail and trucking interests will ensure a healthy future. He believed that the two markets, domestic and international, have needs which require different capacity aircraft. For the 1985-2000 period, international operations will be well served by the B-747, but a limited number of "stretch" versions may be needed. Lighter traffic can be handled by re-engined DC-8s when not needed domestically.

Tigers considers the B-747 as too large for optimal service on its domestic routes. The huge size and heavy weight of the aircraft imposes frequency and airport limitations which constrain or prevent its uses in many markets the company would like to serve. For service to smaller domestic markets a new 40,000-50,000 pound payload cargo airplane with two engines and a two-pilot crew is definitely needed. In a departure from the view of most of the carriers interviewed, Tigers was not particularly interested in fuel efficiency in new aircraft for domestic operation. Pointing out that cargo aircraft had low utilization domestically, the company calculated that it would be better to trade off fuel efficiency for lower capital cost.

Summary: The Flying Tigers line has concluded that in the 1985-2000 period it will need cargo aircraft with three different payload capacities: first, for smaller markets a 40,000 to 50,000 pound payload plane powered by two engines and flown by a two-man crew; second, a 100,000 pound payload plane; and third, a 200,000 pound payload cargo aircraft. The three planes should have logistics commonality. Given the fact that cargo planes have low utilization and that Tigers does not expect fuel prices to increase more than the rate of inflation, the company does not want to invest for fuel savings. The development of a 50,000 pound payload domestic cargo aircraft will permit the expansion of air cargo service to points not now served as well as provide a good "feed" to the larger aircraft. Flying Tigers' engineers are now evaluating the B-727-200F recently ordered by Federal Express.

Because no other aircraft the size of the B-747 exists, and since the cost of building a competitive unit would be staggering, Flying Tigers believes that a more efficient re-engined B-747 will emerge at some point.

6.2 Federal Express

Federal Express represents a different type of cargo service from Flying Tigers. Federal specializes in transporting small packages (70 pounds or less) overnight via a hub-and-spoke system (Memphis being the hub) to a large number of points in the United States. In eight years it has grown from nothing to a half a billion dollar business. The story of its phenomenal growth, originally over the objections of the established airlines, has been told in various business publications and

need not be repeated. Several points, however, should be noted as background for its future plans.

The idea for the service was conceived by the company's founder, Fred W. Smith, an affluent young man, in his master's thesis at Yale. Because of objections by the established airlines, his early efforts to obtain certification in 1971 failed. In 1973 he was able to begin operations under an Air Taxi Exemption of the law which permitted unlimited operations if small planes with a payload of less than 7,500 pounds were used. Business quickly exceeded the 6,200 pound payload capacity of the Dassault Falcons employed. Attempts to secure permission to use a fleet of DC-9s failed. In 1977, however, in concert with others, Federal's efforts for cargo deregulation, so that it could expand unfettered by government policies and legal restrictions, bore fruit.

As a result of its rapid growth, Federal's fleet composition changes often. Its October 1981 fleet and planes on order are listed in Table 6-2.

Table 6-2
Federal Express Fleet, October 1981

Number		Type	Average Stage Length	Weight Capacity
On Hand	On Order			
29	9	B-727-100Q	500-600	42,000
32		Falcon D20	400-500	6,200
4		DC-10-10	900	110,000
0	15	B-727-200F		57,000
<u>65</u>	<u>24</u>			

Initially, the company believed that economies lay in the purchase of used two-engine, two-pilot airplanes. It later purchased several new B-737s because of their efficiency and possible use as passenger planes in off-peak times. However, when Federal Express changed its mind on

passenger operations and found the B-737s too small, it disposed of them in favor of used three-engine, three-pilot B-727-100-QCs which were available at very favorable prices because airlines had found that the "quick change" feature was time consuming and expensive with most of the seats ending up at the wrong end of the route. More recently the company announced an additional move toward three-engine, three-crew member aircraft by ordering new B-727-200s configured for freight and bearing the designation B-727-200F.

Federal Express sees an expanding role for its services in the years 1985-2000 and thus the acquisition of more aircraft. It foresees the need for three categories of aircraft: (1) a 10,000-15,000 pound payload aircraft to replace its 6,200 pound original Dassault Falcons; (2) a 50,000-60,000 pound capacity aircraft to supplement and replace its 42,000 pound capacity B-727-100-QCs; and (3) a 100,000-150,000 pound capacity aircraft for heavy load long hauls. Since the spring of 1981 Federal Express has been studying the economics of and has been negotiating for the rights to operate supersonic Concorde between the U.S. and Europe for high priority mail and express service. Because of the light weight, small bulk and high yield on letters, calculations show promise of much higher yields per pound than for passengers.

As was the case with Flying Tigers, Federal Express emphasized that in its business "Frequency is not the name of the game," nor is high aircraft utilization. As a result, fuel expense is a much lower percentage of operating costs than on passenger airlines. Given the general pressure for two-pilot crews, the continued purchases of aircraft requiring three men may be at first surprising. Federal, however, has found the

cost of the third man is a small fraction of its expense and also that the third man serves an additional function as load master. Therefore, the company is satisfied that for the 1985-2000 period its heavy load requirements can be handled by adding more three-pilot DC-10-10s to its existing fleet. Because the passenger carriers' ardor for wide-bodies has cooled under deregulation, Federal Express expects to purchase used DC-10-10s for its 100,000 pound requirement at advantageous prices.

As previously noted, the company has often indicated a preference for used aircraft over new aircraft because of the high capital cost and financing of charges for the latter. Therefore, its recent announcement of an order for 15 new B-727-200s configured to carry cargo would seem to be a departure from its previous practice in cargo plane purchases. It reasoned that there were going to be an insufficient number of used B-727-100-QCs available to satisfy Federal's expansion program and those that would be available would be old and not as reliable as new aircraft. Further the 15,000 pound increase in payload would be a welcome boost in productivity. Accordingly, the company believes the purchase of the B-727-200F satisfies its wants through the 1990s for a 50,000 to 60,000 pound payload plane. However, should an efficient turboprop at the right price appear, the company would be interested. By the 1990s Federal Express hoped a prop-fan could be developed for longer haul operations.

With the 100,000 and 50,000 pound capacity aircraft selection well in hand, Federal Express' next need is replacement for its 32 Dassault Falcons with their 6,200 pound capacities. Here the company is definitely looking for a turboprop. In testifying before the House Committee

on Science and Technology in February 1981, Federal Express stated that for the short ranges and light loads it had been evaluating the turbo-props being offered to the commuter airlines, but none was satisfactory. Since the Falcons are all paid for and in good mechanical condition, the company believes it has several years remaining before it will be critical to purchase replacements.

Summary: In only eight years from the date of its first flight, Federal Express has developed a half billion dollar small package business requiring the use of 75 aircraft of three distinct payload capacities -- 6,200, 42,000, and 110,000 pounds. In the future it sees a continuation of its aggressive expansion policies so that more of each category aircraft will be needed, as well as replacements for its two smaller categories of aircraft. The company sees some lengthening of stage lengths and entry into some markets not now served, including transatlantic. The economics of its present fleet fit its routes well enough so that there is no plan to readjust the route network because of its fleet.

Although the company generally states that it would take ten hours a day aircraft utilization against its current five hour utilization to justify the purchase of new aircraft because of their high capital cost and high interest rates, it recently ordered new B-727-200Fs to fill a need for a 50,000 pound payload aircraft. Presumably, the company feels that the end of model run price was a bargain compared with the cost of new-technology aircraft. Its next replacement aircraft to be selected will be for the Dassault Falcons presently being used in short-haul operations. Here the company hopes that accelerated turboprop research

will result in a quiet, energy-efficient aircraft carrying from eight to ten thousand pounds of cargo. Contrary to the views of passenger-carrying airlines, Federal Express does not consider fuel a cost constraint. It even indicated that it might accept some degradation in fuel economy for more speed. This was particularly true in the case of the prop-fan if it took more fuel to reach the speed of Mach .76, the minimum speed the company feels is necessary for profitability.

Chapter 7

ROLE PERCEPTIONS OF THREE COMMUTER AIRLINES

Changes in the laws governing commuter airlines and the consequent recent rapid growth of these airlines makes a precise and lasting definition of commuters difficult. Prior to 1972, air taxis and commuters were free from the limitations of certification providing the plane used did not weigh more than 12,500 pounds (equivalent to 19 passengers). This limit provided a barrier to the acquisition of larger more efficient aircraft. In 1972 the limit was raised to 30 passengers, or a 7,500 pound payload. Under the Airline Deregulation Act of 1978 the figure was raised to 56 passengers and then to 60 passengers; for cargo the figure was 18,000 pounds. Although deregulation removed many restrictions from the large certificated carriers, the commuters are even less restricted in entry, exit, fares, and reporting requirements.

Basically a commuter provides regular scheduled passenger or cargo service with aircraft seating 60 passengers or less. Recently several carriers have progressed to 75-passenger jets. However, the bulk of the airplanes are smaller turboprops flying between short-haul markets, often feeding the larger fan-jet carriers. More specifically, the average commuter stage length in 1980 was 120 miles with 87 percent of the flights being 250 miles or less.¹¹ One large commuter had a 67 mile stage length average. In the case of the certificated carriers, only six percent of the flights were 250 miles or less.

¹¹ Commuter Airline Association of America, Commuter Airline Industry, 1980 Annual Report, p. 6.

In November 1980, the Commuter Airline Association of America (CAAA) reported there were 237 commuter airlines flying 1339 aircraft. The CAAA chart reproduced in Chart 7-1 shows the composition of the fleet in terms of percent of all aircraft, percent of hours flown, and percent of available seat miles. Turbine powered aircraft, while accounting for only one-third of the commuter fleet, now provides nearly 75 percent of all industry seat capacity.



To some extent the choice of aircraft and its seating by a commuter was conditioned by crew number requirements. Since 20 passengers would necessitate adding a flight attendant, 19 passengers or less became a popular size. When 30 passengers became the limit, more aircraft in this category began to appear. Finally, the 60 passenger rule provided incentive to build 50 passenger aircraft.

Changes resulting from deregulation accelerated the growth of commuters for five reasons. First, commuters were able to fill a void in the transport system when the larger airlines dropped the unprofitable, lightly-traveled routes under the easy exit provision of the Act. Second, the relaxation of seating capacity made it possible to purchase more productive equipment and service larger markets. Third, the commuters were eligible for federal loan guarantees to assist in financing their equipment. Fourth, subsidies were provided for commuters serving "essential service" communities. And fifth, the regular certificated carriers, in order to receive feed for their own longer routes, found it necessary to be very supportive of the commuters.

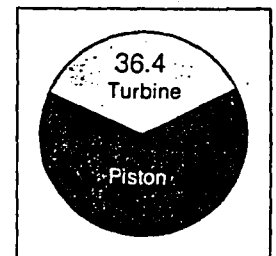
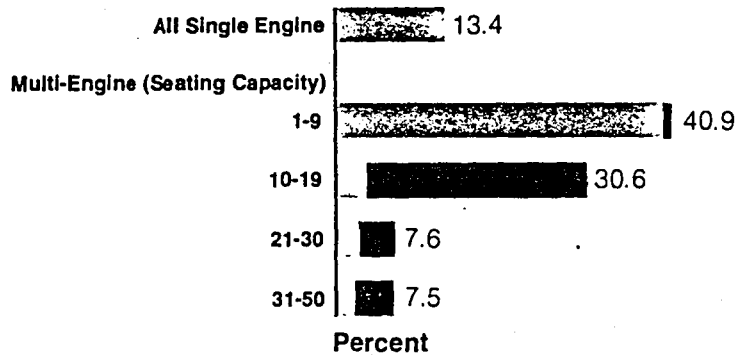
Time and budget restrictions do not permit an extensive examination of perceptions of a large number of commuters for the 1985-2000 period.

Chart 7-1

Analysis of Commuter Aircraft Fleet 1980

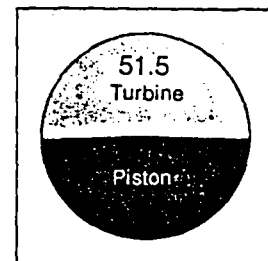
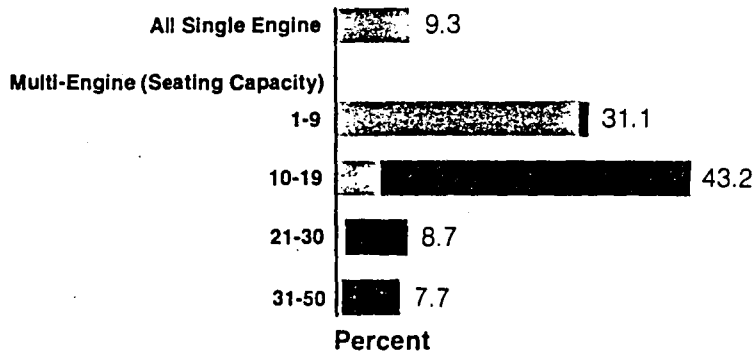
 Piston Powered
 Turbine Powered

Aircraft Composition



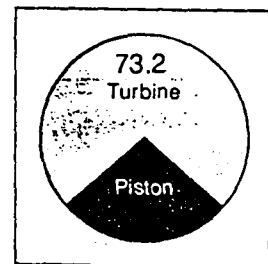
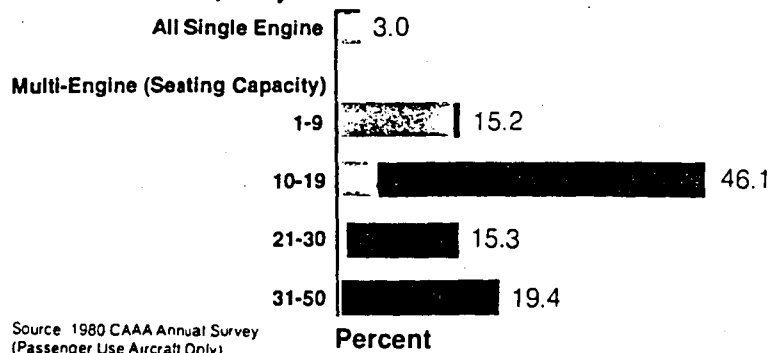
Percent of All Aircraft

Aircraft Hours Flown



Percent of All Hours Flown

Available Seat Capacity



Percent of All Available Seats

Source: 1980 CAAA Annual Survey
(Passenger Use Aircraft Only)

To many of them, anything beyond two years is extremely long-range. Nevertheless, we will attempt to obtain a flavor of their ideas by sampling three commuter airlines: (1) one of the larger established west coast commuters, Golden West; (2) a smaller Indiana-based commuter, Britt; and (3) a relatively new line headquartered in Wisconsin, Midstate.

7.1 Golden West

Golden West is currently the fourth largest commuter airline in the U.S. and is slightly smaller than Air Wisconsin. Headquartered at Newport Beach, California, the company through various predecessor companies and acquisitions -- Avalon Air Transport, Cataline Air Lines, Aero Commuter, Cable Commuter, and Skymark -- has been operating since 1953. The present company is privately owned by three persons and began operations in 1968. As late as 1970 the carrier indicated its future lay in 20-50 mile stage lengths, with a maximum of 100 miles.

Gradually this very short-haul philosophy changed to longer haul as ground transportation improved, as the cost of very short-haul operations increased, and as deregulation modified the environment in which Golden West could operate. The company's current fleet is listed in Table 7-1.

Table 7-1
Golden West Aircraft Fleet, October 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>
11*	DH-6 (Twin Otter)	17
5	SD 330 (Shorts)	30
5	DH-7	48
<u>21</u>		

*Only two are in scheduled service.

Government rules which sanctioned the use of higher capacity planes as commuters permitted the company to acquire 48-seat, four-engined DH-7 turboprops with a much longer range than its Twin Otters and Shorts' 330s. As a result of the factors mentioned previously, the company sees a significantly different role for itself in the 1985-2000 period. Presently Golden West is in transition and is establishing two types of hub-and-spoke networks for the future: (1) a hub-and-spoke system involving segments 100 miles or less; and (2) a hub-and-spoke system centered around 200-mile segments. The latter system will utilize DH-7 aircraft which now number five, but within a year this fleet is expected to reach nine.

Currently the company has 12 stations (San Francisco, Los Angeles, San Diego, Orange County, Ontario, Santa Barbara, Oxnard, Fresno, Bakersfield, Monterey, Lake Tahoe, Santa Maria) which are all in California. As Golden West acquires more DH-7s, it expects to expand to Washington and Oregon, again emphasizing longer stage lengths. As the note on Table 7-1 suggests, the Twin Otters are being phased out. Nine have been taken out of service and the remaining two are expected to be gone by spring of 1982. But for the need for lift following the demise of competing Golden Gate and Swift Aire, they would already be gone.

The difference in the two types of networks now being structured is illustrated by the stage lengths employed. Stage lengths on the Dash 7s average 190 miles while those on the Shorts 330s average only 65 miles. The Shorts 330s appear to have a questionable future at Golden West. They are limited to very short range operations and do not have the performance to be utilized profitably where temperatures are high.

Accordingly, the company seeks a more efficient 30- to 40-passenger replacement for the SD-330. Currently it has found none.

In looking to the next airplane it will need five or more years hence for longer haul operations, Golden West anticipates a significant number of 400-mile stage lengths necessitating a 100-passenger, twin-engine turboprop. While Golden West would prefer an aircraft tailored to its operations, it recognizes that the company is too small to dictate design. It therefore indicated an intention to modify its route structure to conform with the efficiency of future planes.

Although blessed with about the same high yield (39¢) per passenger mile as Air Wisconsin, the PATCO strike, extensive competition (prior to the closing down of Golden Gate and Swift Aire) and interest charges (tied to prime) on its DH-7 fleet, caused a financial loss to be expected for calendar year 1981. However, a pending sale and lease-back of its DH-7s is expected to improve Golden West's financial position.

Summary: Golden West, previously characterized as a very short-haul commuter, has, because of deregulation, improvements in local transportation, and the lack of efficiency of its short-haul aircraft, decided on a new future direction. Its new primary role will be that of a hub-and-spoke longer-haul commuter in the 200 mile stage length category, on flights from 45 to 70 minutes in length. For this role it sees that its 48 passenger DH-7 will be ideal until traffic builds to warrant a 100-passenger twin-engine turboprop.

For its secondary role, Golden West sees the need for a 30- to 40-passenger short-haul commuter to replace its Short 330s for a short-haul

hub-and-spoke system. Although it has examined current offerings, commenting that it had to go to foreign manufacturers in the process, Golden West indicated that no satisfactory plane has been found. Since acquiring the DH-7 the company has been adjusting its route network to fit the economics of that plane.

7.2 Britt Airways

Britt Airways, privately owned by the Britt family, has headquarters in Terre Haute, Indiana, and serves 19 midwest stations. At the present time, most operations are in Indiana and Illinois but some touch Missouri (St. Louis), Ohio (Cincinnati) and Iowa (Burlington). In 1979 it was tenth in number of commuter passengers carried. The company's current fleet is shown in Table 7-2.

Table 7-2
Britt Airways Fleet, October 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>
3	FH-227	48
8	Swearingen Metro IIs	17
12	Beech 99	13

William Britt began a fixed base operation as a crop duster in 1950. In 1968, after acquiring a Beech 99, he became Allegheny Commuter. Britt Airways was formed in 1976 and Britt and Allegheny consolidated into one company in 1981. Its current average stage length is 140 miles.

Although owned by a small family, the company has managed to expand and own its fleet. As it looks to the 1985-2000 period, Britt Airways sees a bigger role for itself. Expansion is planned to Detroit from South Bend, to Akron and Columbus from Indianapolis, and perhaps into another Illinois town.

None of the aircraft in the fleet are considered ideal for the future but neither does the company find suitable replacements. It hopes designs will be forthcoming from U.S. manufacturers. The FH-227s are considered the most suitable available and plans are being made to acquire more used FH-227s since they are no longer in production. Basically Britt Airways wants two new types: (1) a 30- to 40-passenger turboprop burning 100-120 gallons per hour and traveling 300 miles per hour; and (2) a 19-passenger turboprop -- essentially a DC-3 type replacement.

Summary: Britt Airways envisages a modest expansion of its present operations. Basically the company sees a need for a 19-passenger as well as a 30- to 40-passenger turboprop, both with fuel economy and a 300 mile per hour speed. It is not completely satisfied with any type in its fleet and expressed a strong preference for U.S. designed and manufactured replacements.

7.3 Midstate

In one form or another Midstate Airlines has been in business for 17 years. Financial reverses almost caused bankruptcy two years ago, but the company was saved by a takeover by Sentry Insurance Co. of Stevens Point, Wisconsin. Sentry installed new management and provided an infusion of capital which enabled the company to purchase new Swearingen Metro IIs and later order more powerful Metro IIIs to expand operations. With administrative headquarters at Stevens Point, Midstate serves four cities in Central Wisconsin, as well as Milwaukee, Chicago, Muskegon, Flint and Detroit. Its fleet is listed in Table 7-3.

Table 7-3

Midstate Airlines Fleet, October 1981

<u>Number</u>	<u>Type</u>	<u>Seats</u>
2	Swearingen Metro II	16-18 depending on weight of load
2	Swearingen Metro II	18-19 depending on weight of load

Additionally, on order are six Metro IIIs which are more powerful and will carry 19 passengers without load restriction. According to Midstate's president, the equipment modernization has been a success and the company with a high yield of 38 cents per passenger mile -- similar to successful Air Wisconsin -- expects to be profitable. With the resources of an insurance company behind it, Midstate feels it will not be short of capital when a need arises to purchase more flight equipment.

The company defines its future role as that of a short-haul regional carrier, operating frequent flights in a well-defined midwest geographical area, over stage lengths less than 500 miles, at speeds guaranteeing a flight time of less than two hours. Further, its network will retain such hubs as Chicago, Milwaukee, and Detroit, plus some new ones. All flights are planned to be turboprop and will primarily be nonstop.

According to management, this type of operation will eventually require several types of aircraft in the fleet whose capacities might well be 19, 30, 50, and perhaps 80 passengers. Unlike some other carriers who strongly prefer equipment from only one manufacturer, Midstate is not concerned about this type of commonality, reasoning that the right equipment for the mission is more important than staying with one manufacturer. As for the distribution of stage lengths, management sees a spread from 100 to 500 miles with predominant clustering in the 200

7.4 Commuter Summary

The story of Golden West, Britt, and Midstate is a microcosm of the commuter world, and in fact is quite similar to the history of many carriers who now are large and have completely forsaken frequent short-haul service. Many commuters began with the intention of using small aircraft and never exceeding the 19-passenger limit after which a flight attendant would be required. Golden West's predecessor at one time said its role was 20 to 50 mile flights. As the necessity of spreading costs over a greater volume of traffic became clear, pressure was successfully applied by commuters for authority to use larger capacity aircraft.

As larger aircraft are acquired the shortest segments tend to be dropped, followed by the deletion of the smaller airplanes themselves from the fleet. Voids in service often begin with the larger carriers dropping short-haul, light-density services when their new planes are too large for the routes. While a pilot for American Airlines, the writer used to fly a 21-passenger DC-3 from Milwaukee to Chicago, South Bend, Kalimazoo, Battle Creek, Jackson, Detroit, and Windsor. Later American abandoned some of the routes to Wisconsin Central (later to become Republic). Subsequently these types of routes were transferred to smaller carriers, Air Wisconsin, for example. As Air Wisconsin grows it is dropping light-density routes to carriers like Midstate. In California, Golden West is picking up routes dropped by AirCal as the latter purchases bigger equipment and attempts to expand into other states.

Despite the original intent in organizing a commuter, it seems universal for management, once the airline is established, to develop

broader and broader horizons and goals which inevitably lead it to expand to where it thinks in terms of 100-passenger planes -- a size once reserved for major trunk lines -- and routes of 500 miles long, a length once considered in the medium- to long-haul category. Golden West, who not long ago was indicating average stage lengths of 20 to 50 miles in small capacity planes, later progressed to 65 mile stage lengths using 48-passenger planes. Already the company is predicting 200 mile stage lengths and the need for 100-passenger planes.

Britt, which still operates one 13-passenger Beech 99, has moved first to 18-passenger Swearingen Metro IIs and later to 48-passenger FH-227s. By placing primary emphasis on "DC-3 replacements" a secondary emphasis on a 30- to 40-passenger turboprop, and lesser emphasis on replacing its 48-passenger FH-227s, Britt is more conservative in its expectations than Golden West. Midstate, too, although new in management and equipment, has been looking for new fuel-efficient airplanes in the 50-passenger class to enable it to meet its forecast growth rate.

Each of the three carriers perceived itself to have the role of a short-haul carrier providing frequent service to and from hub airports at tariff rates several times those of the major long-haul airlines. Generally speaking, all sought a more efficient 19-seat airplane than they now have. Additionally, none thought the current offerings in the 30- to 50-passenger category met their needs as well as they would like. Finally, all believed that in the past manufacturers paid more attention to larger transports than to replacements for DC-3 and slightly larger

aircraft. All noted that foreign manufacturers seemed to be more responsive to their needs than were American companies.

Chapter 8

FUTURE JET TRANSPORT AIRCRAFT NEEDS: AIRLINE MANAGEMENT VIEW

Chapters 2 through 7 place primary focus on the future role each carrier sees for itself together with some reference to equipment implications. In this chapter the aircraft requirements themselves, as seen by the carriers, are the center of attention. Since introduction of the jumbo B-747 in 1970, subsequent or derivative aircraft have been progressively smaller as carriers and manufacturers recognized that the days of compound traffic growth at annual rates of 15 to 20 percent have passed. Capacities of new aircraft decreased from the 325- to 500-passenger B-747; to the 225- to 300-passenger DC-10, L-1011, and A-300; to the 200-passenger B-767, to the 175-passenger B-757. All of these aircraft benefitted by the use of high-bypass, quiet, fuel-efficient engines.

8.1 The Next New-Technology Series of Jets

As previously indicated, the economic obsolescence which first overtook the B-707/720 and DC-8 series has, in general, overtaken the B-727-100 and early DC-9 series for all but package delivery service, and is expected to overtake later series of these aircraft. Until the last two years, the capacity of these planes has ranged from 85 to 135. "Slim-line" seats have now pushed the seating higher -- to 149 mixed class and as high as 177 all-coach, single-class for the B-727-200 on at least one airline. For some time the development of replacement aircraft has been inhibited by (1) the unavailability of a correctly sized

high-bypass engine, (2) the perceived loss of economies of scale in building smaller aircraft, (3) the preoccupation of aircraft manufacturers with their larger aircraft, (4) the hope that a resurgence of traffic would cause the airlines to grow into larger planes, and (5) the lack of financial resources, both on the part of the manufacturers and the airlines, to handle such a large scale re-equipment program.

However, relatively quickly after the first orders for the Boeing 757 were announced, a flurry of activity in the direction of 150-passenger capacity, new-technology aircraft began. Prior to this time, USAir had issued specifications for replacement of the 110- to 135-passenger DC-9, B-737, and B-727 by twin-engine, two-pilot aircraft equipped with high-bypass ratio engines.¹² While these specifications did not generate a new-technology aircraft, they were instrumental in shaping the derivative DC-9-80 and the B-737-300 which some airlines see as adequate for their purposes almost to the year 2000.

8.2 Management's Perceptions of the 150-passenger Jet

Since Delta with its B-767 and B-757 orders had already committed for about \$2.0 billion of new aircraft, its announcement in the spring of 1981 of an intention to place orders for an additional 100 new-technology 150-seat short- to medium-haul aircraft came as a surprise. Perhaps a greater surprise was the nature of the specifications which focused on optimizing cost on a 400-mile segment, and the clear implication that Delta was deadly serious in its desire to initiate this portion of its massive fleet replacement program by 1986. In other words,

¹² The specifications are detailed in Appendix 2, Speakers' Papers for International Civil Aviation Conference No. 2, April 29-30, 1980, published by Lloyd's of London Press, New York, New York.

despite the poor economic outlook for the industry near term, and the heavy commitments already made, Delta's announcement was not a trial balloon to flush out comments by other airlines and aircraft manufacturers.

Shortly after Delta announced its specifications for 100 new-technology aircraft, estimated to cost \$5.0 billion, United announced that it was asking manufacturers to design a twin-engine 150-passenger airplane and had forwarded specifications or guidelines for the design to manufacturers. Unlike Delta's, the guidelines were quite general and focused on longer stage lengths. Reactions to these proposals were varied among the airlines. Some carrier engineers criticized the Delta proposal as being unrealistic, "pie in the sky," a proposal which must have been devised by people without engineering knowledge. It was alleged by others that the proposal was a plot by Delta to confuse Boeing. Still others, while thinking the specifications to be unusually exacting, looked with favor at their emphasis on short-haul economics.

On the other hand, some faulted the United proposal on the grounds that it was a mass of hastily drawn generalities -- a "knee-jerk" reaction to Delta and was an attempt to obtain publicity at a time when United's executives were having to explain large losses at the company's annual meeting. United's contention was that it was not in the business of aircraft design and did not wish to constrain those who were with the type of detail in the Delta specifications.

No other airlines, largely because of their financial condition have submitted specifications for a 150-passenger airplane. Therefore, manufacturers in the U.S. and abroad have been at work seeking to meld

the United and Delta proposals into one design, it being assumed that for economic reasons two separate aircraft could not be justified. Table 8-1 and 8-2 compare (1) several significant specifications, and (2) the stage lengths of the two carriers. The latter explains in part the reasons for variance in specifications.

Table 8-1
Proposals for 150-Seat Aircraft, Spring 1981

<u>Item</u>	<u>Delta</u>	<u>United</u>
No. of Seats (12/138 configuration)	150	150
Stage length orientation	400	800
Range with passengers & bags	1,400	1,850
Seat miles per gallon: 400 mi. trip	77.6	Not directly specified
Seat miles per gallon: 1,000 mi. trip	92	Not directly specified
Speed	M .83	M .80-.83
Direct operating cost: 1,000 mi. trip	Not specified	10 percent per airplane mile below 757 and 38 percent per seat mile below 727-200
New technology	No limit	No limit

Table 8-2
Distribution of Stage Lengths

<u>Stage Lengths in Miles</u>	<u>Percent of Flights</u>	
	<u>Delta</u>	<u>United</u>
Less than 400	66	14
400-800	21	32
800-1,200	10	24
1,200-1,600	3	9
1,600 and over		20

Delta, having already ordered the B-767 and B-757, saw itself as well situated for its medium- to long-haul flights, but short of modern equipment for its short-haul operations which constitute about two-thirds of the company's flight segments. Since short-haul flights require a high number of cycles (landings and takeoffs) in a given period, the

engines use high thrust for takeoff and climb a greater portion of the time than in cruise. Thus, Delta's specifications emphasized an engine optimized for the shorter segment. A look at United's stage length distribution, plus its failure to order B-757s, explains United's desire for a longer range and therefore heavier aircraft.

On the basis of the published proposals (it must be remembered that individual airlines do not communicate with each other privately on these matters), a number of airlines were queried concerning their interest in the proposed 150-passenger planes, assuming financing were available. On this assumption, interest was shown by American, TWA, United, Northwest, Delta, Eastern, Continental, USAir, Frontier, Air Florida, Southwest, Midway, Piedmont, and PSA. In addition those airlines who feature single-class service -- Frontier, Air Florida, Midway, Piedmont, SWA, and PSA -- were interested in a single-class version.

Northwest was in no hurry because it can add seats to its existing fleet and increase utilization at small cost. Southwest also was in no hurry since it has ordered the B-737-300 which will take care of its needs until the 1990s. American, TWA, Eastern, and several others stated that from a practical point of view their interest was academic. Their financial position was such that only the B-727RE (re-engine) was a possibility. Unless a quick, massive, unexpected turnaround in their fortunes takes place, failure of the re-engine program to proceed will mean the companies will have to shrink in size.

Reconciliation of Delta and United Proposals

Initial information released by Delta and United suggested that their proposals were incompatible. Billed as a "short-haul" feeder,

Delta's airplane was to have costs optimized over a 400-mile segment and a maximum range of 1,400 miles (Table 8-1). While previous airplanes were designed with further growth in mind, the Delta proposal envisioned that "Stringent fuel efficiency requirements would preclude the inclusion of design provisions for growth or derivative versions.¹³ Further, to reach the objectives of maximum fuel efficiency and minimum direct operating expenses on the short-haul, a new high-bypass engine with efficiency focused on climb and descent, rather than cruise, would, according to Delta, be required. On the other hand, since the United proposal specified a much longer range plane, it would spend a great proportion of its time in cruise configuration. This design would involve a heavier plane with a slightly different engine.

A survey of airlines desiring a future 150-passenger aircraft indicated a marked preference for a longer range, more flexible plane than that indicated in the Delta proposal and more like that of United. Even the smaller local service lines which had more modest stage lengths than the trunks, wanted ranges long enough to exceed their current needs. They favored United's proposal. The manufacturers, therefore, seemed to face a dilemma. The airline with the money, Delta, preferred a plane which those currently constrained for funds did not. No aircraft or engine manufacturer could afford to build a new type aircraft or engine for the limited number of planes Delta would need.

Oddly enough, the aircraft designers, after reexamining the specifications more closely, have come to the conclusion that it is possible

¹³ Presentation "Aircraft Evaluation and Selection at Delta" by C. Julian May, vice president-engineering, Delta Airlines, ATRIF, Atlantic City, May 27, 1981.

to design an aircraft which comes very close to meeting the requirements of United and Delta at the same time. How does this happen? It turns out that Delta's specifications have always been extremely conservative which results in a heavier airplane. Delta's reserve fuels, for example, are higher, its holding fuel is greater because it is calculated at a lower altitude. The company allows more weight for cargo. Finally Delta may demand that the aircraft takeoff from high altitude airports on a hotter day than does United. The sum total of all the differences, according to United, Delta, and the manufacturers, means that the total weight of each aircraft is about the same. The longer range desired by United and others can be accomplished by the addition of belly tanks. With regard to the engines, some engineers now say that design requirements are not significantly different for the short-haul engine than for the longer-haul powerplant.

This report, by its terms, was limited to perceptions by the airlines and thus powerplant designers such as General Electric, Pratt & Whitney, and Rolls Royce were not included in the interviews. Preliminary investigations indicate, however, that optimistic news of satisfactory design accommodation between the United and Delta proposals come more from the airframe designers than from engine manufacturers. In any event, the original target date of 1986 for in-service operations of the new plane will slip by at least one or two years. Engine design lead time is greater than that for the airframe and the precise requirements have not yet been defined. Additionally, a new engine is a tremendous financial undertaking involving great risk, perhaps \$1 billion. The

financial condition of the airlines and the manufacturers is not such as to lead them to rush into new engine development.

Summary: A wide variety of airlines from trunks to regional airlines agree on the need for a 150-passenger new-technology airplane in order (1) to comply with noise regulations which are being progressively phased in, (2) to replace aircraft which have been made uneconomical because of increasing fuel prices and the development of more efficient technology, (3) to provide aircraft properly sized to furnish the frequency of service necessary to be competitive in a deregulated environment, and (4) in some cases, such as growing regionals, to provide the next step in equipment required by their increasing traffic.

Unfortunately, although the airlines agree that in the 1985-2000 period most of the B-727-100/200, B-737-200, and DC-9-30/50 series need replacing, only three major airlines -- Delta, United, and Northwest -- were optimistic about financing purchases when such replacement aircraft become available. Among the non-trunks, the profitability of Frontier, Piedmont, and SWA indicates that should they choose to reorient their equipment purchases to a new-technology, 150-passenger plane, they would be able to secure financing.

Delta, pursuing its long established policy of continually modernizing its fleet sent specifications to manufacturers, for an economical new-technology aircraft tailored to its needs on its "bread and butter" short-haul routes. Such an aircraft would give Delta a competitive advantage over airlines forced to fly high-cost obsolescent equipment. United followed with specifications for a more flexible longer-haul aircraft -- specifications which other carriers seem to prefer. Engineers

now are at work consolidating the two sets of specifications into one aircraft. When the airframe and engine designs meet the requirements of Delta and United, the problem for most managements will be financing purchases.

8.3 Prospects for a 130-Passenger Jet

Although it is almost certain that the next transport jet will be one of 150-passenger capacity, until recently there was reason to believe that a 130-passenger transport might be built in lieu of, or in addition to, the 150-passenger size. Some airline planners argued that strong growth of the regional airlines required something larger than the B-737 and DC-9-10/15/30 series -- something about the size of the B-727-200 but with greater economy and less noise. When placed in a single-class configuration, such an airplane would accommodate as many as 160. These planners also felt that the additional competition brought about by deregulation made it necessary to hold the size down in order to provide the frequency of service desired by the airline to attract customers.

A point made by a senior official of a large trunk was that even if a 150-passenger plane were desired, airlines should ask for a 130-passenger transport. History showed, he said, that every plane introduced had grown substantially from its original design objective. Therefore, to obtain an efficient 150-passenger plane, it was necessary to start at 130. The last time the executive heard an airframe designer begin a talk about a 150-passenger plane, within the hour the designer had begun to discuss how the plane could easily and better be built to

carry 170. Although the foregoing might sound "tongue-in-cheek," other airline executives somewhat ruefully agreed that there was a real danger that a design originally aimed at a 150-passenger aircraft might end up at a larger figure.

Airbus Industrie, which already had carved a niche for itself -- particularly in Europe -- in the wide-body market with its A-300 series, decided to attempt a greater penetration of the U.S. market by announcing in May 1981 an A-320-100 with 135 mixed class or 154 coach class passengers, and a longer A-320-200 with 156 mixed class and 172 passengers in an all-coach version. When Airbus discovered that the longer plane, which was aimed at the United and Delta specifications, did not come as close to the specifications as planes designed by competitors, it abandoned the two fuselage concept with the wider variation in seating capacities to hone directly in on a 150-passenger, mixed-class, with 12 first class and 138 coach passengers. If configured for all coach the capacity became 162 (32" pitch). Two models, however, were still envisaged: one for Delta without a center section tank and another with a center-section tank for United. Since no one else is designing a new-technology, 130-passenger plane the closest planes to that size will be the DC-9-80 and B-737-300, both derivative aircraft. Should airline financial difficulties continue and should engine manufacturers not be able to commit the estimated one to two billion dollars necessary to develop a high-bypass engine tailored to the 150-passenger plane, such a plane may not be built thus giving new life to derivative aircraft. As of December 1981 the prospects for a new 130-passenger transport have all but vanished.

8.4 Management and Re-engining the B-727

If airlines cannot afford the high capital cost of purchasing a new-technology plane to replace the aging, fuel-thirsty B-727 and DC-9 series, or if aircraft manufacturers cannot finance building the replacements, what then? Managements believe there are three alternatives:

(1) re-engine the B-727 with two high-bypass engines which not only will meet Stage 3 noise requirements but will provide substantial fuel economy, (2) phase out the airplanes and operate with a reduced fleet, or (3) continue to operate aircraft hoping that moderating fuel price escalation and higher fares will permit profitable operation. Option three also involves obtaining some relaxation of noise regulations.

Of the alternatives, managements considered number three the least likely. Given the pressure for low fares under deregulation, given managements' perceptions that fuel prices are likely to continue to rise, and given public resistance to lifting noise regulations, the continued operation of these planes was considered unlikely. American Airlines has a large fleet of B-727s which are becoming uneconomic and in need of replacement. Since the company cannot afford replacement with new aircraft, it has taken the lead in advocating re-engining those B-727s with the structure capable of modification. American has investigated with Boeing the practicality of the conversion and believes that about 800 airline B-727s are candidates for re-engining which would result in a 26 percent saving in fuel burn per seat mile, and perhaps an extension of the plane's useful life by 15 years. For reasons of economy, American's motto has been to keep the modification as simple as

possible, which means keeping the same capacity and a minimum of cockpit and system changes.

The likelihood at present that the plane will be re-engined is, in the eyes of most airline managements, small. Among other problems, the plan advocated by American requires adding several thousand pounds of ballast in the nose of the airplane to counterbalance the heavy weight in the tail caused by the substitution of two new, larger engines. A number of managements rebel at the thought of carrying this unproductive weight around when a "plug" could be added in the fuselage which would eliminate the need for the weight and at the same time increase the seating capacity. The expense, however, would be considerable. Moreover, the increased seating would place the plane in competition with Boeing's 757 -- a factor not pleasing to Boeing, particularly when it stands to gain little financially in the re-engining in comparison with an engine manufacturer.

Interviews revealed little support for American's re-engining plan. Delta and United, occupied with their new-technology specifications have no interest. Northwest indicated that it could afford to sit back for several years before deciding which option is best for it. TWA doubted the desirability of the modification and said it could not afford a modification even if it were practical. Eastern expressed an interest providing the total investment would involve two B-727s for the price of one new-technology plane. Continental, busy with takeover and financial problems, clearly was in no position to show interest. Piedmont considered itself to be an interim B-727 operator and hence re-engining was

not being considered. Finally, USAir was not following the re-engine project closely.

Perceptions of commuter managements about their aircraft needs are more appropriately discussed in Chapter 9 which deals with turboprops and prop-fans.

Summary: Twin- and three-engine narrow-body aircraft for short- to medium-haul service were introduced into U.S. service in the early 1960s. Some DC-9s, B-727s and B-737s are still being manufactured. Although over the years these aircraft have been stretched and improved, increasing fuel prices, advancing technology, noise regulations, and inflation indicate their growing obsolescence.

Beginning in 1970 application of high-bypass engines to large-capacity wide-body aircraft resulted in both fuel-efficiency and lower noise levels for aircraft so equipped. Overly optimistic predictions of traffic growth resulted in a slow progressive reduction in aircraft size for application of high-bypass technology. An increase of fuel price from ten cents a gallon to over a dollar caused the percentage of fuel cost to direct operating cost to rise to 50 percent, driving the early pure jet DC-8s and even fan jet B-707 from regular service. The same increase in fuel price is rendering all but the most recent model DC-9s and high-density configured B-727s uneconomic at present fare levels. Moreover, these aircraft do not have the most modern instrumentation and avionics.

For the last two years there has been controversy over the size and characteristics new-technology replacement aircraft should have. Financial success of the regional airlines following deregulation suggested

replacements might well include aircraft in the 120- to 130-passenger category. Orders for derivative aircraft, i.e., the B-737-300 and the DC-9-80, and the recent decision of Airbus to drop its 130-passenger project, seems to have brought an end to the development of this size transport.

In the spring of 1981, Delta and United circulated specifications for a 150-passenger (mixed-class) plane. The specifications emphasized economy of operation over short to medium ranges. Foreign and domestic manufacturers are now striving to meet these specifications. Because of financial constraints only two or three airlines could finance new aircraft. Similarly, because a new engine will cost approximately one to two billion dollars to develop, engine manufacturers are not yet ready to move. Given present economic conditions, the 1986 target date listed for service by Delta and United is unrealistic.

An alternative to the high capital cost of a new-technology aircraft has been suggested by American Airlines in the form of re-engining the B-727-200. While investigation has determined that the re-engining is technically feasible, other carriers do not share American's enthusiasm for the modification. A new-technology aircraft is preferred by all.

Since many of the current transport aircraft do not meet the new Stage 3 noise rules, although they met government noise rules when introduced, it may be in the public interest to assist engine manufacturers with research funding to accelerate a new engine timetable so that a forced reduction in U.S. air transport service does not take place with the mandatory phasing out of noisy aircraft.

Chapter 9

FUTURE FOR TURBOPROPS AND PROP-FAN TRANSPORTS: AIRLINE MANAGEMENT VIEW

9.1 Early U.S. Turboprop Experience -- Large Airlines

Turbopropeller (turboprop) transport aircraft were introduced into U.S. scheduled airline service by Capital Airlines in 1955 with the 48-passenger English-made Viscount. Featuring greater speed (about 300 mph), less vibration, and lower noise levels than competing aircraft, it initially met with success in attracting passengers. Early in 1958 Continental began flying a later model Viscount carrying 15 additional passengers. Finally, for about three years Northeast Airlines in the early 1960s operated Viscounts. Despite their smoothness, speed and reliability, such factors as reluctance to buy abroad, some accidents, and the unexpected success of turbojets, resulted in short life for this aircraft, and by 1970 they had been phased out.

In the initial stages of design it was anticipated that turbojets would be economical only on long, nonstop routes. Moreover, runway requirements for the early jets exceeded the lengths available at many high-density airports such as La Guardia and Chicago (Midway). American Airlines, followed by Eastern, sought a short- to medium-haul turboprop for markets which the jets could not serve. The result was the Lockheed L-188, Electra, a 400 mph, 66- to 86-passenger turboprop with good economics and excellent performance.

At the peak of L-188 popularity in 1962, there were 122 L-188s in service on six domestic carriers. The Electra's four-bladed "paddle props" geared to a constant speed turbine engine permitted takeoffs from

runways covered with snow to a depth which grounded pure jets. Similarly, reversing the propellers on landing provided for much shorter stopping distances than did the thrust reversers on pure jets. With a significantly lower fuel consumption than jets, fueling of the L-188 could be more infrequent and holding in ATC stacks rarely included a time constraint. On short hauls it was believed that the time differential between turboprops and turbojets would be insignificant.

Nevertheless, there were undesirable technical problems. Among them: gearbox difficulties, the complexity of the pitch changing mechanism as well as problems associated with maintaining the integrity of the reversing and full feathering systems. Additionally, there were the difficulties and expense of keeping the propellers in "phase-sync" so that the passengers would not be annoyed by propeller "beat." The down time when propellers had to be changed and the expense of propeller and gearbox maintenance were considered unsatisfactory. Several accidents resulting from a design defect cause some loss of confidence in the aircraft. Finally, those passengers seated in the plane of propellers were subject to unsatisfactory noise and vibration.

The turboprop era, which was to resurface in modest proportions in the case of local service airlines and more robustly in the case of commuter airlines, never reached full flower on the trunk lines. It was not so much the problems listed above that brought about a cessation of orders, but the wide acceptance of jet travel and rapid development of short- to medium-haul jet transports -- such as the DC-9 and B-727 -- which combined greater speed and significant improvements in cabin noise and vibration with the magic attached to the name "jet." With jet fuel

at only ten cents a gallon, the lower maintenance costs experienced with jet engines and the deletion of gearbox and the propeller costs more than overcame the expense of the greater fuel consumption of the turbojets. Although a few L-188s survived in specialized services -- such as the Eastern shuttle and some cargo operations -- and notwithstanding their appealing fuel economy in short- to medium-haul operations, recently there has been a noticeable lack of demand on the part of trunks or local service carriers for a replacement turboprop.

9.2 Local Service Airlines Turboprop Experience

The performance and cost advantages of the turboprop led to its greater acceptance by local service airlines. In 1958 and 1959 the 290 mph, 40-passenger Fokker F-27, and the 52-passenger Convair CV-540 were introduced on West Coast Airlines and Allegheny Airlines respectively. In the decade of the 60s the following aircraft made their appearance.¹⁴

Table 9-1
Turboprops of the 60s

<u>Year</u>	<u>Aircraft</u>	<u>Seating*</u>	<u>Airline</u>
1964	Convair 580	52	Frontier
1965	Nord 262	27	Lake Central
	Convair 600	40	Central
	Convair 640	56	Caribbean Atlantic
1966	Fairchild FH-227	52	Mohawk
	Nihon YS-11	52	Hawaiian
1969	DHC-6 Twin Otter	20	Los Angeles

* Seating subject to considerable variance depending on class of service, perceived availability of traffic, etc.

Source: CAB, Handbook of Airline Statistics, 1973 edition.

The Convairs were conversions from earlier piston CV-240/340/440 lines.

¹⁴ Samuel E. Eastman, "Economic Regulation of Air Services to Small Communities: Origins to the Airline Deregulation Act of 1978," TRB Meeting, January, 1981, p. 14.

Economic regulation under the Civil Aeronautics Act had a major influence in aircraft acquisitions of local service lines. It was not until 1959 that the Board decided it would subsidize a carrier with aircraft larger and more modern than a 21-seat DC-3. The federal government's loan program by 1966 had guaranteed loans for 48 aircraft worth \$38 million -- all aircraft over 36 seats.¹⁵ By 1970 there were on the aircraft roster of the local service lines 30 piston aircraft, 228 turbo-props (of which 107 were CV-580, and 75 were F-27s and F-227s) and 157 turbojets.¹⁶ Ultimately by 1977 loan guarantees covering equipment costing \$355 million were made, but they were primarily for jets. However, opportunities for expansion became limited when the Board placed a moratorium on route awards and when the Board's Bureau of Operating Rights indicated, "In general, operation of the standard 40- to 60-seat aircraft employed by local service carriers is economically justified only at points originating 40 or more passengers a day."¹⁷

Local service airlines, as soon as the moratorium was lifted, showed a strong desire to expand to longer haul routes and use jet aircraft. Since the public more readily accepted jets where jets and turboprops operated side by side, and since the objectives of management were to acquire longer haul routes which were more suitable for jets, the use of

¹⁵ George C. Eads, The Local Service Airline Experiment, Brookings Institution, 1972, p. 152.

¹⁶ Michael D. Rice, "Government Guarantees for Airline Financing," Journal of Air Law and Commerce, Vol. 6, No. 2, 1981, p. 333.

¹⁷ CAB, "Service to Small Communities, Part I, Local Service Carrier Costs and Subsidy Need Requirements to Serve Marginal Points," March 1972, p. V.

turboprops tapered off. When deregulation moved from proposal to de facto status and on to be the law of the land, expansion plans of the local service lines did not involve the acquisition and promotion of turboprop service. By 1981 only a few scattered turboprops were in use on local service (national) carriers, and they were in the process of being phased out. Interest in current type turboprop aircraft has, since deregulation, centered on 19-, 30-, 40-, and 50-passenger planes for the expanding commuter market.¹⁸

9.3 The Prop-Fan

Because of turboprop fuel economies, a resurgence of airline interest in this type of aircraft might be anticipated, particularly if the latest engineering improvements were incorporated to further reduce fuel consumption and minimize the disadvantages previously enumerated. Accordingly, one task of this study was to ask each airline surveyed concerning its interest in operating turboprop aircraft in the 1985-2000 period. The questioning was also to include the type of interest, if any, the carrier had in a new advanced technology turboprop which has been differentiated in terminology with the name "prop-fan."

One significant difference between existing turboprops and jets is the the former, operating around .6 or .7 Mach, is several hundred miles per hour slower than the latter. As stage lengths become longer, the time differential increases -- a characteristic which, American Airlines

¹⁸ In a step which will for a long time perpetuate the confusion caused by the CAB's changing airline classification from trunks, local service, and commuters to majors, nationals, large regionals, and small regionals the Commuter Airline Association of America in November 1981 abolished the name "commuter" and replaced it with the name "regional." Thus former commuters are now referred to as regionals.

discovered to its regret, rendered the Electra at a competitive disadvantage as soon as jets capable of flying La Guardia to Chicago (726 miles) were introduced. It has been reasoned that if a turboprop could be developed which matches the speed of a turbofan aircraft, i.e. Mach .78-.83 and still retain its fuel economy characteristics, not only would the industry be saved hundreds of millions of dollars on fuel costs with their inevitable impact on fares and traffic, but also the country would be benefitted by reduced usage of the scarce energy resource, oil. Proponents of the prop-fan quantify their views by forecasting, presuming introduction in 1990, a market for 4,000 planes and a saving of six billion gallons of fuel in ten years.¹⁹

Essentially the prop-fan would replace the fan of a high-technology turbo-fan with a multibladed propeller (perhaps 8 or 10 blades) featuring advanced swept-back blades having many times more thrust than older propellers of the same size. Preliminary research suggests that prop-fan speeds approaching Mach .80 are possible. Such speeds would narrow or eliminate the time differential between turboprops and jets and thus stretch the economic usefulness from short-haul operations to much longer segments. For several years NASA has been working on advanced prop-fan technology but on a smaller scale than necessary for early adoption. An engine technology program as well as airframe program and much acoustical work is needed if this type of efficient propulsion is to replace low-bypass, old-technology powerplants. Present

¹⁹ Testimony of R.L. Foss, chief engineer, Lockheed California Company, before House Committee on Science and Technology, Feb. 26, 1981. In the same hearing United Technologies estimated a 2,000 plane market in the 80- to 180-passenger category.

thinking is that the propfan would be 60 percent more fuel-efficient than present low-bypass engines and 15 to 20 percent more efficient than the most efficient high-bypass turbofan powerplant.

The following section lists the current degree of management interest in turboprops and prop-fans.

9.4 Larger Carriers' Views on the Turboprop and Prop-Fan

American. As previously indicated, American is fully occupied with significantly changing its route structure, in reorganizing to reduce costs -- including the elimination of B-707 service and a cutback in wide-body operations -- in order to afford the acquisition of new-technology aircraft, or at least a re-engining of its B-727 fleet. Pre-occupied as the company is with serious nearer term problems, it is not surprising that its turboprop and prop-fan interest is limited to watching developments from the side lines and "scoping" those focusing on short-haul aircraft which may be defined as aircraft optimized for 300 to 500 mile segments. American also joins other carriers in urging Congress to provide funds for further research including building an eight to ten foot propeller, which is considerable longer than the earlier two-foot experimental model.

It appears that until American's financial position is strengthened, and until research on the prop-fan has more definitive answers, the company does not really know what its future posture will be. This much, however, is reasonably clear. First, the company is only interested in the prop-fan version of the turboprop and that only if the speed is Mach .76 or higher. Secondly, the long range planners in the company are more

enthusiastic than are the operating departments. The latter recall only too well the propeller and gearbox technical and cost problems associated with the Electra. Further, they are not sanguine that these difficulties can be solved in a matter satisfactory to them. Finally, since American has repeatedly emphasized speed -- witness the DC-7 and the Convair 990 purchases -- it is not surprising that even if there were some cost advantage in a trade-off of speed for fuel economy, the company feels it must be competitive in flight times. Therefore, unless the bottom line is satisfactory at speeds of Mach .76 to .80, a prop-fan would not be purchased.

Some elements in American see a medium-capacity (no larger than 150 passengers) short-haul prop-fan with low airplane-mile costs as well as low seat mile costs as a way to compete with low-cost, new-entry operators on the presumption that the latter will be forced to use less efficient equipment.

TWA. This major company indicated that the prop-fan of the size it would be interested in, i.e. 150 passengers, is so far in the future that it is not worth considering in the present planning cycle. If cabin noise and vibration can be decreased to acceptable levels, and if lower fares can be justified, TWA felt public acceptance will be forthcoming. Since the public is very sensitive to speed differences and since to the general public turboprops would appear to be a step backward, for a major airline there could be no trade-offs of speed for fuel economy. Finally, TWA planners believed that the first new prop-fan would be in the 75- to 100-passenger category, a size too small for the company.

United. While in some companies operations, engineering, and planning departments spoke with somewhat different voices, this was not true at United where the chairman and CEO, the senior V.P. of corporate planning, and the V.P. of engineering were in complete agreement. Simply stated, they were enthusiastic about the need and prospects for a Mach .80 prop-fan with 30 percent greater fuel efficiency than the best current high-bypass turbofan. More than any other carrier, United emphasized that prop-fan speed must be competitive with that of turbofans. Not only would the company not trade speed for lower fuel consumption, but on the contrary would under certain circumstances consider a reverse trade-off of fuel economy for more speed.

As to the size of the prop-fan aircraft, the consensus at United was that the first such transport aircraft would probably be smaller than the yet undefined size desired by United. However, United's engineers did not see the same technical difficulties associated with the gearbox, propellers, acoustics, and vibration as did representatives in other carriers. Modern engineering and new technology were capable of handling the problems. Having analyzed the results of a passenger survey taken two years ago, the company is satisfied that the public will accept reverting to turboprop operation "if the price is right." Therefore, United has been in the forefront of those urging NASA to build a larger size working model of a prop-fan than it has in the past. At the present time, many of the reservations about the turboprop and its derivative prop-fan which were expressed by other major airlines are heavily discounted by United.

Northwest. As pointed out in Chapter 2, Northwest, with a strong financial position and a relatively modern fleet, can increase capacity inexpensively by adding more seats to its "roomy" planes and by increasing its low rate of aircraft utilization and, therefore, is not in a hurry to re-equip. Nevertheless, it sees the need to replace its B-727 fleet before a suitable prop-fan is available. While the company has no "mindset" against turboprops or prop-fans -- indeed, it recalls with nostalgia the performance of the Electra in rain, sleet, and snow -- NWA realistically believes that the B-727 will by 1987 be replaced by a 150-passenger turbofan and then perhaps ten years later, with a similar or slightly larger capacity turboprop or prop-fan.

Northwest usually begins to replace a given model aircraft while the plane still is in demand and while it still commands a good price. In the past Northwest has been successful in so doing and then has used the proceeds for newer equipment. The company, however, recognizes that rapidly rising capital costs make it more difficult to pay off the new greater investment. Additional interest and depreciation charges may well offset savings in direct operating costs. Thus, the company points out, the pay-off of the very significant savings on fuel with a turboprop or prop-fan when fuel prices are assumed to be, say, five dollars a gallon may be much less attractive should such fuel prices fail to materialize.

Northwest has never led the way in the design phase of new equipment. Thus it will not put its financial resources into pushing a new-technology turboprop. However, depending on how it assesses "the bottom

line" when such an aircraft is available, it will not stand back because of previous turboprop experience.

Delta. Although Delta is among the companies urging Congress to appropriate the necessary funds for NASA and others to complete research which would lead to a prop-fan aircraft, its long-range plans do not envisage use by Delta of that technology before the year 2000 if then. Presently the company's engineers believe that a 150-passenger prop-fan would be the smallest size it would consider because by the time such a plane is available 150-passenger capacity will be the smallest size practical for Delta's fleet. On the other hand, other voices suggested that because of the pressure from smaller carriers operating over less dense, short-haul routes the 75-passenger version would be the first produced and this would not be of interest.

As noted earlier, Delta's policy is to keep a relatively young and fuel-efficient fleet by continuously phasing in the highest technology equipment available. Its 1979 and 1980 purchases of the B-767 and B-757 extended high-bypass technology to aircraft in the 178- 220-passenger category. Delta's current attention is on obtaining a builder for its "Delta-3" 150-passenger aircraft for which only turbofan engines will be available by the company's late 1986 or early 1987 deadline date. Such a 100-plane fleet is estimated to cost \$50 billion by delivery time. Since Delta's total assets were \$2.8 billion and revenues \$3.5 billion in fiscal 1981, the magnitude of future financing may present a problem.

There are many outside of the Delta family who, because of the chaotic financial position of the carriers (Delta excepted) and the financial constraints faced by airframe and engine manufacturers, doubt that

a new 150-passenger turboprop meeting Delta's and United's specifications will be built. Should this be the case renewed attention will be given to a turboprop or prop-fan in this category. Delta's preoccupation with the turboprop version of its 150-passenger proposal and its consequent lack of detailed study of the prop-fan resulted in no answer to the question of trade-offs of speed for fuel economy.

Eastern. Because of the company's pressing current equipment replacement problems -- mainly its large quantity of narrow-bodies and lack of financing ability -- Eastern is not actively interested in turboprops. However, it does follow turboprop/prop-fan research and believes that accelerated government funding by NASA and others can bring an economical plane into being. In this connection some in Eastern think that, given a little time, those pursuing the Delta specifications of optimization of costs at 400 miles will find a prop-fan solution more economical than a turboprop. However, if Mach .80 or higher and additional range is required, then only a turboprop will provide the answer. In any event, where competition is concerned, speed is considered so important that Eastern would not trade speed for additional fuel economy.

Western. Because of more pressing equipment and restructuring matters, the turboprop/turboprop alternative to turboprops has not been thoroughly addressed by Western. However, the following comments were made in answer to questions. Increasing congestion at Los Angeles Airport has inhibited the company's ability to provide the desired frequency of service to Las Vegas. Therefore, Western could be interested in a large capacity turboprop to provide low-cost service in an aircraft equipped with high-density seating. For this type of service, speed

would not be at a premium so a trade-off of speed for fuel economy would be acceptable.

In general, the company thought improved turboprops would have a market among commuters rather than larger airlines, and since the company was not a commuter, it did not wish to suggest sizes appropriate for turboprop or propfan aircraft for this category of carrier.

Continental. Public acceptance of turboprops, according to Continental, would not be a problem. Subject to financing ability, it would be interested in a turboprop provided speed was in the range of Mach .78 to .82. Since competition under deregulation rendered wide-bodies less desirable than narrow-bodies, the plane of interest to Continental would be in the 130- to 170-passenger range. As for trade-offs of speed for fuel efficiency, trades down to .78 Mach would be of interest if necessary to reach a target rate of return on investment. However, being competitive with other carriers would still be the controlling factor.

USAir. Previous experience with the complexity and high maintenance costs of turboprop aircraft caused USAir to indicate no interest in acquiring turboprop or prop-fan aircraft. Its recent decision to purchase B-737-200s and 300s in the 120- to 130-passenger capacity range has given breathing room before new equipment is necessary. Nevertheless, recognizing the need for something smaller to replace aircraft of the size of a DC-9, USAir felt that if a new-technology turboprop were built it should be in the area of 100-passenger capacity.

Republic. Like USAir, Republic had a strong aversion to turboprops. The company view was that "Things would have to get awfully desperate before we would consider going back to turboprops." Republic believed

that the public would not accept turboprops on anything but very short-haul routes. Doubt was expressed that any major carrier would be interested in a propeller-driven airplane. If there were any market for turboprops among the regionals it would be, according to Republic, for a 75-passenger plane.

Frontier. While not showing great excitement over a new turboprop or prop-fan, Frontier did exhibit some interest in a short-haul turboprop with a capacity of 75 to 100 passengers. Believing that turboprops were of maximum usefulness on trips of less than 500 miles and should be competitive with automobile travel, Frontier reasoned that low cost should receive the greatest attention and, therefore, felt that trade-offs of speed for fuel economy would be warranted if the trade-off resulted in a measurable difference in fares. If the fare differential between the turboprop and turbopropfan were significant, a turboprop could be 10 to 15 minutes slower without suffering a diminution in passenger acceptance.

Piedmont. As a result of its recent experience with the Nihon YS-11, which has just been phased out, Piedmont has more definite ideas about the future use of turboprops and their derivatives than many of the preceding companies. Noting its passengers lack of enthusiasm for the YS-11 by reason of its slow speed, cabin noise, and lack of comfortable ride because of altitude limitations, Piedmont would not purchase another turboprop unless these deficiencies are corrected.

As to the size and speed, a 100- to 130-passenger plane capable of handling short-haul segments in block times within 10 minutes of existing jets, and at a much lower cost, would interest the company. Since the

YS-11 suffered from lack of speed, it is not surprising that the company viewed negatively a trade-off of speed for fuel economy.

9.5 Turboprops and Prop-Fans as Viewed by Medium Size Carriers

AirCal. This company, which began operations with turboprop Electras, progressed to jet aircraft and has increased its stage lengths. AirCal is glad to be out of turboprops and has no further interest in them. Because of this lack of interest, AirCal provided no response to the question of the future size for turboprops.

Air Florida. In its meteoric growth Air Florida has left turboprops -- earlier it operated Lockheed L-188 Electras on short-haul intrastate routes -- for the turbofan fleet mentioned in Chapter 4. Currently a commuter airline affiliate operates 28-passenger CASA turboprops. As short-haul traffic grows, Air Florida sees the need for new 60-passenger turboprop aircraft for the commuter industry and the same size airplane for cargo work to feed larger carriers. But for its own operations Air Florida does not see the use of turboprops or prop-fans.

The opportunistic management of Air Florida has been mentioned in Chapter 4. Thus, although the company states it has no interest in turboprop technology, should a turboprop with favorable economics and passenger appeal become available at a price to give a satisfactory return investment, one can be sure that Air Florida would negotiate for such equipment.

Air New England. During the drafting of this report Air New England, because of financial problems, ceased operations. Therefore, its views on turboprops are not relevant.

Southwest (SWA). Southwest, probably because it has been so successful with a single plane fleet -- the B-737 -- initially evinced little interest in a propeller aircraft. The company, however, did see a major niche for a 50-passenger pressurized turboprop in the commuter market. In fact, Southwest saw the possibility to "grow down" to the smaller cities with this type of aircraft.

Southwest did not see public acceptance of a turboprop as a problem, particularly if lower fares were possible. For the 1990-2000 period, when it expected to be involved in a re-equipment program, a 160-passenger pressurized prop-fan would be of interest. There was, however, one caveat: the plane must be able to fly from Dallas to Houston and not be more than 15 minutes slower than a competing turbofan aircraft.

Pacific Southwest (PSA). At one time in the early 1960s PSA successfully operated a turboprop fleet of L-188s until forced into jets when United and Western blanketed the Los Angeles-coastal cities routes with much faster B-727 and B-720 schedules. Additionally, because of the lack of efficient turboprop aircraft for its shorter-haul routes, PSA has been dropping these short segments and expanding to longer routes in the Pacific Northwest. Stating that "The short range efficient commuter aircraft has not been invented yet," and "Neither the right aircraft design or engine are here yet," the company suggested that it would take a new-technology turboprop or prop-fan to cause it to reassess its decision to leave the short-haul market. A hub-and spoke feed system might then be practical.

A turboprop or prop-fan of interest to PSA would be 100 to 125 in passenger capacity and have extremely low fuel consumption. As for

trading speed for fuel economy, the company felt this would be dependent upon length of haul. Since short-haul service is less sensitive to speed differences, PSA would be willing to sacrifice speed for lower fuel burn on this type of operation.

Actually, PSA has no real interest in turboprops. For one thing, it believes them to be "pretty far downstream." Secondly, the company's interest for the 1985-2000 period is in maximizing its use of a large fleet of DC-9-80s with an eye to the acquisition of high-density B-757s. It places low priority on the type of routes it believes are appropriate for turboprops and has not really considered prop-fans.

Midway Airlines (MDW). Less than two years old and fully occupied with organizational and growth problems, Midway is thus far committed to jets and is not positioned for turboprops or propfans. However, should such aircraft become available, Midway's interest would be in the 100, 125, or 150 capacity size, with a preference for 125 if only one size were to be built. As was the case with other airlines interviewed, Midway felt that a turboprop or prop-fan with significantly lower operating costs would be competitive providing its block times were within 10 to 15 minutes of those of conventional jets.

Flying Tigers (FT) and Federal Express (FE). The companies, both cargo carriers, have similar views on the merits of propeller-driven aircraft for portions of their business and therefore, will be treated together. Both believe that current technology turboprops -- which operate at about .62 Mach -- are much too slow for their purposes. Accordingly, confirming his February 1981 congressional testimony,

Federal Express' senior vice president of operations planning said, "A prop-fan is exactly what this company needs."

While both companies saw applications for aircraft of varying capacities, each carrier focused on a 40 to 50 thousand pound payload aircraft with primary cost efficiency in the 500 to 800 mile range. The maximum range desired was 1,500 to 2,000 miles. Because of Federal's need for replacing its small Falcons with a greater capacity plane, Federal would also look seriously at a prop-fan with a 10 to 15 thousand pound capacity.

Curiously, although the main advantage stressed by passenger airlines for the prop-fans was its fuel economy, both cargo carriers downplayed this aspect when they discussed trading off speed for fuel economy. The quote from Flying Tigers executive vice president, "We would not want to invest capital for fuel savings," represents the view of both companies. They explained that unless their low utilization was doubled it would not be economical to slow the aircraft to save fuel. To the contrary, both carriers agreed that they might trade some fuel efficiency for more speed under certain conditions.

In brief, Flying Tigers and Federal Express indicated a strong desire for prop-fan aircraft primarily in the 40 to 50 thousand pound payload category. The prop-fan's short field performance in comparison with turbofans and its predicted economics were the main attractions. The lower flight altitude of operation was not a concern for cargo operation. Neither company thought that the problems of reliability and maintenance expense which plagued earlier large turboprops would be repeated with the prop-fan.

9.6 The Commuters View of Turboprops and Prop-Fans

The limited number of commuters surveyed -- four including Air Wisconsin -- provides little more than an inkling of the attitude of the approximately 250 commuters toward current and prospective turboprops. Supplementary information, however, was obtained from discussions at the fall membership meeting of the Commuter Airline Association of America in November 1981.

As commuters grow there is continuing evidence of a desire on the part of some to turn to jets. AirCal, Air Florida, and PSA were once considered commuters but have moved on. Air Wisconsin's growing business has provided the company with the incentive to purchase 100-passenger BAe 146 jets and drop some of its short-haul cities. Altair and Empire have recently joined the list of commuters purchasing jets. And Golden West predicts the need for a twin-engine 100-passenger jet in four years. Nevertheless, the greatest number of commuter aircraft are turboprops.

Despite the fact that there are many more makes of commuter aircraft offered for sale than is the case for large transports, many managements feel that aircraft offered to commuter airlines for near-term delivery do not provide the comfort or efficiency needed. The constraining effects of the early CAB size rules have not worn off. Those looking for efficient aircraft, particularly in the 30- to 40-passenger category say they do not have much from which to choose.

Golden West, Air Wisconsin, and Britt highlighted the need for a more efficient 30- to 40-passenger turboprop.²⁰ All seem to feel that aircraft capable of flight times of one hour for flights of 200 to 250 miles would be ideal.

Air Wisconsin. Although the company has recently sold some of its Swearingen Metroliner turboprops and ordered for 1984 delivery the BAE-146 jet, this does not presage a wholesale shift to jets. Actually the 16-passenger Metroliners became too small and without a suitable 30- to 40-passenger turboprop replacement available the company is substituting additional 50-passenger DeHavilland Dash-7s. After having examined 30- to 40-passenger turboprops which are likely to be available by 1985, Air Wisconsin believes that, in general, they lack either the economics or the baggage capacity the airline needs. Currently the company appears to favor the DeHavilland Dash-8 on which it has options. Its objective is a 350 mph 36-passenger plane for use on 150 to 200 mile route segments. Thus it would like more speed than the Dash-8 provides. Although the company believes that jet speed is not needed on short-haul routes, speed in current technology turboprops is sufficiently important that, economics permitting, Air Wisconsin would trade some fuel economy for additional speed. The company did not express an opinion on the desirability of the prop-fan.

Golden West. Although the company sees a bright future for the 48-seat Dash-7, its plans also involve a 30- to 40-passenger plane for

²⁰ Air Wisconsin does have options on the DeHavilland Dash-8, 36-passenger turboprop equipped with the new PW 120 engine. However, it is not clear that these options will be exercised if something more to its liking comes along.

200-mile segments as well as a 100-passenger jet or prop-fan for 400-mile route segments. A turboprop plane with better economics would be desirable for frequent service if it were not more than 5 to 10 minutes slower than a jet. Finally, since the company considered fuel to be a driving force on costs, it would be willing to trade speed for fuel economy down to the 5 to 10 minute time differential.

Britt. In large companies planners are not necessarily engineers or operations or finance people. Thus it sometimes is not clear who has the dominant voice and precisely what equipment is wanted. Such is not the case in a closely held small company like Britt Airways which has been guided from its inception by its current president, William Britt, who was most candid in articulating Britt Airways' equipment views.

From the company's perspective all the turboprop aircraft recently offered for quick delivery represent old technology and thus less than desirable economics. Some aircraft have large struts and other appendages which accumulate ice as well as a physical appearance which makes one wonder if they could fly. Britt would like two classes of fuel efficient turboprops -- the company does not need jets for its short-haul routes, many of which are 100 to 150 miles in length. These two types are a 19- and a 30- to 40-passenger plane respectively. Other specifications included 300 mph cruise speed, 100 knot approach speed, and the capability of operating from 5,000 foot runways.

Fuel consumption is extremely important to Britt Airways and thus it desires fuel consumption of 100 to 120 gallons per hour for its 30- to 40-passenger craft. This results in still air cruising seat miles per gallon of over 100. Britt's fuel consumption objective for a 19-seat

aircraft is less than 90 gallons per hour. Of the new planes available for the 1985-2000 period, the Beach 1900 in the 19-passenger category, and the Fairchild SAAB 340 in the 30- to 40-passenger category, appear to be of the most interest to Britt.

Britt Airways definitely has no interest in jet aircraft, believing them to be inappropriate for such short-haul operations. Looking to the future the company finds two deterrents to the acquisition of a prop-fan. First, the additional speed is not thought necessary for short stage lengths. Second, the cost of developing and manufacturing this high-technology plane will be so great that neither Britt or other small carriers will be able to afford it. Britt points out that they can acquire used 48-passenger FH-227s for about \$1,000,000 or \$21,000 per seat, compared with about \$6,000,000 or about \$120,000 per seat, for a new Fokker F-27. Britt does not see that the additional efficiency pays off the cost. He shudders at the thought of the price of a prop-fan.

Midstate. Like Britt, Midstate plans to stay with turboprop aircraft and avoid jets. This recently reorganized airline has not projected the need for aircraft other than the Metro III for several years to come, but perceives its next step will be a 30- to 40-passenger aircraft. When the new management undertakes long range planning for more than five years in advance, it will then review the advantages and disadvantages of the propfan.

9.7 Summary

Among the large old-line carriers only Western, with an allusion to a possible 150-passenger plane for short-haul Los Angeles-Las Vegas, and

Frontier, with a suggestion for a 70- to 100-passenger economical turbo-prop for its short-haul operations, expressed any interest in conventional turboprops. Of the eleven large carriers, only United Airlines viewed the development of a prop-fan with great enthusiasm. Management was concerned that when such a transport was built it would be smaller than the 150-passenger capacity United would wish. All carriers in this group, except Frontier, agreed on two points. First, if an economical prop-fan were built, it should be 150 passengers in capacity. And secondly, if lower fares could be justified, the aircraft would not have to match jet speeds. Block times of 10 to 15 minutes longer than jets would still attract passengers.

Views of the medium size carriers can be summarized as follows: Of the six -- AirCal, SWA, PSA, MDW, FT, and FE -- none opted for current technology turboprops. Flying Tiger and Federal Express expressed strong interest for a 40 to 50 thousand pound payload prop-fan aircraft but made it clear that they would prefer to trade fuel economy for speed -- just the reverse of most passenger carriers. All these companies agreed that an economical prop-fan did not have to be as fast as a jet. Surprisingly, each carrier, without prior knowledge of what others had said, volunteered that passengers would not object to a 10 to 15 minute schedule differential if the fare were significantly cheaper.

Four commuter lines were in close agreement on the following three points. First, their type of very short-haul operations did not need a prop-fan. Second, a faster, pressurized, more economical 30- to 40-passenger turboprop than those presently in service was needed. Several

aircraft not yet certificated were, however, being seriously considered. Finally significant improvements were desired for the 19-passenger offerings.

All expressed concern that the rapidly escalating cost per seat, when coupled with their current and projected financial condition, might preclude financing new-technology aircraft when they became available.

Chapter 10

FOREIGN TRANSPORT AIRCRAFT: MANAGEMENT ASSESSMENT AND INTEREST

10.1 Background

Following World War II, the United States became the acknowledged world-wide leader in the production of transport aircraft -- a leadership which continued during the first two decades of jet production. During the recession of the early and mid 70s thousands of U.S. aircraft engineers and production workers became unemployed. The recession made it painfully clear that purchases of high-capacity, wide-body B-747s, DC-10s, and L-1011s had been made in advance of the traffic growth necessary to sustain them. Many were grounded. In Europe, particularly France, Germany, and England, a concerted effort was initiated to develop efficient transports slightly smaller than the large wide-bodies. The first successful result was the Airbus 300 series with U.S. engines.

In Europe and elsewhere Airbus began to carve out a significant portion of the wide-body market which in one year reached 38 percent. In the U.S. it was alleged that many of these foreign sales were made because of government subsidized financing and this was unfair competition. Early in 1978 when Eastern announced a \$778 million order for the Airbus (albeit with American General Electric engines), and Pan American a \$480 million order for Lockheed L-1011-500 aircraft with Rolls Royce engines, Congress was asked to look into the matter. American manufacturers and American labor unions objected that foreign subsidies to aircraft manufacturers, if allowed to continue, could deepen unemployment,

cause the loss of our technical skills, harm our national defense, and worsen our balance of payments problem.

No conclusion came from Congress on the validity of the allegations, but subsidized transport aircraft financing by foreign banks through their governments as well as our response through the Eximbank has continued to be a concern not only to manufacturers but to foreign governments and the U.S. government as well. Governments of aircraft producing countries are becoming resistive over deploying resources from taxpayers to subsidize aircraft purchases.

10.2 The Changing "Foreign Aircraft" Picture

As traffic improved in 1978, domestic aircraft sales increased dramatically. Although Airbus and Rolls Royce received additional orders outside the U.S., further U.S. orders did not materialize. This being the case, proposed legislation carrying "Buy American" provisions was not enacted. There are other reasons why the "Buy American" movement subsided: (1) the fear of retaliation by other countries, and (2) the difficulty of deciding when a plane is foreign. The Airbus has been reported to be 30 to 45 percent American. Conversely, American planes now have many foreign components. The Department of Commerce estimates that the Boeing 767 is 25 to 35 percent foreign. Further, the cost of developing and manufacturing commercial transport is so high that domestic and foreign manufacturers are busy looking for foreign partners or consortia to share the risk and burden. Air transport manufacturing has become so international in scope that the "Buy U.S." argument has lost its appeal.

This study reports on the extent to which U.S. carriers themselves have a "Buy U.S." policy, the perceived quality of foreign offerings, and whether special financing inducements might sway their order to a foreign manufacturer.

10.3 Major, National and Regional Airlines (Non-Commuters)

Of 21 large and medium sized carriers interviewed, 17 stated that they had no "Buy American" policy, their sole criteria being economics. One carrier, while stating it had no "Buy American" policy, admitted to an emotional bias toward an American plane where evaluations showed the foreign and American planes to be equal in all other respects. Two carriers stated that they did have a "Buy American" policy but this stemmed not from patriotism but from their location very close to a domestic manufacturer and from their satisfaction with the product support received. The remaining carrier related that it formerly had a "Buy U.S." policy, primarily because of the fear over the quality of foreign product support. This preference no longer exists because of favorable reports from other carriers concerning plane quality and product support from abroad.

As to the quality of foreign offerings, all carriers judged it to be very high. In fact, the opinion was expressed several times that foreign electronic equipment was superior to that of the U.S. The reason was that poorer weather in Europe in crowded airspace provided greater incentive to develop more precise and reliable advanced technology equipment. The same degree of quality is being found in other components being made abroad for U.S. transports. On several occasions,

Boeing has commented on how perfectly the Japanese-made parts fit when mated to the main assembly.

When the Japanese are asked how soon they will market Japanese transports to compete in the world market, they respond that the small size of their country, their small aircraft industry, and their lack of experience preclude this from happening for many years. However, after noting the Japanese success in autos, watches, electronics, and other products, many analysts in the U.S. think that this low-key approach may lead the rest of the world into a false sense of security. Recent courting of the Japanese by American manufacturers wishing to obtain a partner in the 150-passenger transport competition, may result in giving the Japanese a greater share of control than the manufacturers originally had in mind, and may be a giant step toward a Japanese transport.

Research into whether subsidies in financing, either directly by foreign governments, or through banks or other institutions controlled by foreign governments will lead U.S. carriers to purchase foreign aircraft -- if indeed one can define what is foreign -- instead of domestic aircraft, leads to a negative response, except in one situation. If the U.S. Eximbank cannot (and of course by definition it cannot) finance a domestic aircraft at rates competitive with foreign subsidized rates, U.S. international carriers face a dilemma. Assuming a foreign and domestic plane of equal quality, a U.S. airline planning to buy the American product may be faced with competition from a foreign carrier whose costs may be lower because of subsidized financing, or it may be forced to purchase the foreign plane to remain competitive.

Although it is true that financing was the key to the Eastern Airbus acquisition at a time when many felt that Eastern was headed toward bankruptcy, and although financing was the key to Pan American's purchase of Rolls Royce engines, it appears from the interviews and from the subsequent lack of foreign orders in the U.S. that in the last three years subsidized loans have not caused U.S. airlines to purchase abroad.

The likelihood of continued foreign low interest rate loans is diminishing. Governments around the world are increasingly pressed for revenues and are closely reviewing where to allocate subsidies which are paid for by the taxpayers. Transport aircraft are not on the priority list. To avert an export credit war among commercial aircraft exporting countries by insuring that no one offers terms more favorable than those agreed to, a proposed Standstill Agreement between U.S., Germany, England, and France would fix interest rates at 12 percent -- up from previous rates of around 9 percent under Standstill. If governments must pay 15 percent or more for money, the burden on the taxpayers of the differential is substantial. Thus efforts are underway to eliminate the differential completely by transferring financing from the official export credit bank to the private sector and at that point having an asset in the private sector which could be repossessed if necessary.²¹

In any event, focusing on interest rate differentials can be misleading. Much greater financial inducements exist in the unpublished arrangements. For example, the price may include, in the case of engines, upgrading another series of engines owned by the airline, and in

²¹ For details see paper "Aircraft Financing: The International Equipment Trust," presented at ATRIF, October 28, 1981, Northwestern University Transportation Center, Evanston, IL.

the case of an airframe, certain modifications on existing planes to standardize the fleet. Offsets, such as building part of the plane in the purchasing country to relieve unemployment, or paying for part of the plane in golf carts or ham, may be implicit in the deal. Finally, in some cases purchases are announced and a year or so later it is revealed that financing has yet to be arranged. In these cases, subsidized financing is obviously not the cause of the aircraft's selection.

A general summarization of managements' stated views on the effect of low cost financing in aircraft selection is that only in the case of a tie in the evaluations would a foreign manufacturer win with a below market rate subsidized loan. Several managements then added that they had never seen a tie.

10.4 Commuter Airlines and Foreign Aircraft

The common complaint of commuter airlines is the lack of attention paid by U.S. manufacturers to their needs. Commuters point out that in some cases there are no U.S. manufacturers of the aircraft category in which they are interested. Under this situation, none can have a "Buy American" policy if it wants to. Of course, part of the reason for lack of interest has been that for years commuters were limited to 19-passenger or smaller aircraft -- sizes considered uneconomic to operate without substantial subsidies. This constraint has now been lifted and the outlook for a broader coverage of seating capacities is improved. Nevertheless, foreign manufacturers are still more active than domestic. Illustrating this point is a sample list, Table 10-1 of commuter aircraft operating in 1981.

Table 10-1

Commuter Aircraft of 15 Seats or More, 1981

<u>Aircraft Model</u>	<u>Manufacturer</u>	<u>Seating</u>	<u>Place of Manufacture</u>
C99	Beech	15	U.S.
Jetstream	Handley Page	18	U.K.
CASA 212	CASA	28	Spain
Twin Otter	DeHavilland	19	Canada
Dash 7	DeHavilland	50	Canada
Bandeirante	Embraer	18	Brazil
F-27/FH-227	Fairchild	46	U.S.
F-27/F-28	Fokker	50/85	Netherlands
262/298	Nord	27	France
330	Shorts	30	Ireland
Metro	Swearingen	19	U.S.

While commuters have a broader list of sizes from which to choose in the future, a representative sample, Table 10-2, of new aircraft either in production or for which plans are in process, indicates that foreign producers still have by far the largest number of offerings.

Table 10-2

New Commuter Aircraft Offered For Sale November, 1981

<u>Aircraft Model</u>	<u>Manufacturer</u>	<u>Seating</u>	<u>Country of Manufacture</u>
ATR 42	Aerospatale/ Aeritalia	42	France/Italy
101-B	ARAVA	18	Israel
1900	Beech	19	U.S.
748	British Aerospace	48	U.K.
146	British Aerospace	100	U.K.
CN-235	CASA	38	Spain/Indonesia
Dash 8	DeHavilland	36	Canada
228	Dornier	15	Germany
Brasilia	Embraer	30	Brazil
Gulfstream	Gulfstream American	37	U.S.
N24A	Nomad	16	Australia
340	Saab-Fairchild	34	Sweden/U.S.
360	Shorts	36	Ireland
404	Ahrens	30	Puerto Rico
CAC-100	Commuter Aircraft	50	U.S.
Metro III	Swearingen	19	U.S.

However, when the ratio of U.S. manufactured or designed powerplants to non-U.S. is calculated, the preponderance of U.S. equipment is clear. For example, the Pratt & Whitney Division of United Technologies furnishes PT6 turboprop engines for the following: Shorts 330 and 360, ARAVA, Beech C99 and 1900, Twin Otter, Bandeirante, and Swearingen Metro IIIA. Its PW100 series is offered to power the ATR 42, the Dash 8, and the Brasilia. Other U.S. manufacturers such as General Electric, Garrett, Allison, Lycoming, and Continental have engines powering commuters. Pratt & Whitney estimates that 86 percent of commercial aircraft in the world are powered by U.S. engines.

In the foreign commuter field, the largest engine supplier is Rolls Royce which powers the HS 748, the F27, the F28, and the Gulfstream series.

Commuters purchasing foreign planes have had access to export credit bank facilities abroad. A recent \$70 million purchase of the BAe-146 by Air Wisconsin will be financed by a \$45 million credit at 8 3/4 percent for a ten-year term. At present, future rates cannot be less than 12 percent under the Standstill Agreement. Air Wisconsin insists that there were no U.S. manufactured planes suitable for its operations and that, therefore, the subsidized financing did not harm the U.S. aircraft manufacturing industry.

Summary: The quality of workmanship in medium and large size foreign transports is deemed to be excellent by U.S. air carrier managements. Equally high ratings were given to the level of technology employed. In fact some perceived that in certain areas the Europeans now have a slight edge.

Except for the two cases in 1978 -- Eastern and Pan Am -- no carrier would agree that financing with below market rate subsidized interest rates would cause a company to purchase a foreign plane over a U.S. plane. That difference could not overcome the advantage of close communication in a common language, commonality with their present fleet, and particularly the advantage of the enviable reputation for product support which has been carefully nurtured by U.S. companies. Finally, the internationalization of aircraft manufacturers is rapidly reaching the point where all transports have a significant proportion of parts manufactured outside the U.S. so that the distinction between American and foreign is becoming unclear.

Air carrier assessment of U.S. versus foreign aircraft in the commuter area was somewhat different. As to the quality of foreign transports in the 15-passenger and over category, commuter managements were reasonably well satisfied but did not rave about "excellence." Although, the technology involved in aircraft flying in 1981 was believed to have lagged below that which could have been employed, there was some optimism about the upgrading being undertaken on new or derivative products scheduled for delivery in the 1982-1985 period. Even here, however, there was criticism that some of the alleged "new" aircraft were merely bigger but did not represent real solutions to the commuters needs. Two new aircraft were judged to be of particular interest.

Commuter managements repeatedly expressed disappointment that they had to go outside the U.S. so often in search of a product to meet their needs. From their point of view, it was "unfortunate" that U.S. manufacturers did not have designs for 30-passenger and 50-passenger planes

well underway in anticipation of the change in Federal Air Regulations authorizing larger aircraft. This delay, they maintained, has cost the commuters dearly and impeded adoption of U.S. aircraft.

Chapter 11

MANAGEMENT PERCEPTIONS OF FUTURE GROWTH

11.1 Background

An air carrier's equipment needs in the 1985-2000 period depends not only on the role it sees for itself but also on its forecast growth rate. Also of interest for comparison purposes is the rate of growth it sees for the industry.

11.2 Forecasts of Individual Carrier and Industry Growth

Forecasts of growth by individual carriers are listed in Table 11-1. Basically the table shows agreement that the domestic airline industry will grow at the rate of 4.5 percent per year in the 1985-2000 period but that each carrier will grow at that rate or at a greater rate. The two rates are mathematically incompatible. Since some new entrants under deregulation are growing rapidly and since additional entrants will certainly join the industry, some carriers will have to grow at less than industry average.

There are qualifications to be kept in mind when reading the tabulation. First, concerning industry growth forecasts, a number of those interviewed commented that normally five years was their maximum forecast period and thus estimating for 1985-1990 was questionable, and 1990-2000 forecasts could only be termed pure speculation. As indicated in the table, several companies gave no estimate at all because the time frame was excessive. USAir indicated that forecasting was most difficult against a background of two years of declining traffic -- only once in history had this happened and then the decline was less than one percent. Finally,

Table 11-1

ANNUAL GROWTH AS FORECAST BY CARRIER FOR 1985-2000

<u>Air Carrier</u>	<u>Percent</u>		<u>Notation</u>
	<u>Company Growth</u>	<u>Industry Growth</u>	
American	4.4	4.4	"possibly slightly less than industry"
TWA	5	5	
United	Proprietary	4-5	No forecast beyond 1990
NWA	NA	NA	No forecast that far in advance
Delta	Proprietary	4-5	
Eastern	4.5	4.5	
Western	NA	NA	Exceeds forecast period
Continental	6-8	6-8	
USAir	5	4.5	"we should outpace the industry slightly"
Republic	4.75	4.5	
Frontier	10	5	Industry tapering to 4%
Piedmont	15/12/5	4.5	15% to '88; 12% to '90; 5% thereafter
AirCal	NA	NA	Exceeds forecast period
Air Florida	Proprietary	4.5	Exceeds forecast period
SWA	6	4	SWA to double by 1988 and again by 2000
PSA	9 4.5	5 5	To 1990 only, if can expand If route limited
MDW	5-10	5-10	Much more 1981-1985
Flying Tigers	More than industry	More than GNP	
Federal Express	15	No forecast	Had no industry forecast
Air Wisconsin	More than industry	No forecast	
Golden West	More than industry	4-5	
Midstate	No forecast	No forecast	Exceeds forecast period
Britt	No forecast	No forecast	

since the individual estimates for the industry are so close and since they correlate so well with the Air Transport Association's forecast, the independence of the forecasting process is brought into question. It is well known that before finalizing their predictions of industry growth, airline forecasters revise their figures after checking with their counterparts in other airlines. Since no forecaster wishes to be proved wrong, particularly if his predictions are at a variance with those of other forecasters, this checking process tends to yield strikingly similar individual forecasts. The Air Transport Association consolidates these slightly varying predictions into one growth rate which most airlines then adopt as their "official" forecast.

The company forecast of its own rate of growth also can lack objectivity. A forecaster has a built in bias against showing that his company will not do as well as the average. Of those willing to answer questions on their future growth, only American mentioned that its growth rate might be below average. United and Delta considered that to protect themselves from competitors, their growth forecasts were proprietary in nature. Fast-growing Piedmont had an interesting and detailed forecast of 15 percent per year to 1988, tapering to 12 percent for two years to 1990, at which time its growth would fall to five percent, the same as the industry to 2000.

Not surprisingly, the most optimistic about their own future were the currently successful older carriers -- Frontier and Piedmont -- and the rapidly growing newer successful carriers -- Federal Express, Midway, and PSA. Starting from a much lower traffic base makes the realization of their forecasts less difficult. Nevertheless, Federal Express' 15 per-

cent per year compounded for 19 years would result in a 16-fold increase in its traffic. And if the business were all in its small package operations, its current run of 120,000 packages a day would rise to almost 2,000,000.

Summary: At the present time, traffic growth of 4.5 percent per year is the consensus for industry growth through the year 2000. With limited exceptions, individual carriers see themselves as growing at the same rate.

Since the forecast horizon of most airlines is five years or less and since their technique is not noted for its sophistication, the credibility to be attached to their forecasts suffers. Many airlines disdain forecasting longer than a year or two. When a rapidly expanding carrier which had purchased new aircraft for delivery some years hence was asked how the equipment acquisition was justified on the basis of forecasts, the reply was that the carrier had made no such forecasts and that it had no idea on which routes the planes would be used. The company, recognizing that larger new-technology aircraft would be needed by it or someone else, purchased the planes on speculation so that when delivery time came it could profitably employ them or dispose of them. On the other hand, there are companies which claim to make very elaborate traffic studies and projections before purchasing aircraft. However, the unanticipated actions of new entrants and competitors under deregulation often invalidate these forecasts.

Chapter 12

INTERFACE AMONG TYPES OF CARRIERS

Preceding chapters have outlined each management's view of its company's role in the new environment characterized by deregulation, inflation, strict aircraft noise abatement regulations, aging aircraft, and unstable fuel supplies and price. These chapters also dealt with the types of aircraft needed to fulfill this role as well as the attitudes toward purchasing foreign aircraft. The final subject to be treated in this report is how managements see their future relations with other types of carriers.

12.1 The Majors: AA, TW, UA, NW, DA, EA, WA, CO, USAir and Republic

According to managements of major airlines, interfacing with foreign airlines will not be adversely affected by the new environment. In fact, several suggested there may be more cooperation than before. Some of it may be "forced cooperation" in that foreign relations may make it wiser to cooperate to be in a favorable position to ask for reciprocal treatment. Only one major airline characterized its foreign interface arrangements as being competitive. Another put it, "We generally cooperate because we feel we have to. When we think we don't have to, we don't." Another very large carrier said, "We are very dependent on foreign carriers for our feed and, therefore, try for maximum interfacing."

Relationships between majors and commuters has undergone a considerable change in the last three years. There was a time when the commuters were considered little more than annoyances to the rest of the industry. Problems of joint fares, ticket counter space, OAG listings, baggage

transfer, and interline reservations were considered bothersome to the non-commuters. On the other hand, under deregulation large carriers have looked to commuters to pick up their unprofitable short-haul routes which they have dropped. Further, the passengers on these dropped routes were part of a longer haul -- sometimes a very long haul which the major carriers did not want to lose. Therefore, every carrier emphasized its deep interest in interfacing with such statements as "Cooperation with commuters is the name of the game."

In responding to questions about interfacing with charter airlines, managements, without exception, held that deregulation brought about such a reduction in fares on the major airlines that the charter carriers were no longer a competitive threat and, therefore, interfacing was not a problem. One carrier indicated that it did some interfacing with charter carriers by transporting baseball teams and saw this as a means of obtaining more efficient use of its resources.

To summarize the effect of the current environment on the interfacing of major carriers with other types of airlines, the conclusion is that interfacing with foreign carriers and with commuters has increased and will continue to hold at the present level or increase because these relations are mutually beneficial. Charter and cargo service represent such a small part of total operations that the majors did not have a position on interface.

12.2 Nationals and Regionals: Frontier, Piedmont, AirCal, Air Florida, SWA, PSA, Midway, Flying Tigers, Federal Express

Since the national and regional airlines, with the obvious exception of Air Florida and Flying Tigers, do not engage in significant for-

foreign operations,²² it is not surprising that their interface is cooperative in nature and designed to provide traffic feed. This feed, however, furnishes but a small amount of business and is thus not considered to be of great importance. On the other hand, Air Florida's aggressive expansion internationally has been made possible in part by successful interfacing with foreign carriers. Notwithstanding, cooperative arrangements do not always run smoothly. Laker has been cooperative with Air Florida, taking the attitude "If you are better, you deserve the business." On the other hand, British Caledonian Airways (BCAL) discontinued its interline agreement with Air Florida. Of course, there is no love lost between Air Florida and Eastern, so that the interface between these Miami base airlines is highly competitive.

National and regional airlines have about the same cooperative interface arrangements with commuters as do the majors. Stage lengths of the nationals and even the regionals are long enough to benefit from feed supplied by the commuters. One national airline, however, pointed out that while it desired to be cooperative, it had to guard against giving up too much of value in the way of ticket counters, gate space, etc. in the process. Another national carrier made the point that the degree of cooperative interfacing depended upon how much good the commuter could do for it. Blanket cooperation was not the policy. In the case of a large cargo carrier, like Flying Tigers, whose planes are often too large to serve small or medium size airports, it has cooperative arrangements with commuters to feed its large aircraft.

²² For this purpose we disregard the limited "foreign operations" of PSA and Frontier to Mexico and Canada.

There is little interface between nationals and regionals on the one hand and cargo carriers on the other. In fact, as the size of carriers decreases, so does the amount of interface. Generally speaking, nationals and regionals have little cargo business so that it is to their interest to have cooperative interfacing to feed their belly compartments. However, such companies as Flying Tigers and Federal Express, who are almost exclusively cargo carriers, in their scramble for business have competitive relationships with other cargo carriers.

Regionals and nationals had little to say about interfacing with charter airlines, pointing out that freedom of entry and exit, as well as pricing freedom available under deregulation, has resulted in marginal pricing with which the charter carriers have been unable to compete. Therefore, charter companies have declined in importance. Only one carrier thought there was a likelihood of a charter resurgence. In the present recessionary period, with cheap secondhand piston planes and cheap labor available, Flying Tigers has established contracts with small companies to haul cargo in DC-6s and CV-440s to major hubs, in order to feed jumbo B-747s which by themselves could not operate profitably in and out of minor markets.

One final point: New carriers who focus on low-cost service between high-density markets do not attempt interface arrangements because of a desire to keep operations simple and maintain flexibility. Southwest and Midway stated that questions on interfacing with foreign, commuter, cargo, or charter carriers did not have relevance for them.

12.3 Commuters: Air Wisconsin, Air New England, Golden West, Midstate

Since only a few commuters operate from international airports, the opportunities for commuters to interface with foreign airlines are limited. Generally interfacing is limited to conventional interline arrangements and is cooperative in nature.

As the preceding portion of this chapter has shown, commuters are presently being courted by larger carriers as a means of providing the latter with longer haul traffic. However, the interface of commuters with other commuters is, as would be expected, largely competitive. Air Wisconsin, whose route structure and operations seem to be moving it away from the commuter class, proved to be an exception indicating that most of its commuter interfacing was cooperative.

Charter operations were considered to be a small part of commuter operations. Beyond interlining a commuter may be chartered to a company like Flying Tigers to feed traffic by air instead of by truck. Air Wisconsin indicated its interfacing with cargo carriers was cooperative. Golden West and Midstate said their charter interface was small or nonexistent.

Commuters indicated an ongoing interest in building their cargo business and, to this end, were pursuing cooperative arrangements with other carriers at the interface. Air Wisconsin in particular felt its interfacing was more cooperative than competitive. Britt and Midstate had interline arrangements which were deemed to supplement their own loads.

12.4 Summary

National and international air carriers provide service from small cities to large hubs and to international destinations employing various types of carriers such as: long-haul, medium-haul, short-haul, commuter, cargo, and charter. Some compete not only for passengers and cargo but also for scarce resources such as gate space, reservation facilities, airport use, and air space. To provide service required by the public interest, as well as to maximize their earnings, the carriers interface at points where they operate from the same airport and this interface extends to beyond points. This chapter examined whether the managements view these relations as competitive or cooperative. The answer was clearly on the cooperative side. To the extent that deregulation in the future will further fragment the system so that large carriers will concentrate on different types of operations from the medium sized and commuter carriers, the more extensive will make cooperative arrangements at the interface.

The zeal with which commuters are being courted demonstrates that the larger carriers wish not only to retain feed from routes they have dropped but wish to acquire additional feed to increase load factors on their present and future aircraft equipment.

Chapter 13

SUMMARY AND CONCLUSIONS

The decade of the 1970s and the first two years of the 80s have been a period of dramatic and, in some cases, traumatic change for airline managements. Prior to 1970 management worked in a reasonably comfortable economic and regulatory environment characterized by: (1) increasing aircraft productivity and lower unit costs, (2) a stable price level, (3) a high degree of regulatory protection from new-entry competition and predatory pricing, (4) a population with an increasing disposable income and with an inclination to allocate some of it to air travel, and (5) a fairly clear division between unsubsidized long-haul carriers, then called "trunks," shorter-haul subsidized smaller carriers, called "local service" airlines, and a group of very short-haul carriers called "commuters." The latter were severely limited in the size of aircraft they could use.

A number of managements operated profitably in this environment but some regulatory and business policies fell into public disfavor. The CAB at one time frowned upon attempts to stimulate traffic by discount fares, placed a route moratorium in effect, approved a capacity control agreement, and proposed floors for charter fares. By 1975 the CAB and Congress began to show interest in permitting management to make entry, exit, and pricing decisions in a competitive framework.

Initially the large carriers, who had much turf to protect, vigorously opposed deregulation. However, United, who had good reason to complain that its management had not been able to manage effectively

because it had been uniformly denied route applications by reason of size, supported deregulation. Then one by one the major carriers, at least publicly, fell into line and followed United. Local service carriers, who had long coveted some major markets, gave their support early. In October 1978 the Air Deregulation Act became law. Basically it provided almost complete freedom of entry, somewhat less free exit, wide flexibility in setting fares, relative freedom to merge with or acquire another carrier, and a guarantee of service for a limited term to communities labeled "essential." Managements were faced with a competitive environment in which some airlines were not fully prepared to cope. Cases of wild and conservative expansion or both occurred.

In the hearings leading to the passage of the deregulation act, much emphasis was placed on the success of PSA and SWA, two carriers which had avoided the constraints of CAB regulations by confining themselves to intrastate operations and which had engaged in low-cost, high-frequency service accompanied by very high load factors. Proponents argued that under deregulation this type of operation would find increasing favor with the scheduled air carriers and would offer lower fares to the public and better profits for the airlines. Although the specter of cut-throat competition was raised, it was usually in terms of new "fly-by-night" operators who would buy cheap used aircraft, employ cheap labor, and skimp on maintenance. It was not in terms of major airlines consuming themselves with below cost pricing on major route segments.

Managements agree that deregulation has a significant effect on their equipment needs for the 1985-2000 period. While officially

forecasting a 4.5 percent growth rate, "off the record" managements are more pessimistic. Given the belief that "frequency is the name of the game," and that the competitive environment leads to more carriers per route, they conclude that large wide-bodies, such as the DC-10, L-1011, and A-300, have limited usefulness. The sizes managements now foresee as needed in the future are smaller than they had previously thought.

Two other factors having major impacts on management's assessment of aircraft needs arose in the 1970s, namely fuel price escalation and aircraft noise emission regulations. Noise regulations, when fully implemented in the middle 80s will require the removal from service of a significant number of jet transports and the replacement or significant and expensive modification of others. Low-noise emission aircraft may become a marketing tool.

Escalation of fuel price per gallon from 10 cents in the early 1970s to the current level of \$1.05 has raised the fuel portion of direct costs from 10 percent to 30 percent, and the portion of cash operating costs for some fuel-inefficient aircraft to over 50 percent so that a portion of variable cost can now exceed total fixed costs. This dramatic influence on costs has wrought revolutionary changes in the operating, engineering, maintenance, and route planning departments. Many managements have made significant alterations in the type of routes flown so as to adjust them to the economics of their fleets. By the same token, in their future acquisitions, seat miles per gallon has emerged as a major factor. Future acquisitions, when they can be financed, will no longer turn on attractive and comfortable passenger amenities, but on low airplane mile costs and low seat mile costs. Ownership costs,

particularly with high interest costs, will be scrutinized to see that they do not offset the cash operating expense economies provided by the new technology incorporated in the aircraft.

As an airline management looks to the 1985-2000 period it sees that the comfortable environment of the 1960s has been replaced by one of uncertainty and instability involving: (1) its future role, (2) the type of aircraft needed, (3) whether to purchase foreign transports, (4) how much, if any, growth to plan for, and (5) the extent of interfacing with other airlines.

13.1 Future Role (Chapters 2-7)

Management's views of the future role of its company appear to be largely a function of the airline's financial status. Thus, companies like Delta, United, and Northwest feel not only that they will be survivors under deregulation and inflation but will emerge stronger and be capable of excelling in short-haul, long-haul, and very long-haul international operations at the same time. Delta and United have submitted specifications for new-technology highly efficient planes calculated to give them a competitive advantage over those not able to finance purchases. On the other hand, other large carriers, like American, feel that they will not be in a position to purchase a new 150-passenger aircraft when it is offered for sale, and thus believe they will have to shrink the size of their companies. American has admittedly changed its network to fit the economics of its fleet where it cannot meet the lower costs of new "upstart airlines" in point-to-point competition.

All carriers using wide-bodies in domestic service were concerned that if used in the frequent service needed to attract passengers, the wide-bodies would not attract break even loads except in holiday seasons, periods of fuel shortage when less efficient planes would be grounded, or when air traffic control constraints were present.

Although many major carriers view the future with some degree of concern, such was not the case with the nationals (former local service) and regionals, all of whom were greatly pleased with the opportunities afforded under deregulation. Their deregulation experience is characterized by a lengthening of stage lengths and a movement to extended operations once considered the province of the trunks. Accordingly, they tend to look for 1985-2000 fleet additions which would involve some larger aircraft than they now have.

As was the case with the local service carriers, the success of Southwest Airlines, Pacific Southwest and Midway breeds in each of them the desire for further expansion. This was not true of Southwest when the interview with their President Howard Putnam was conducted. However, shortly thereafter Mr. Putnam moved to become president of Braniff and Southwest's new chief executive, Herbert Kelleher, announced a significant interstate expansion program for his company.

The cargo carriers, Flying Tigers and Federal Express, both proponents of deregulation, envisaged an expanded role for themselves with a much greater rate of growth seen by Federal Express. Also relatively optimistic were the commuter carriers, each of whom planned interstate expansion with longer haul segments.

13.2 Type of Aircraft Needed 1985-2000 (Chapters 8 and 9)

The major airlines are in agreement that their most pressing need is replacement for the DC-9, B-727, B-737, B-707, and BAC 1-11 fleets. Many of these are noisy, fuel-inefficient, reaching 20 years of age and contain less than state of the art technology. Since the passenger capacities of such aircraft run from the high 80s for some DC-9s to approximately 149 (mixed class) or 177 (coach class) for the B-727-200, one size plane will not suffice.

150-passenger plane: Sixteen carriers are in general agreement that a twin-engine, 150-passenger (mixed class) two-pilot, very fuel-efficient aircraft meeting Stage 3 noise rules is badly needed. More specifically, this design should be optimized around stage lengths ranging for 600 to 900 miles, but be relatively efficient over a much wider range. Only Delta and United believe they can finance such a plane and say they are prepared to order them. Northwest and SWA do not yet have the need for this type aircraft and thus prefer to sit on the sidelines. All the other airlines see financing as an impossible stumbling block until there are several years of robust earnings, which they define as at least five percent on revenues.

The difficulty in climbing the financial hurdle involved in purchasing a new-technology 150-passenger aircraft led American Airlines to propose re-engining the B-727-200 series with two fuel-efficient, quiet new-technology engines. Estimated to cost \$12 million each in 1981 dollars, the plane would be designated the B-727RE. Thus for a price of a new-technology plane the company could extend the life of its current B-727-200s perhaps 15 years and have an aircraft almost as

efficient as the "clean sheet" new aircraft. Carriers operating B-727s, except for United and Delta, show interest in the B-727RE provided a "plug" added to the fuselage would increase capacity and eliminate the need for carrying a heavy weight of lead in the front to counterbalance the weight of the rear engines. On the other hand, American, hewing to its "keep it simple and keep the cost down" approach asserts it is only interested in the less expensive "no plug" modification.

130-passenger plane: A new-technology plane in the 130-passenger size had support in some quarters of Eastern for two reasons: first, unless very rose-colored glasses were worn, this size would be ideal for many of Eastern's present and future markets, and second, the aircraft might easily, through growth during design, develop into the ideal 150-seat plane. The smaller of the major airlines, as well as former local service airlines, indicated a desire for a 130-place plane. However, following Airbus' dropping of the 130-seat version of its A-320 design, and after reviewing the tasks ahead for the aircraft manufacturers, the carriers reluctantly concluded that no "clean sheet" airplane would be built. Rather, derivatives from the B-737, B-727, and DC-9 would be the alternatives. USAir's conclusion that the B-727-300 was close enough to its specifications for a new aircraft, and SWA's view that the B-737-300 would take the company almost to the year 2000, tend to confirm the conclusion.

100-passenger plane: Eastern and some of the former local service lines, discounting the view that the halcyon growth days of 1945-1970 will ever return, believe a new 100-passenger (mixed class) plane is needed to replace their obsolescent equipment. However, they see little

prospect of such an aircraft being developed by Boeing, Douglas, or Lockheed -- their regular American suppliers. Several regional carriers perceive an 85- to 100-passenger jet as meeting their future needs. Thus far Air Wisconsin has been the first to order a new 100-passenger jet, the British-made BAe 146. Altair and Empire, commuters, have also adopted jet equipment, the 85-passenger Fokker F-28 Mk4000.

Turboprops and prop-fans: The prop-fan, which is advanced, jet speed development of turboprop technology, was highly desired by United and Federal Express. Both saw no problem with public acceptance or with the successful application of the technology required. Other large carriers, however, particularly those with previous turboprop experience (AA, DA, EA, USAir, PI, and Republic) had serious reservations about the likelihood of solving the noise, vibration, and maintenance and gearbox problems. Every carrier urged that research on prop-fans be accelerated to hasten the day they will be operational.

Given the present emphasis on fuel economy, a primary benefit of a prop-fan, it was surprising that the cargo carriers considered speed so important as to be willing to trade-off some fuel economy for speed. Without exception, all airlines thought an economical propfan did not have to match exactly the speed of a turbofan. In return for lower fares, passengers would accept a differential block time of 10 to 15 minutes. Accordingly, some airlines would accept a lower speed down to this bench mark in return for additional fuel economy.

In aircraft below 100-passenger capacity and involving short-haul operations, the overwhelming desire was for "clean sheet" new-technology turboprops. The greatest interest was in the 30- to 40-passenger size

to fill the void developed under earlier CAB constraints. Commuters regretted that foreign manufacturers were more attentive to their needs than were U.S. companies. After the interest in the 30- to 40-passenger size came a desire for a significant improvement in present 15- to 19-passenger commuter turboprops so that management could effectively use the aircraft's full seating and some cargo capacity on longer stage lengths. Carriers were not convinced that new technology had trickled down to their aircraft in a timely fashion.

Finally, despite the performance advantages of turboprops in short-haul operations, commuter and other managements expressed a desire to turn to jets where possible. Some have begun to do so and are finding it necessary to drop certain former turboprop route segments in the process.

13.3 The Purchase of Foreign Transport Aircraft

Purchases of the wide-body A-300 by Eastern and Rolls-Royce engines by Pan American fueled a "Buy American" movement in the late 1970s when there was high unemployment in the aerospace industry. This movement subsided as air transport production became more international in character. A growing number of American components find their way into foreign aircraft and an increasing number of American components are contracted to be made in foreign countries. What is American and what is foreign has become unclear.

All the large carriers and all but two of the small carriers denied any bias against purchasing a foreign aircraft and stated that only in the case of a tie in the competition would they favor the American

supplier. These same carriers reported that the quality of foreign aircraft and engines was excellent and in some cases, particularly avionics, was better than U.S. The two carriers having a definite preference for U.S. built planes attributed their preference to their location near the aircraft manufacturer's plant and to excellent support experience, and not to any patriotism or questions of foreign quality.

The lack of U.S. offered commuter planes in some categories has made it impossible for commuters to have a "Buy American" policy. However, while they consider foreign quality reasonably good, they would, if given the proper product buy in the U.S. The commuters general complaint is that American manufacturers have lagged behind their foreign counterparts in being responsive to commuter needs.

13.4 Managements Growth Forecasts (Chapter 11)

Periods of overcapacity in the past have resulted from aircraft purchases based on forecasts of growth which did not materialize. Therefore, it is not surprising that some carriers consider forecasts for their company's growth a proprietary matter, and that others frankly say they don't forecast more than two years ahead. In any event, all consider forecasts beyond 1985 as questionable and those beyond 1990 to be little more than scattergun shots in the dark.

Having supplied these caveats, management, in response to the question of forecasting industry and their company's rate of growth, uniformly predicted an industry growth rate of 4.5 percent per year. Their growth rates, they forecast, would be equal to or greater than the industry rate -- indicating that some individual forecasts are in error.

Finally, since it is rare for airlines to agree with each other, the fact that each airline forecast the same industry growth suggests a lack of independent forecasting. As a matter of fact, the airline forecasters consult each other through the Air Transport Association and agree on a figure which all then use. In this way no one's incorrect forecast stands out above the others.

The individual forecasts are even more suspect. First, no one is below the industry average -- a contradiction in terms. Secondly, a forecaster is not likely to hold his job if he keeps telling his management that it is doing less well than the competitors. Several said, off the record, they did not believe their own forecasts. Thus the reports in this forecast chapter should not be given much credence.

13.5 Interfacing with Other Carriers (Chapter 12)

The purpose of Chapter 12 was to ascertain the type (cooperative or competitive) and extent of interfacing the carriers anticipated in the future as a result of the new economic, regulatory, and technological environment. In an era characterized by competition there will be by definition more carriers and areas of specialization both in passenger and cargo carriage. Each carrier has a strong interest in receiving feed from others at the point of interface. Therefore it is anticipated that the present extensive interface arrangements now existing between domestic and foreign carriers not only will continue but will increase in scope. Of course, at the regional and commuter level there are fewer points of international interface. These arrangements are cooperative in nature.

Since deregulation, the larger carriers have dropped some of their short-haul segments as they concentrated on what they perceived to be more profitable long-haul operations. Not wishing to lose the feed from these routes and hoping to receive feed from other routes, the major, the medium size, and the regional airlines have been establishing increasingly cooperative arrangements at the interface. All the carriers interviewed anticipated that these types of arrangements would continue to develop in number and importance in the 1985-2000 period. However, some concern was shown that the long-haul carriers might give away more value than they received in their efforts to woo the commuters.

The ability of charter carriers to compete successfully on price with scheduled carriers has diminished in the last few years as the scheduled carriers gained more pricing freedom. As a result, they are no longer considered a competitive threat by most carriers. There is almost no interfacing and this condition is expected to continue in the 1985-2000 period.

Generally speaking, domestic carriers of all types, including commuters, have excess capacity in their belly or other cargo compartments. Accordingly, their interest in utilizing this space has spawned cooperative arrangements at the interface. It was the consensus of opinion that the 1985-2000 period would see no change.

13.6 Conclusions

With the caveat that generalizations imply variations and exceptions, the following represents a distillation of the perceptions of airline managements as to the 1985-2000 period:

1. For the large major airlines, deregulation and inflation will cause some shift in their roles in the industry. Some will shrink in size as they specialize in limited types of operation rather than being all things to all people. It was predicted that some would fall by the wayside; but it was always "some of the others."
2. Medium size, small size and commuter airlines expect to expand and be profitable as they select longer stage length routes of the larger carriers and as they acquire more efficient aircraft.
3. Except for United and Delta, both of whom are seeking "clean sheet" aircraft tailored to their needs, airlines expect continuously to "fine tune" their routes in accordance with the economics of their fleets.
4. Although fuel efficiency has been highly touted as the controlling factor for planes to be used from 1985-2000, most carriers say this is an oversimplification. It is only the "bottom line" after taking account of higher depreciation caused by inflation and the cost of new technology, and the new higher order of financing rates, which controls. In two cases carriers were willing under some situations to trade fuel efficiency for more speed.
5. Notwithstanding number 4 above, fuel costs, noise regulations, and increasing maintenance costs will force the replacement in 1985-2000 of most B-707s, B-727s, B-737s, DC-9s and BAC 1-11s operating in 1981.
6. Although the majors and some regionals are in agreement on the need for a 150-seat, and possibly a 130-seat (both in mixed class) replacement, the chaotic financial state of the industry leads the majority to believe that financial constraints will prevent the aircraft from being undertaken for a number of years, if ever.
7. One large carrier short of financing ability, American Airlines, is leading a movement to modify the three-engine B-727 into a twin-engine plane of the same capacity but with more powerful, quiet, fuel-efficient, high-bypass engines. If this can be done at half the cost of a new technology plane, the company believes the project to be affordable and a way to prevent serious shrinkage of the company's operations. The other operators who cannot afford a new-technology plane favor the re-engining idea, but only if a costly plug containing additional seats is inserted into the fuselage.
8. The speed of new-technology airliners will not be reduced below current operating practices to take advantage of fuel economy. Specifications for new jets call for current Mach numbers. In fact, two major cargo carriers indicated that they might be willing to sacrifice fuel economy for speed in the case of acquisition of turboprops or prop-fans.

9. Although all carriers earnestly desired accelerated research to bring turboprop speeds close to those of jets via a high-technology prop-fan, a few, primarily those with previous turboprop experience, had reservations about the solution of vibration, noise, and maintenance problems. On the other hand, two large carriers, United and Federal Express, thought modern technology would solve the problems and, therefore, these airplanes representing significant economies in fuel usage were eagerly awaited.
10. With some well defined exceptions, carriers saw turboprops in the 1985-2000 period as becoming more efficient but their use confined to aircraft carrying 100 passengers or less and on routes on which the block time differential between them and turbojets did not exceed 10 to 15 minutes.
11. All but two carriers denied any bias against foreign planes. Even though they may have purchased American transports in competition with foreign planes, managements gave high praise for the quality of foreign wide-bodies -- even indicating that in some areas the quality and technology exceeded that of the U.S. built aircraft. Growing internationalization of aircraft under which there is an increasing mix of construction locations and origin of component parts has blurred the distinction between U.S. and foreign to the point where the "Buy American" argument has lost its logic. Failure of American companies to purchase foreign transports was based upon the aircraft not being right for the mission or would duplicate aircraft in the company's existing fleet.
12. In the smaller plane area, commuter airlines felt that American manufacturers, concentrating on larger aircraft, had not paid sufficient attention to the needs of commuters who were thus forced to make most of their purchases abroad. The central needs of the commuters for the 1985-2000 period are: (1) a more efficient 15- to 19-passenger plane (turboprop), and (2) a 30- to 40-passenger turboprop to fill a void created by CAB regulations which have now been lifted. While not enthusiastic about the technology in foreign-built commuters, the carriers considered the workmanship to be good.
13. Considerable concern was expressed as to the future of the three-engine, three-pilot wide-bodies. Competition resulting from deregulation, air fares rising more rapidly than the consumer price index, and a general downturn in economic conditions make it difficult, if not impossible, to fill these wide-bodies and provide the frequency of service needed to attract passengers. Secondly, the efficiencies and route capabilities of the forthcoming twin-engine, two-pilot B-767 and B-757 cast further gloom on these wide-bodies.

By 1992 some three-engine wide-bodies will be 20 years old. Since the aircraft are currently quiet, fuel-efficient, and since they

provide low seat mile costs, little has been done to plan for their future. Studies are now underway investigating re-engineing programs. Unless there is return to a growth pattern greater than currently forecast, the capacity of the wide-bodies in the changed environment may lead to their transfer from the American scene.

14. No concern was felt for the long run future of the Boeing 747. Evolutionary changes constantly improve this aircraft and no other manufacturer can at current prices afford to build a competitive model. All concerned felt that when needed a new more efficient engine would be developed to extend the aircraft's useful life.
15. When asked for industry traffic forecast to the year 2000, managements, while responding with a 4.5 percent figure, disclaimed any accuracy for it. Figures two years out were treacherous, they said, and anything beyond 1985 was guesswork. Individual forecasts for company traffic growth, which ranged from 4.4 percent to 15-20 percent annually to the year 2000, were even more questionable. Admittedly a manager has a strong bias against forecasting that his company will do less well than his competitors.

Appendix A

Sample questions addressed to airline managements in NASA study of future aircraft needs, 1985-2000, under the changed economic, regulatory and technological environment.

1. Given the changes of the 1970s and 1980, how does the airline see its future role in the air transport system?
 - a. What is the size and type of aircraft this role requires?
 - b. What stage lengths will be involved?
 - c. Will it be necessary to readjust the airline's route network to fit the economics of the current fleet?
 - d. Or is it planned to obtain a completely new plane optimal for the airline's new strategic plan?
2. If new aircraft are in the picture, what percent fuel savings over existing equipment is necessary to interest management? 50%? if not that, what percent?
3. What is the appropriate stage length(s) and Mach number(s) around which a future plane(s) should be designed?
4. What passenger capacity would be desired for a new turboprop, propfan, or fan jet for the airline?
 - a. 25, 50, 75, 100, 125, or 150 passengers?
 - b. given the existing capital constraints, how many sizes could the carrier handle?
5. Addressing the turboprop and propfan, are there possible trade-offs between speed and fuel efficiency? For example, is fuel efficiency the driving force in all cases?
6. How does the carrier see itself and the industry interfacing with foreign carriers in the future? With commuters? With cargo carriers? With charter? Will it be competitive or cooperative?
7. How does the carrier view the trends in foreign offerings in comparison with U.S. manufactured planes? Do you have an expressed or latent bias against foreign aircraft?
8. Do you see replacement or reengining of the B-747, DC-10, L-1011, A-300?
9. What type of traffic growth is expected by 1990 and 2000?
 - a. air transport generally
 - b. your company

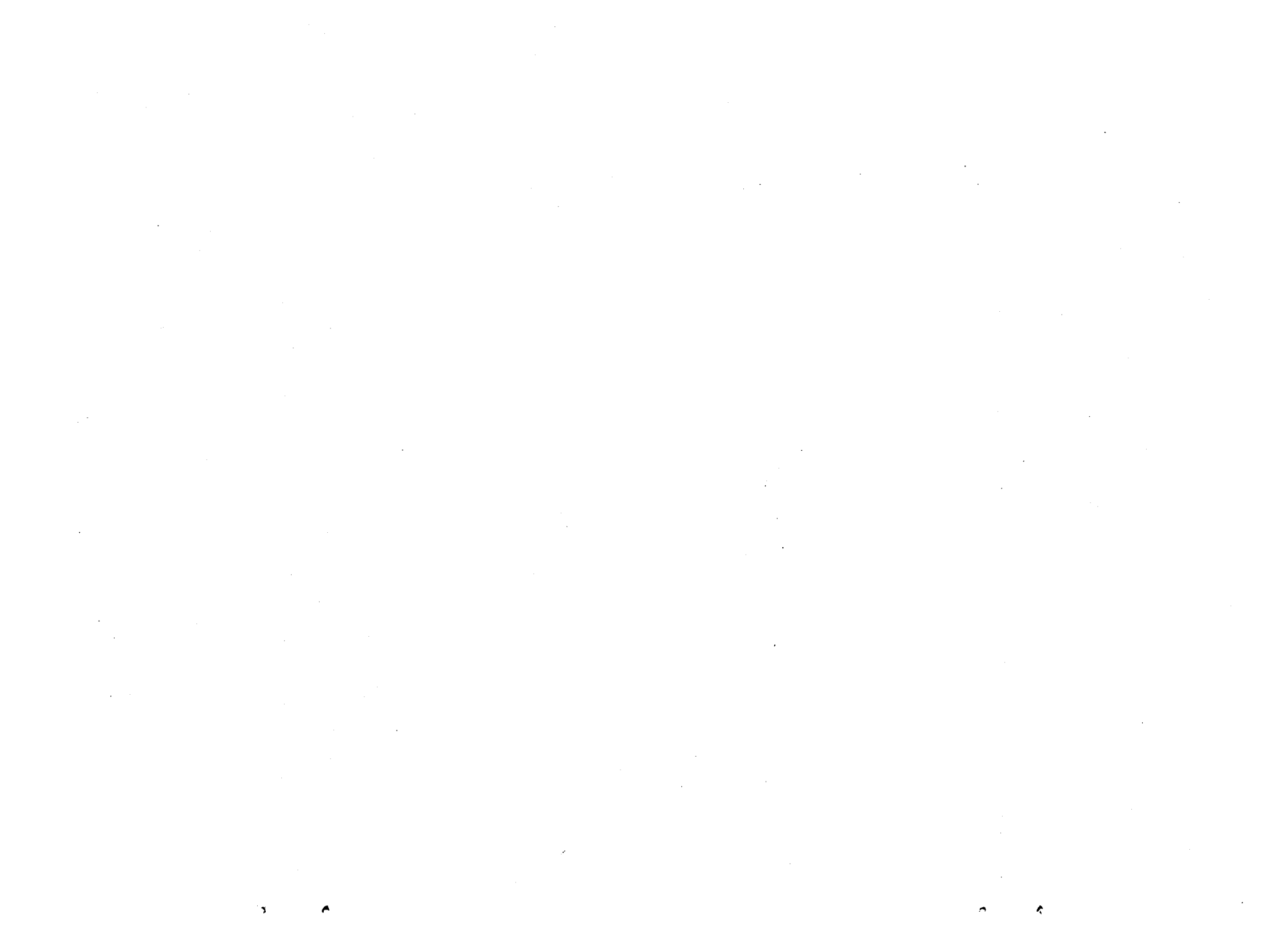
Appendix B

Individuals Interviewed in Preparation of NASA Study

<u>1981 DATE</u>	<u>COMPANY (PLACE)</u>	<u>NAME</u>	<u>TITLE</u>
May 15	American (DFW)	Donald Lloyd-Jones	Sr. VP Operations
		Richard Linn	Dr. Technical Development
		Earl Ditmars	VP Forecasts, Research & Traffic
May 18	Air Florida (Miami)	Don Garvett	VP Planning (also other staff)
May 19	Eastern (Miami)	Wayne A. Yeoman	Sr. VP Finance
		Alfred Brescia	VP Economic Planning
		D.S. Klein	Dir. Special Planning Studies
		Gary Purvis	Mgr. Fleet Planning
		Robert Cozzi	Mgr. Passenger Forecast- ing & Planning
		Paul Johnstone	Sr. VP Operations Svc.
June 9	USAir (Washington)	Garner W. Willer, Jr.	Sr. VP Maintenance & Engineering
		Edwin I. Colodny	Chairman & President
		Randall Malin	Sr. VP Marketing
June 15	Delta (Atlanta)	A.C. Ford	Asst. VP Long Range Planning
		C. Julian May	VP Engineering
		Walter Overend	Gen. Mgr., Programs & Performance Engineering
		Capt. Robert A. Byrd	Mgr. Flight Operations- Technical
June 18	USAir (Pittsburgh)	Garner W. Miller, Jr.	Sr. VP Maintenance & Engineering
June 24	Republic (Minneapolis)	J.F. Nixon	Sr. Vice Corporate Planning
	Northwest (Minneapolis)	Donald Nyprop	Consultant and Former Chairman & President
June 25	United (Chicago)	Richard Ferris	Chairman & CEO
		Edward Beamish	Sr. VP Corporate Planning
		Sven Madsen	Fleet Planning
June 30	SWA (Dallas)	Howard Putnam	President & CEO
		Harold F. Reilly	VP, Schedule Planning

<u>1981</u> <u>DATE</u>	<u>COMPANY</u>	<u>NAME</u>	<u>TITLE</u>
June 30	American (DFW)	Earl Ditmars	VP Forecasts, Research & Traffic
		Peter A. Pappas	Asst. VP Economic Planning
		William H. Troxel	Sr. Director - Forecasts
July 1	AirCal (Newport Bch)	Harry G. Lehr	VP Planning
		Barbara Mowry	Dr. of Planning and Analysis
		Flying Tigers (Los Angeles)	John E. Flynn Richard Brannon
July 2	Western (Los Angeles)	James L. Mitchell	Sr. VP Corporate Planning
		Robert Ross	Dir. of Flight Schedules
		Continental (Los Angeles)	Dan Love Richard Adams
July 8	TWA (NY)	Neil Effman Russell Garlin	Sr. VP-Airline Planning Mgr. of Fleet Planning
July 10	Piedmont (Winston- Salem)	R.L. James D.W. Witte	Dir. of Route Development Mgr. Marketing Research Planning
July 14	Frontier (Denver)	Dan A. Hersh	VP-Future Planning
	PSA (San Diego)	Byron H. Miller	VP-Fleet Planning
July 28	Golden West (Boston)	Richard Russell	Dir. of Planning
July 29	Air New England (Boston)	Stephen Gill	Sr. Dir. Marketing Planning
Aug. 7	Midway (Chicago)	Gordon Linkon Arlene Dunn	President Dir. of Economic Planning
Aug. 11	Federal Express (Memphis)	Theodore L. Weise Ronald Ponder	Sr. VP Operations Planning VP Advanced Projects & Research
Aug. 12	Midstate (Stevens Pt., WI)	Bryce Appleton	President

<u>1981</u> <u>DATE</u>	<u>COMPANY</u>	<u>NAME</u>	<u>TITLE</u>
Aug. 12	Britt Airways	William C. Britt	President (questionnaire response from Mr. Britt)
Aug. 18	United (San Francisco)	Robert C. Collins Dick Coykendall	VP-Engineering Mgr. Aircraft Development Engineering
Aug. 25	Air Wisconsin (Appleton WI)	William H. Geenan	VP & Treasurer
Dec. 3	Federal Express	Peter S. Wilmott	President



1. Report No. NASA CR-165887		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle A REAPPRAISAL OF TRANSPORT AIRCRAFT NEEDS 1985-2000: PERCEPTIONS OF AIRLINE MANAGEMENT IN A CHANGING ECONOMIC, REGULATORY, AND TECHNOLOGICAL ENVIRONMENT				5. Report Date March 1982	
				6. Performing Organization Code	
7. Author(s) Frank A. Spencer				8. Performing Organization Report No. 530-01-13-02	
9. Performing Organization Name and Address Transportation Center Northwestern University Evanston, Illinois				10. Work Unit No.	
				11. Contract or Grant No. NAG1-180	
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546				13. Type of Report and Period Covered Contractor report	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract Aircraft choice is one of the most important strategic decisions involving the most costly capital expenditures that an airline must make. Long lead times and changing conditions heighten the risk involved. This study surveys views of the executives of 24 major, national, regional, and commuter airlines concerning the effect of recent regulatory, economic, and technological changes on the roles they see for their airlines, and the consequent changes in their plans for acquiring aircraft for the 1985-2000 period. Differing perceptions on the economic justification for new-technology jets in the context of the carriers' present and projected financial conditions are outlined. After examining the cases for new or re-engined intermediate size jets, the study discusses turboprop powered transports, including the carriers' potential interest in an advanced technology, high-speed turboprop or prop-fan. Finally, the implications of foreign competition are examined in terms of each carrier's evaluation of the quality and financial offerings, as well as a possible "Buy American" policy predisposition.					
17. Key Words (Suggested by Author(s)) Aircraft Airlines Deregulation Economics Management			18. Distribution Statement Unclassified - Unlimited Subject Category - 03		
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 178	22. Price A09

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