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STUDY OF QUIET TURBOFAN STOL AIRCRAFT

FOR

SHORT-HAUL TRANSPORTATION

FINAL REPORT

VOLUME V

ECONOMICS

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ADVANCED CONCEPTS AND MISSIONS DIVISION
NATIONAL AERODYNAMICS AND SPACE ADMINISTRATION
MOFFETT FIELD, CALIFORNIA 94035

Douglas Aircraft Company - Long Beach

FOREWORD

This document is one of six volumes which comprises the final report of a contract study performed for NASA, "Study of Quiet Turbofan STOL Aircraft for Short-Haul Transportation," by the Douglas Aircraft Company, McDonnell Douglas Corporation.

The NASA technical monitor for the study was R. C. Savin, Advanced Concepts and Missions Division, Ames Research Center, California.

The Douglas program manager for the study was L. S. Rochte. He was assisted by study managers who prepared the analyses contained in the technical volumes shown below.

Volume I	Summary	
Volume II	Aircraft	L. V. Malthan
Volume III	Airports	J. K. Moore
Volume IV	Markets	G. R. Morrissey
Volume V	Economics	M. M. Platte
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The participation of the airline subcontractors (Air California, Allegheny, American and United), throughout the study was coordinated by J. A. Stern.

The one year study, initiated in May 1972, was divided into two phases. The final report covers both phases.

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1.0 SUMMARY

1.1 General

This volume contains the economic data developed by the Douglas Aircraft Company (DAC) through its Economic Analyses effort during Phase I and Phase II of the Study of Quiet Turbofan STOL Aircraft for Short-Haul Transportation. These data are derived and exhibited in accordance with the requirements shown in the NASA Request for Proposal and the DAC response (Reference 1) to this RFP. Methods and techniques used to derive these data are also delineated.

Economics was integrated as an active contributor in the definition and development of air transportation systems and in the selection of airplane configurations. This involvement also included support of trade studies, sensitivity analyses and cost estimating. The concept of total system cost encompassed the complete identification of the resources and interfaces required throughout the assumed economic life of the system. Airline consultants were used to provide the realism that was needed from the operators viewpoint to properly identify the issues and resources.

Equipment and operating costs were derived in Phase I to (1) assess the economic impact of parametric configurations designed to a stipulated sizing mission, and (2) determine the economic viability of an operating fleet in six representative regional networks. Four significant measures were used to evaluate configurations along the sizing mission profile and in the six regions:

- Airplane Prices - computed with one of the standard Douglas advanced design cost models.
- Direct Operating Costs - calculated with a STOL modified ATA formula.
- Indirect Operating Costs - based upon mutual agreements on industry data between the contractors and the NASA.
- Return on Investment - calculated for the incremental airplane using a discounted cash flow approach.

The primary Phase I objective was to generate a plausible range of candidate configurations and through these appropriate evaluation techniques reduce the number of configurations to those showing promise for further evaluation and detailed analyses in Phase II. Aircraft analysis started from seven hard point designs and proceeded through a full matrix of 202 parametric airplanes from which 53 designs were screened. Detailed analysis further reduced the number of candidates that were subjected to systems analysis. The output resulted in a total of eight propulsive lift and mechanical flap short-haul airplanes as the configurations identified for further detailed analysis in Phase II - See Table I-1. An advanced conventional takeoff and landing (CTOL) airplane was carried along for comparison.

Final economic evaluations included financial and subsidy analyses and examined the performance of the baseline airplane in the Chicago region STOL system. The Chicago region results were used to estimate the steady state results of the other five continental U. S. regional airlines. These data together with detailed facilities requirements and the airplane program data provided total system cost measures of the domestic STOL system. These total estimates subsequently were time phased and processed through the Douglas national econometric model to estimate external effects.

All costs developed for this study through the application of the DAC advanced design cost model and other estimating techniques are to be considered as rough order of magnitude estimates and are used for Budgetary and Planning purposes only.

TABLE I-1

RECOMMENDED PHASE II AIRPLANE CONFIGURATIONS

FIELD LENGTH FT.(METERS)	PASSENGERS		
	100	150	200
2000 (610)		AUGMENTOR WING EXTERNALLY BLOWN FLAP UPPER SURFACE BLOWING	
3000 (915)	EXTERNALLY BLOWN FLAP	EXTERNALLY BLOWN FLAP MECHANICAL FLAP	EXTERNALLY BLOWN FLAP
4000 (1220)		MECHANICAL FLAP	

PR3-STOL-1678

1.2 Phase II Baseline Airplanes

1.2.1 The Phase II initial baseline airplane. - The Phase II initial baseline airplane was the 150 passenger, 3000 foot (914 m) field length externally blown flap (EBF) airplane. The EBF concept is based on the use of engine exhaust to generate propulsive lift. This is accomplished by placing the engine forward of the wing so that the engine exhaust is turned by the flap system in a downward direction. The lift generated is comprised of the normal aerodynamic lift, the component of direct gross thrust that is turned by the flaps, and the induced lift of the wing caused by the engine exhaust. Lift coefficients generated by this type of lift system are approximately twice those of conventional systems.

A high-wing design has been used to alleviate the impact of adverse ground effects that occur with the use of these large lift coefficients. The "T" tail was dictated by high lift capabilities and the downwash velocities on the empennage. The tail surfaces themselves are large compared to conventional airplanes to attain the low approach and takeoff speeds required for short field performance.

A supercritical wing airfoil section has been used to take full advantage of this wing technology which is being developed by wind tunnel and flight test experience. The use of the supercritical wing enables a thicker and lighter wing section to be used for a given design cruise Mach number.

A large stroke landing gear is required to match high approach sink rates. The main landing gear is mounted in wheel pods and retracted into the lower fuselage cross section.

Very high bypass ratio variable-pitch fan engines are used to attain noise levels approaching 95 EPNdB on a 500 foot (152 m) sideline distance. These engines have an advantage over conventional designs because thrust reversing is achieved through reverse pitch of the fan in lieu of the conventional heavy reverser designs.

The fuselage interior consists of wide tourist seats arranged six abreast and a 34-inch pitch with two 20-inch aisles.

1.2.2 Final design airplanes. - All of the candidate airplanes were subjected to a number of iterations to refine their weights and performance. The airplanes were then given detailed economic, market, systems analyses, and airport compatibility studies. Airplane trade studies were performed on noise level, performance trade-offs, landing ground rules, avionics, ride quality, alternate missions, effects of composite materials, and feasibility of military/commercial commonality. These studies showed that the greatest impact on airplane designs was the noise goal of 95 EPNdB. A number of final EBF baseline airplanes emerged that had sideline noise levels of 96 EPNdB, but were much lighter in takeoff gross weight and exhibited consequent DOC improvements. Figure 1-1 shows the final 150 passenger 3000 ft. (914 m) baseline design.

1.3 Market and System Synthesis

1.3.1 Fare levels. - The results of the modal split analysis determining demand reaction to frequency, airplane payload, and fare levels consistently showed a sharp adverse demand reaction whenever STOL fares were set higher than CTOL CAB jet coach fares. Recognition of this demand behavior throughout the economic studies placed an upper limit on relative fare levels.

EXTERNALLY BLOWN FLAP AIRCRAFT

150 PASSENGERS - 3000 FT (914 M) FIELD LENGTH

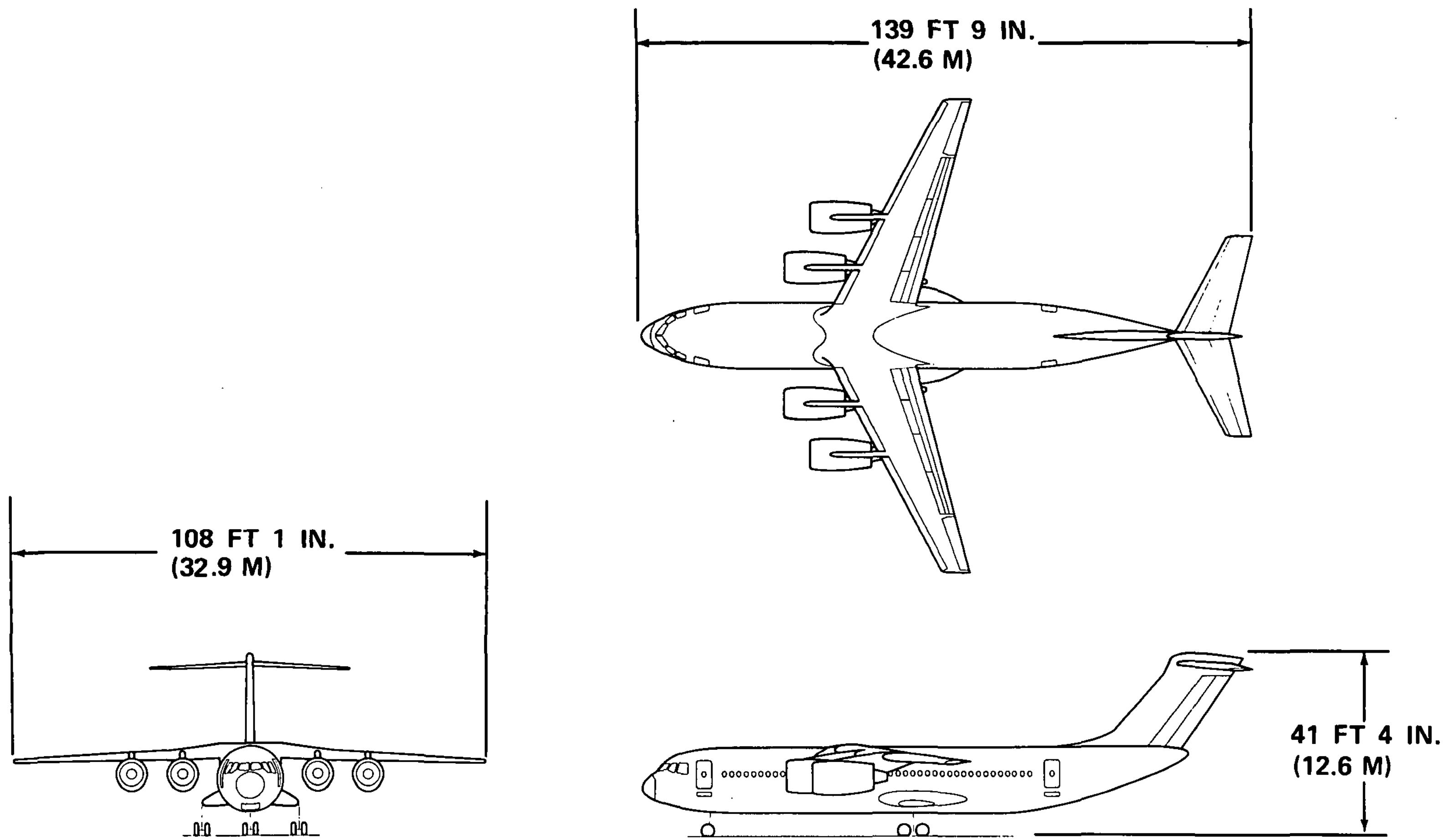

FIGURE 1-1.

PR3-STOL-1512B

1.3.2 System concept. - The system analysis results showed a satellite STOL system, i.e. several moderate sized STOL airports within an urban area, was preferred to a point-to-point concept, i.e. many STOL ports within an urban area. The results of the fare level and system concept conclusions directed the investigation toward considering moderate to large (100 to 200 passenger) airplanes. The use of airplanes in this size regime necessarily implied a need for experienced airline management and operating personnel and therefore to the central thesis of evolutionary STOL system development. Under this concept STOL organizational entities would evolve from current CTOL entities forming, in fact, autonomous operating divisions of existing airlines. Although the point was not specifically addressed, the autonomous entity concept subsumes a gradual route development process. During this development marginal CTOL routes would be phased into the STOL entity.

1.3.3 Domestic STOL airplane market. - Evaluation of the potential airplane market with regional simulation of the representative U. S. short haul market showed a need for a total U. S. domestic fleet of 426 150-seat STOL airplanes. Estimates were made of the 100 and 200 passenger capacity airplane as alternate sizes. Domestic requirements for the 1985 traffic level are 643 (100-seat) or 324 (200-seat) airplanes.

Seven representatives regions comprising a total of 497 city pairs and 145 million passengers were examined during Phase II of this study. Each of these city pairs was required to be within the 0-600 statute mile (966 km) range category and to generate 50,000 or more origin and destination passengers by the year 1985.

Seven baseline regional networks evolved from the market and system analyses: Chicago, California, Northeast, Southeast, Northwest, Southern and Hawaii. These systems service 19, 22, 18, 36, 7, 20 and 7 airports, respectively. In some instances a single city may be serviced by more than one regional network. The total number of airports in the baseline network was 101. Within the respective regions there are 7, 4, 7, 1, 10, and 4 cities in the congested classification. There are another 14 cities classified as constrained. STOL airplanes cannot utilize congested airports because they are physically saturated. On the other hand constrained airports can be used by STOL airplanes if a STOL runway is constructed. Out of the total of 101 network airports, 30 percent are congested and another 13 percent are constrained. Congestion relief became a major objective at almost 50 percent of the points serviced. The seven final regional networks are displayed in Figures 1-2 to 1-8.

A detailed examination was made of system performance in meeting a system objective of major airport congestion relief. A target of 20 percent reduction of airplane movements from (1985) saturated carrier airports was selected. Five major airports were examined for flight operations results from an initial set of travel demand data. Relief was not sufficient to satisfy the 20 percent objective. The allocation and distribution of travelers from the baseline travel demand market was changed to expand the original regional samples and to include additional higher, medium and lower density routes in the network. These changes expanded the total U.S. STOL airplane market and achieved more satisfactory congestion relief at the congested airports. Figure 1-9 presents the representative short haul markets for the medium and higher density city pairs comprising the baseline network.

1985
CHICAGO REGION - PHASE II

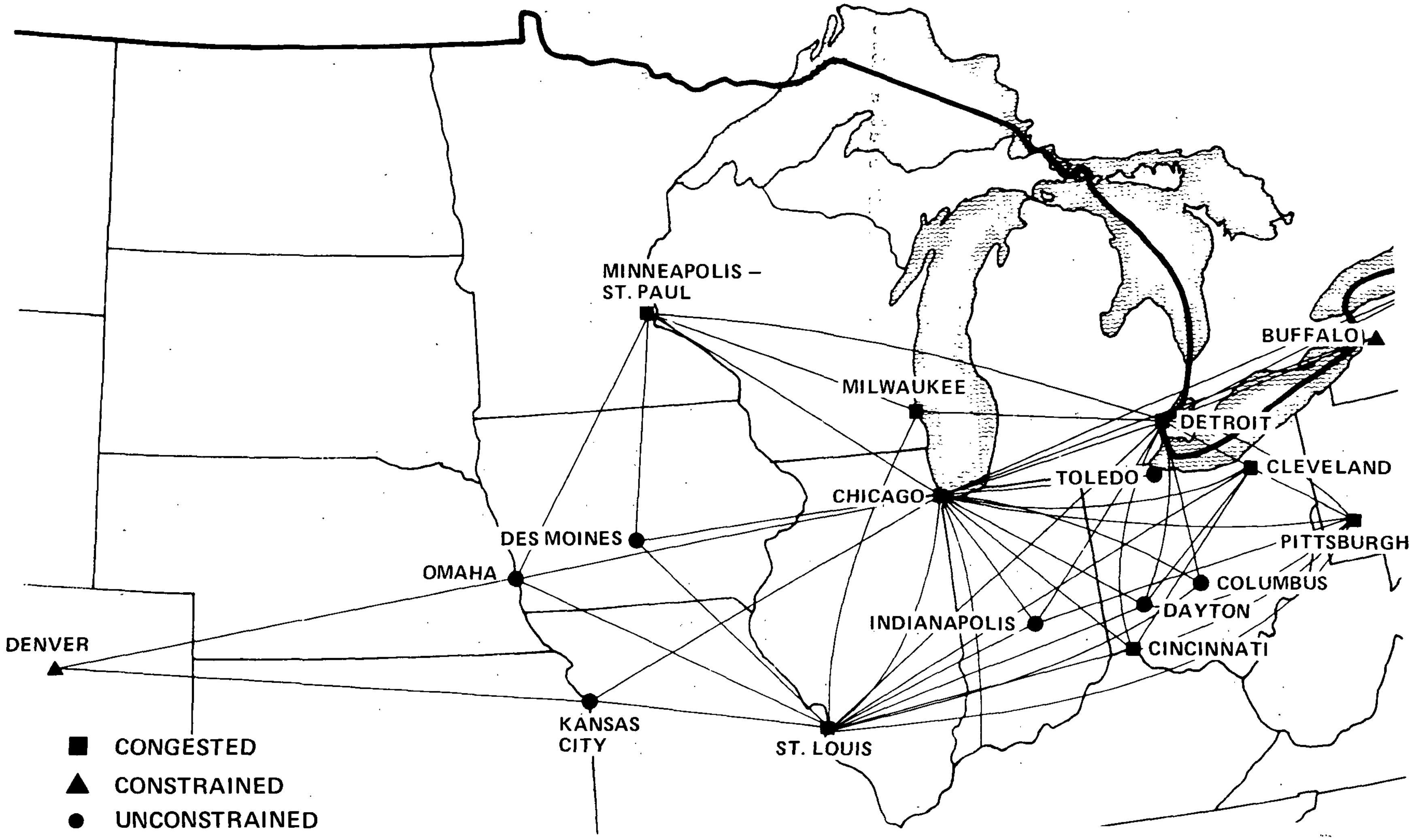

FIGURE 1-2.

1985
CALIFORNIA REGION - PHASE II

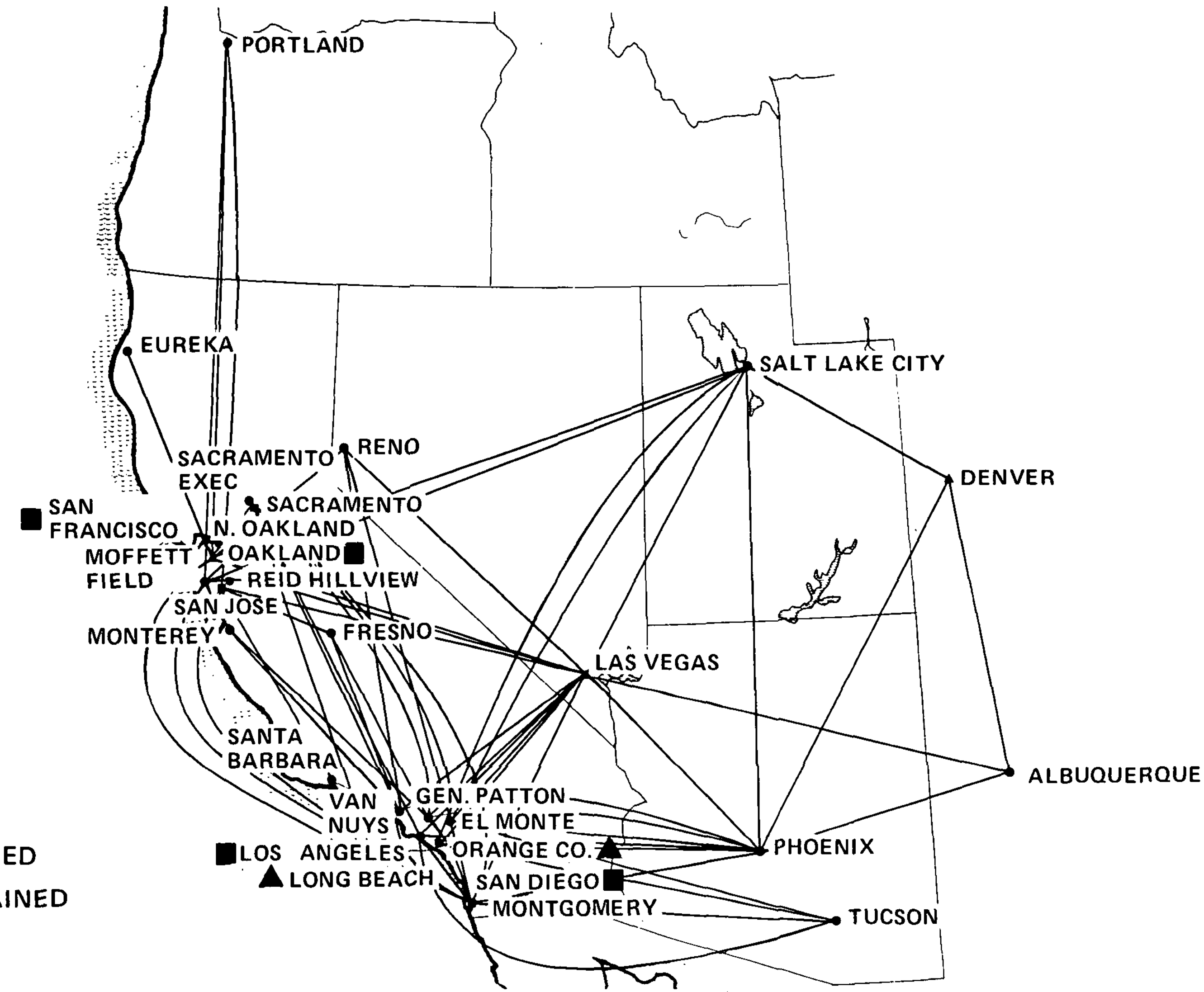

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FIGURE 1-3.

1985
NORTHEAST REGION-PHASE II

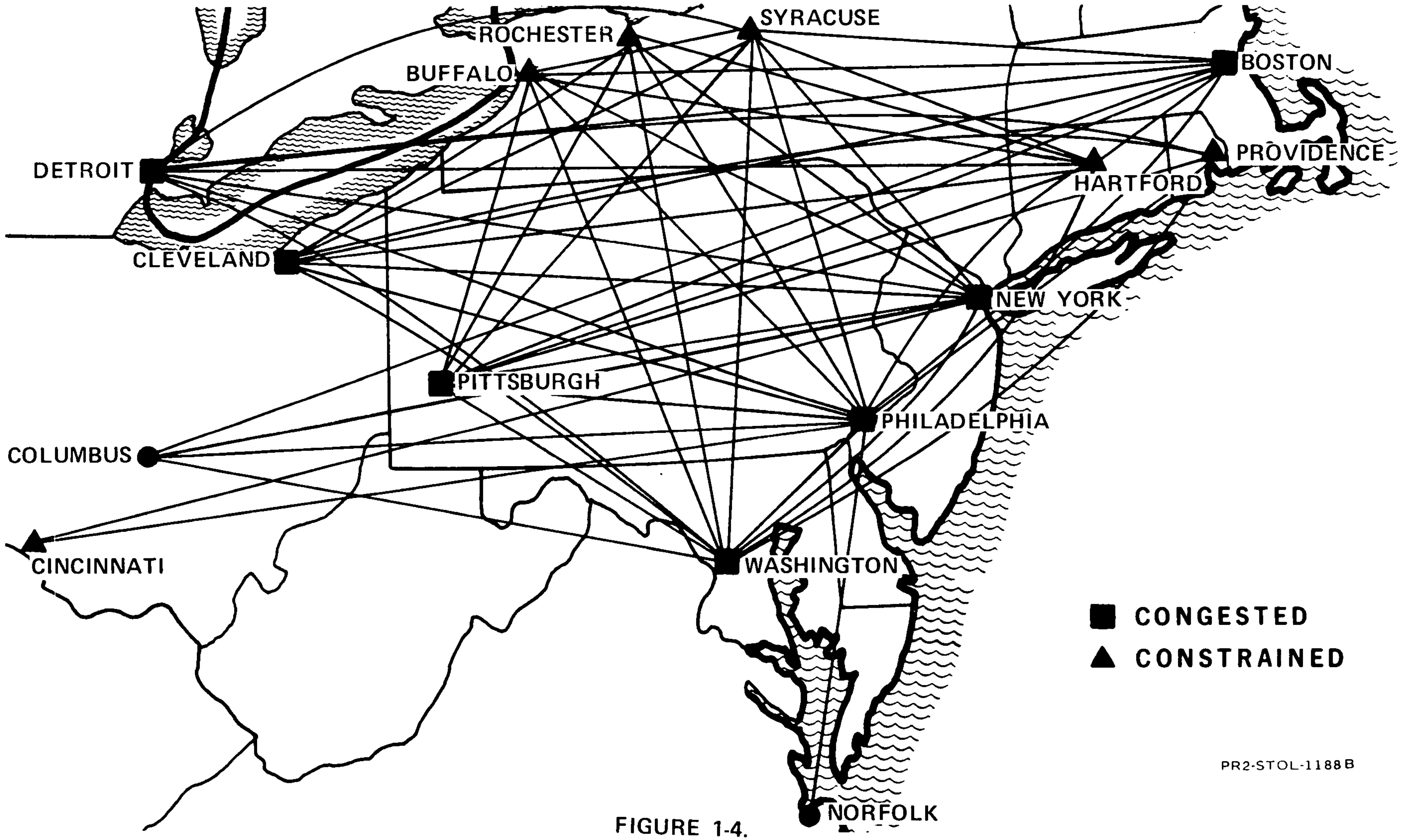

FIGURE 1-4.

1985
NORTHWEST REGION - PHASE II

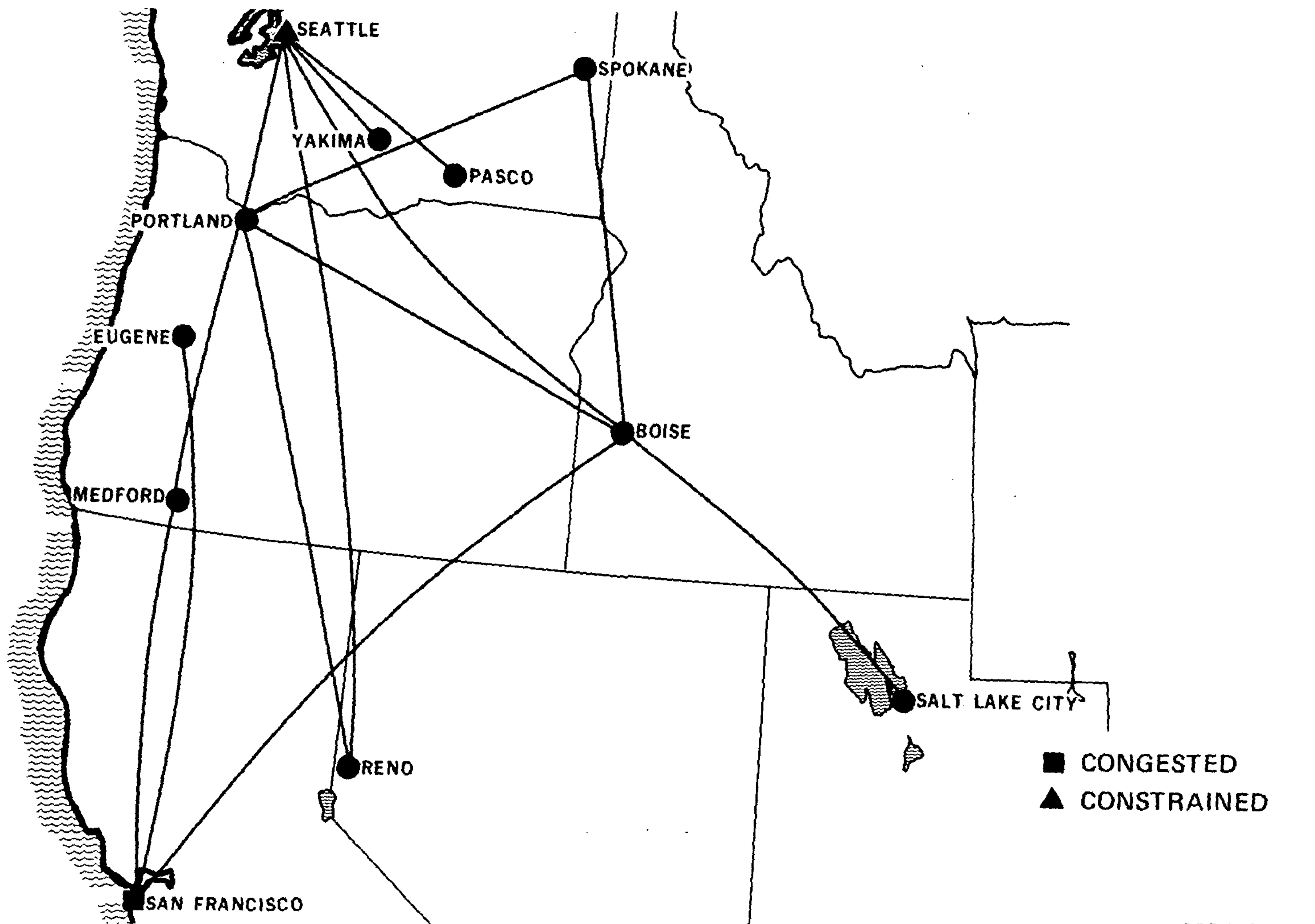

FIGURE 1-5.

1985 SOUTHEAST REGION - PHASE II

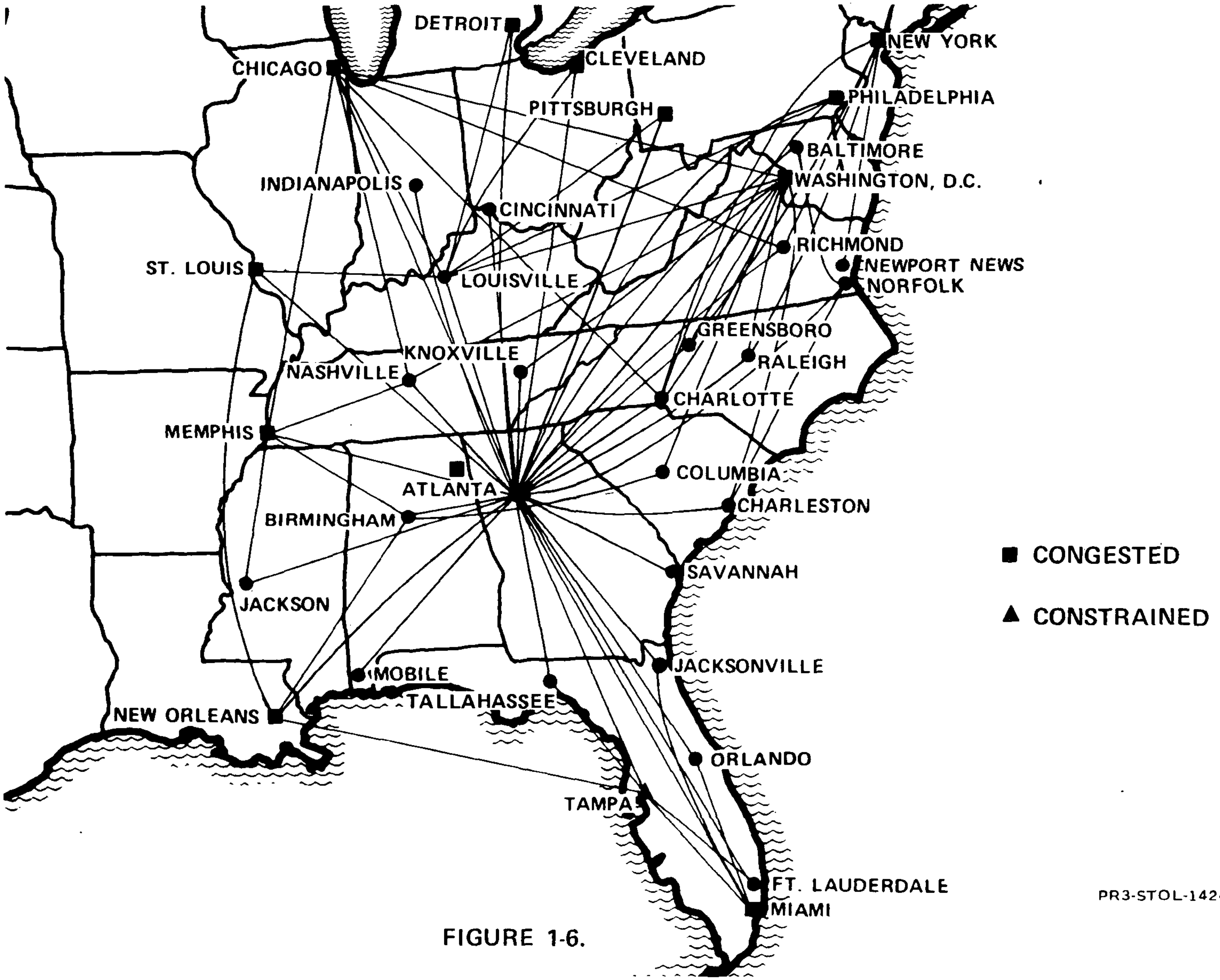

FIGURE 1-6.

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1985
SOUTHERN REGION - PHASE II

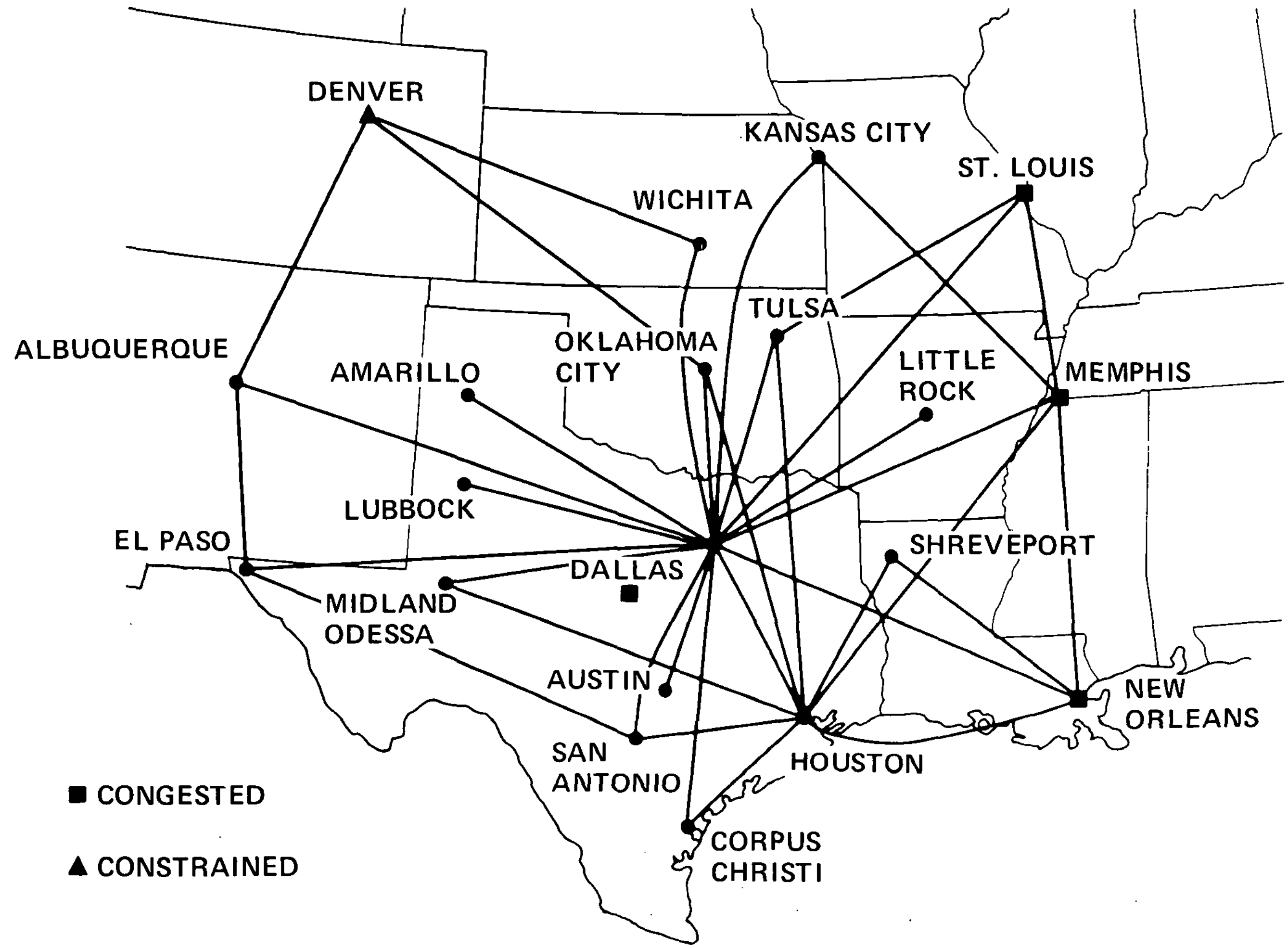

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FIGURE 1-7.

1985
HAWAII REGION-PHASE II

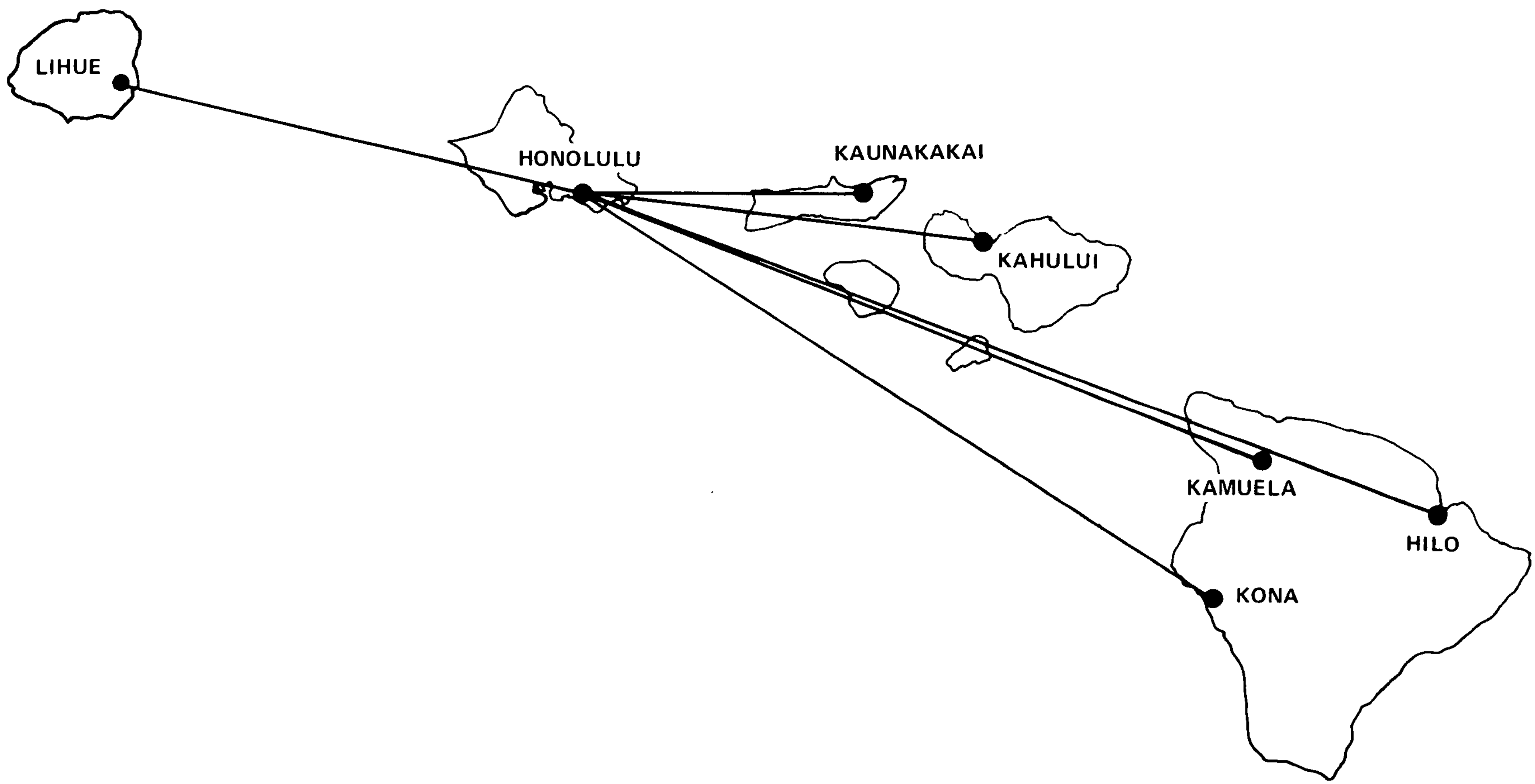

FIGURE 1-8.

REPRESENTATIVE SHORT-HAUL MARKET REGIONS

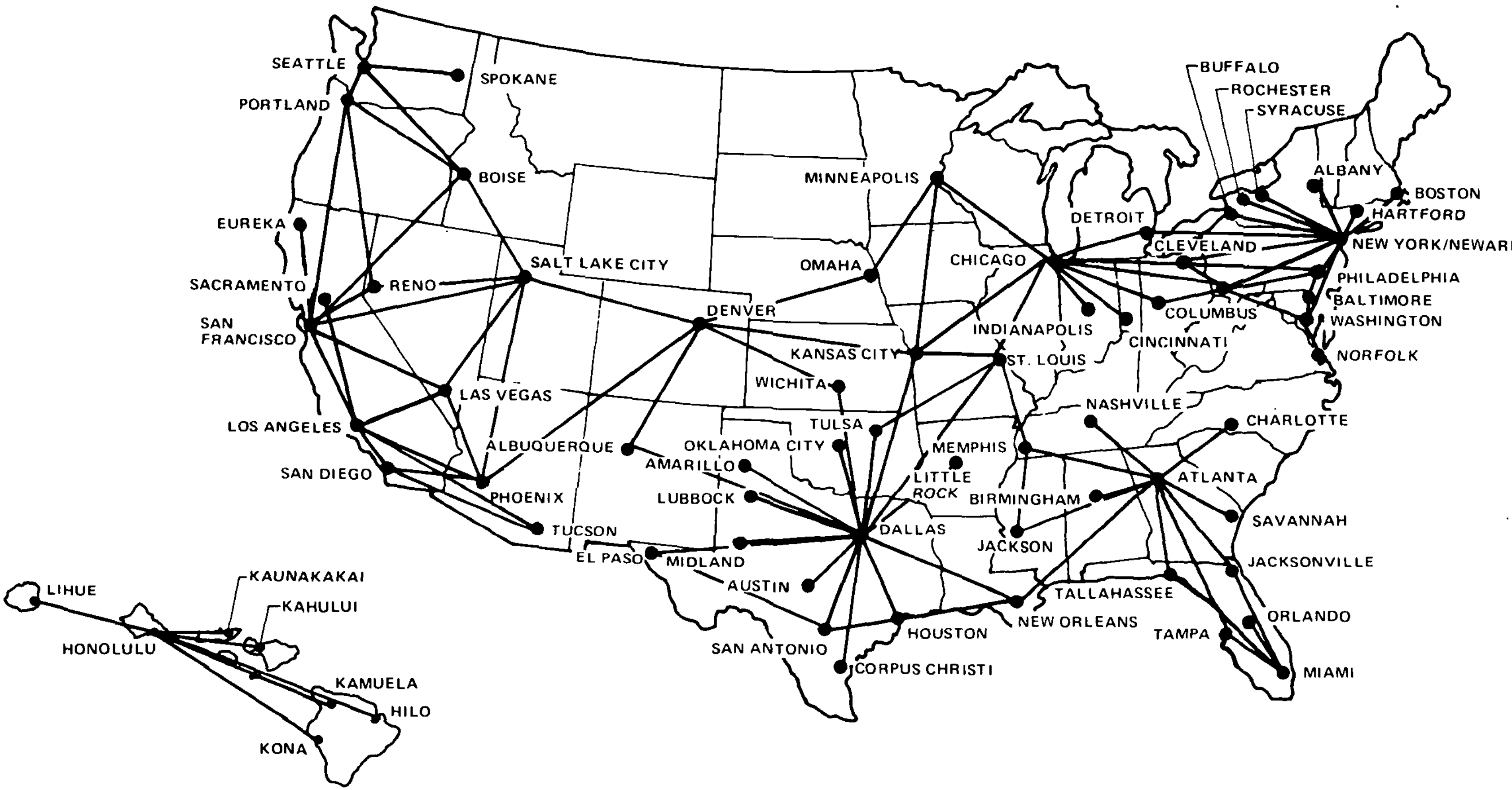

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FIGURE 1-9.

1.4 Findings

- It takes a market share of approximately 400 airplanes to induce one airplane manufacturer to initiate a commercial program. The estimated world market for STOL airplanes of 625 to 1075 one-hundred and fifty-passenger airplanes by 1990 suggests that it would be profitable for one or two manufacturers to produce STOL short-haul airplanes.
- Short takeoff and landing airframe (airplanes less engines) prices fall within the 1969 price per passenger seat range of current transport airplanes ($42,000 per seat for externally blown flap, 150-passenger, 3000-ft (914 m) field length airplanes, based on a noise requirement of 95 EPNdB at 500 foot sideline distance). A summary of the airplane prices and their major subsystems in 1972 dollars are shown in Table I-2.
    - The airframe portion of current transports is priced between $32,000 and $52,000 per passenger seat. The baseline (E150.3000) airframe price per passenger seat is about $42,000, the median of the range.
    - These data indicate there is no significant cost penalty per passenger seat for STOL short-haul airframes.
    - The airframe for STOL airplanes weigh approximately 20 percent more than the advanced CTOL airframe of the same payload capacity, based on the same technology.
    - STOL engine and nacelle prices are sensitive not only to thrust level variations, but also to engine and nacelle configurations and, therefore, lift concepts. A new engine pricing methodology is needed.

TABLE I-2

SUMMARY OF PHASE II SYSTEMS ANALYSIS AIRPLANE PRICES BY MAJOR SUBSYSTEM
[1972 Dollars]

AIRPLANE TYPE / FIELD LENGTH FT	E 150 2000	A 150 2000	U 150 2000	E 100 3000	E 150[b] 3000	M 150 3000	E 200 3000	M 150 4000
SYSTEM ANALYSIS AIRPLANES[a]								
MWE, LB	148,900	144,360	173,540	75,860	110,900	125,340	151,880	103,070
CW, LB	131,236	126,504	156,300	65,562	96,540	112,150	132,906	90,030
THRUST PER ENGINE, LB	26,830	22,200	27,475	14,520	21,270	34,840	28,790	34,390
ACQUISITION PRICE, $M								
AIRFRAME	9.017	9.268	9.996	5.000	6.931	7.708	9.090	6.317
NACELLES	0.428	0.536	0.964	0.252	0.352	0.556	0.452	0.546
ENGINES	3.764	3.036	3.300	2.972	3.412	2.266	3.872	2.244
AVIONICS	0.628	0.628	0.628	0.628	0.628	0.628	0.628	0.628
TOTAL	13.837	13.468	14.888	8.852	11.323	11.158	14.042	9.735
FINAL BASELINE AIRPLANES								
MWE, LB	141,710	146,530	169,380	70,170	99,770	136,290	127.880	104,270
CW, LB	124,610	131,910	150,980	60,560	87,110	122,430	112,330	92,800
THRUST PER ENGINE, LB	25,830	19,200	29,490	13,200	18,260	36,990	22,925	32,450
ACQUISITION PRICE, $M								
AIRFRAME	8.625	9.595	9.652	4.683	6.370	8.343	7.906	6.516
NACELLES	0.412	0.488	0.992	0.228	0.308	0.578	0.376	0.524
ENGINES	3.720	2.884	3.412	2.884	3.212	2.332	3.520	2.200
AVIONICS	0.628	0.628	0.628	0.628	0.628	0.628	0.628	0.628
TOTAL	13.385	13.595	14.684	8.423	10.518	11.881	12.430	9.868

[a] USED FOR PHASE II ECONOMIC ANALYSIS.
[b] Baseline

PR3-STOL-1848

- Airframe, engine and noise suppression technologies can produce STOL airplanes (95 EPNdB at 500-foot/152 m sideline) capable of operating with a direct operating cost (DOC) of about 2.08 cents per available seat statute mile (ASSM) (1.29¢/ASKM). Comparative DOC's at the 575-st. mi. (926-km) design point for STOL and short-haul mechanical flap airplanes are shown in Table I-3. In this comparison the systems analysis baseline (E150.3000) airplane is about 18 percent higher than the advanced CTOL 150.7500 airplane. The DOC's versus field length curves for the systems analysis airplanes at stage lengths of 200 st. mi. (322-km), 300 st. mi. (483-km) and 575 st. mi. (926-km) are shown in Figure 1-10. However, the final design STOL baseline (acoustic modifications) has a DOC of 1.91 cents per ASSM (1.3¢/ASKM), about 8% below the systems analysis version and about 14 percent higher than the equivalent-design advanced CTOL. A comparison of the operating cost for the systems analysis STOL baseline and the advanced CTOL serving comparable high-density networks (e.g. Chicago Region) show similar results as follows:

	STOL E150.3000	CTOL C150.7500
Average stage length, st. mi. (km)	319 (513)	291 (468)
DOC, ¢/assm (¢/askm)	2.23 (1.38)	2.08 (1.29)
IOC, ¢/assm (¢/askm)	2.04 (1.27)	2.18 (1.35)
TOC, ¢/assm (¢/askm)	4.27 (2.65)	4.26 (2.64)

- A regional STOL air transportation system with an organization structure specializing in the short-haul high density market can achieve indirect operating costs (IOC's) on the order of

TABLE I-3

PHASE II DIRECT OPERATING COST SUMMARY[a]
[Systems analysis airplanes at 575 st. mi. (926 km)]

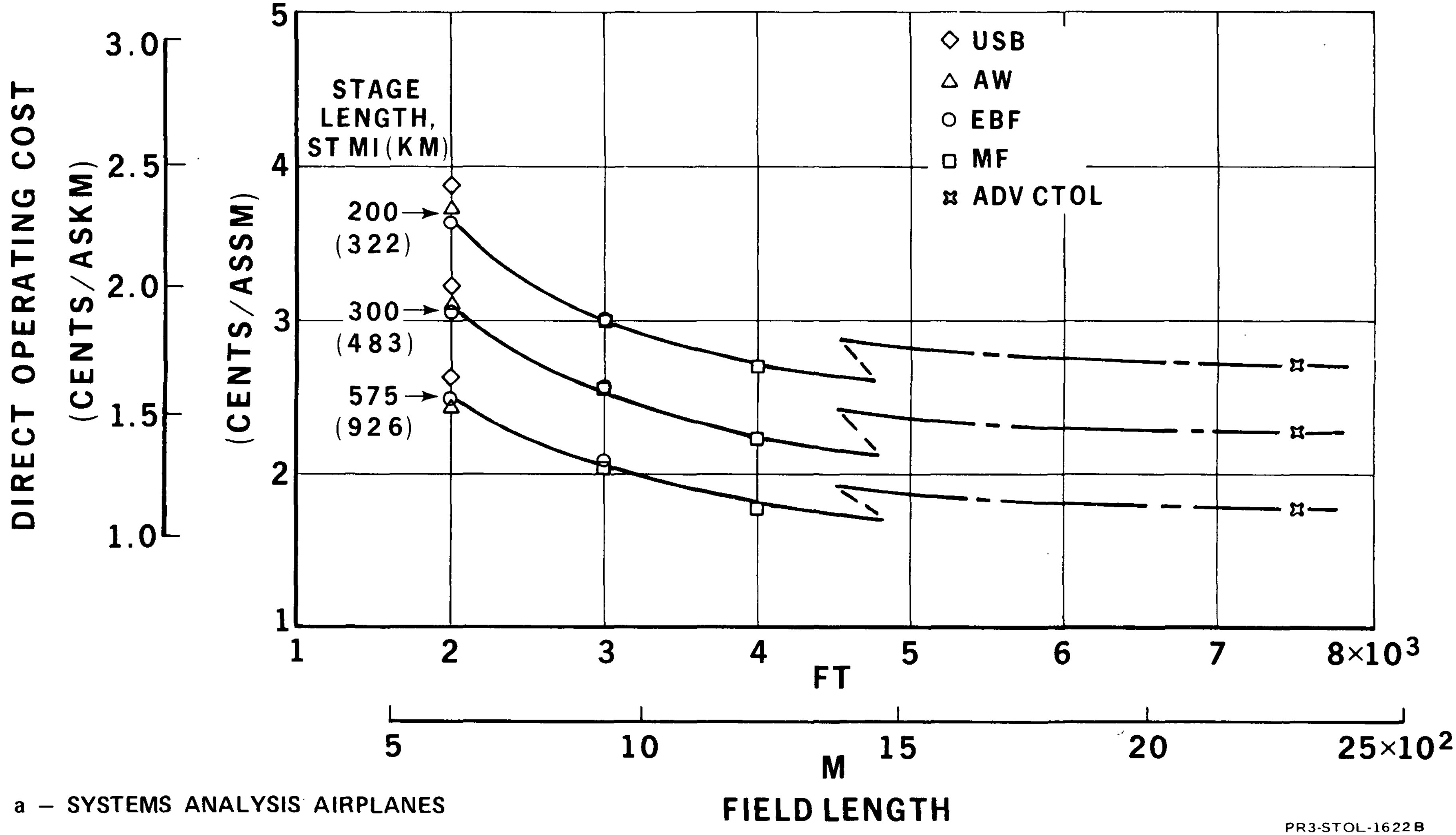
LIFT CONCEPT	Dollars per airplane -		Cents per available -	
	mile	km	seat-mile	seat-km
EXTERNALLY BLOWN FLAP (EBF)				
E150.2000.68	3.72	2.31	2.48	1.54
E100.3000.67	2.55	1.58	2.55	1.58
E150.3000.68	3.12	1.94	2.08	1.29
E200.3000.70	3.74	2.32	1.87	1.16
MECHANICAL FLAP (MF)				
M150.3000.71	3.02	1.88	2.01	1.25
M150.4000.76	2.67	1.66	1.78	1.11
AUGMENTOR WING (AW)				
A150.2000.79	3.67	2.28	2.45	1.52
UPPER SURFACE BLOWING (USB)				
U150.2000.70	3.92	2.44	2.62	1.63
ADVANCED CTOL[b]				
C150.7500.80	2.63	1.63	1.75	1.09

[a]DOC's are at 1972 price levels, for 2500 blk hrs/yr utilization.

[b]Data are for 575-st. mi. (926-km) range; design range for this airplane is 1381 st. mi. (2222 km).

DIRECT OPERATING COST[a]

CENTS/ASSM (CENTS/ASKM) vs FIELD LENGTH AT SELECTED STAGE LENGTHS



a – SYSTEMS ANALYSIS AIRPLANES

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FIGURE 1-10.

$11.00 per passenger as opposed to current operating results of $5.00 (Reference 58) to $12.00 (Reference 59) per passenger at equivalent stage lengths - about 300 st. mi. (483 km). The IOC's for the Phase II airplanes are shown in Table I-4.

- Even though STOL IOC's can be reduced from $12.00 per passenger to $11.00 per passenger, they are still higher than DOC's at short stage lengths.
- Employee productivity on the order of 1600 to 2500 passengers per employee appears to be required to achieve these lower IOC's.
- Lower intrastate fares prevailing in California require stringent controls of IOC's as roughly measured by very high passenger per employee ratios.
- Control of IOC's may be more crucial than control of DOC's for successful STOL operations.

- The total cost per passenger over a 320 st. mi. stage length is about $25.00 before interest, depreciation acceleration, federal income taxes and profits depending upon load factor, operating policies and route structure. The combination of available technology and specialized organization means that viable regional STOL systems can be developed provided market growth rates (6 percent short-haul) persist and competitive load factors in the 55 to 60 percent range can be attained. Under these conditions and with a Civil Aeronautics Board (CAB) jet coach fare structure, regional STOL systems can provide

TABLE I-4

PHASE II INDIRECT OPERATING COST SUMMARY[a]
[Systems analysis airplanes at 575 st. mi. (926 km)]

LIFT CONCEPT	Dollars per airplane -		Cents per available -	
	mile	km	seat-mile	seat-km
EXTERNALLY BLOWN FLAP (EBF)				
E150.2000.68	2.15	1.34	1.43	0.89
E100.3000.67	1.38	0.86	1.38	0.86
E150.3000.68	2.00	1.24	1.33	0.83
E200.3000.70	2.64	1.64	1.32	0.82
MECHANICAL FLAP (MF)				
M150.3000.71	2.03	1.26	1.35	0.84
M150.4000.76	1.94	1.20	1.29	0.80
AUGMENTOR WING (AW)				
A150.2000.79	2.15	1.34	1.43	0.89
UPPER SURFACE BLOWING (USB)				
U150.2000.70	2.24	1.39	1.49	0.93
ADVANCED CTOL[b]				
C150.7500.80	1.96	1.22	1.31	0.81

[a]IOC's are at 60% load factor and 1972 price levels.
[b]Design range for this airplane is 1381 st. mi. (2222 km).

estimated ROI results of about 10.5%[a] as measured by the simplified CAB formula. This annual ROI of 10.5 percent reflects system maturation assumptions, phased route development, fare dilution, route load factor and frequency growth and the increasing ability of the operating results to absorb fixed operating costs.

- The potential long term viability of the various STOL airplanes was also addressed using the discounted cash flow method. Figure 1-11 shows the steady state ROIs for the eight systems analysis airplanes. All airplanes carrying 150 or more passengers and designed for 3000 ft (914 m) or greater field lengths are viable given a market and suitable ride qualities. The 1985 market for the 200-passenger EBF is not large enough to encourage private manufacture. The MF 3000 ft (914 m) ride qualities are unsuitable. The satisfactory potential of the 150-passenger EBF is indicated by by the arrows in Figure 1-11 showing the variation in the computed ROI performance. At the lower end, 13% dilution and start up costs put ROI just below the viability threshold. At the upper end, zero dilution and steady state performance make it attractive. The private decision to initiate STOL service, therefore becomes conditioned by the individual entity's appraisal of the investment vis-a-vis other currently available alternatives; i.e. additional CTOL airplanes, hotels, real estate, etc.

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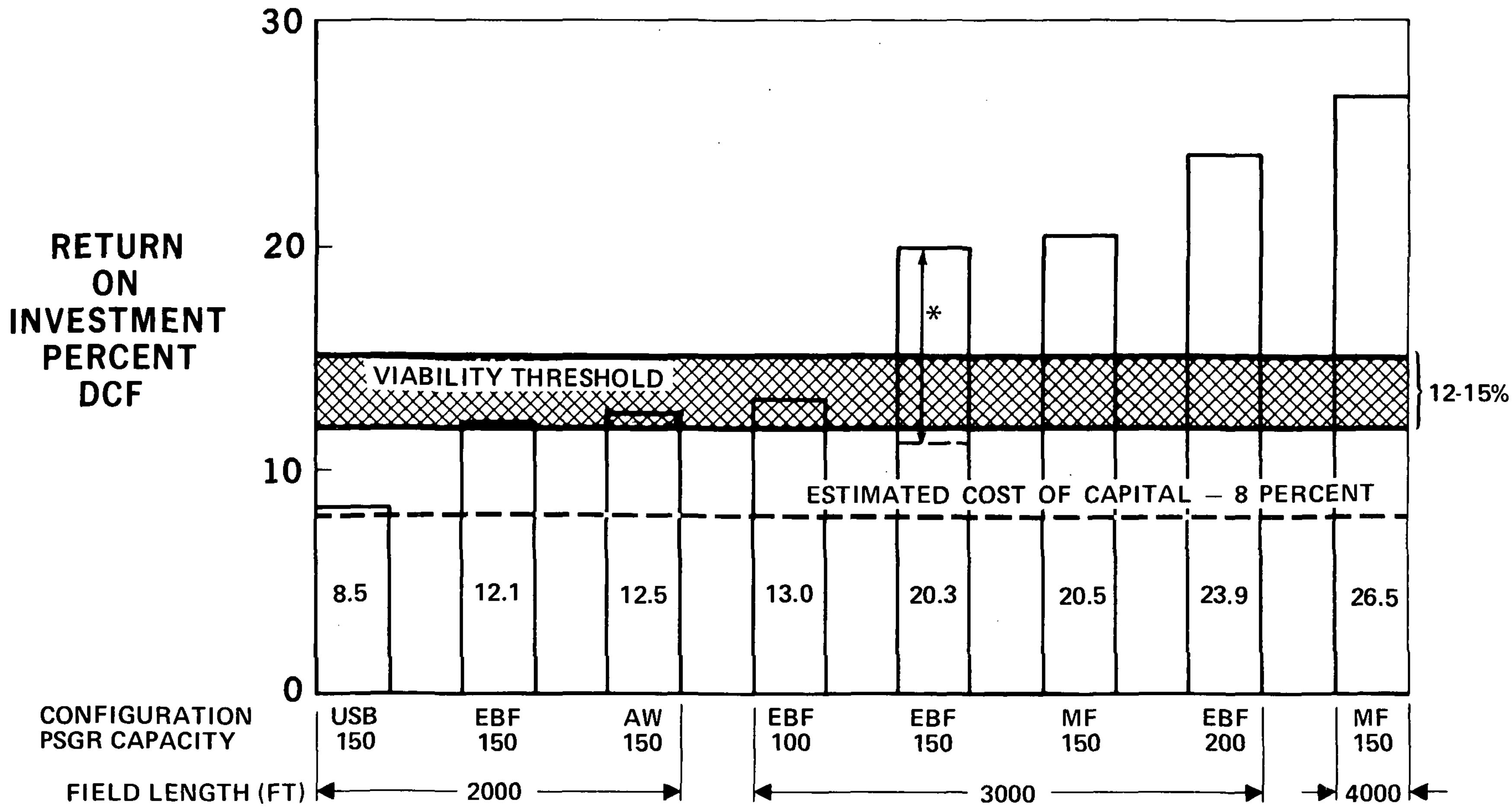
[a]The California regional STOL system is a special case. In the California corridor intrastate fare structures on the order of 50 percent of the CAB Phase 7 jet coach fares present a special entry barrier. This region is discussed separately in Section 4.5.

RETURN ON INVESTMENT - DISCOUNTED CASH FLOW

REPRESENTATIVE REGION (CHICAGO)



*ROI VARIATION DUE TO FINANCIAL, OPERATIONAL AND DYNAMIC PERTURBATIONS.

PR3-STOL-1839 A

FIGURE 1-11

- Despite the promise of long term viability, the initial operating years probably would require subsidy, if basic assumptions are accurate. The cumulative profits may not be large enough to induce the required investment. The regional systems studied might require subsidies for a few years. The sharply improved operating results probably would preclude subsidies to individual operators after the fifth or sixth year.
- The financial outlook is not as sanguine wherever a regional STOL system must compete against intrastate operations constrained to the sharply reduced fare structures imposed by state Regulatory Commissions. For example, the California Region system would require an annual $60.5 million pre-tax subsidy to offset lower yield from California intrastate flights. The choice under these circumstance is either permanent subsidy either direct or in the form of premium route awards or alternatively deep cuts in indirect operating costs. Direct costs cannot be substantially trimmed while maintaining flight safety. Of course the STOL airplanes offer more comfort than the typically high density intrastate configurations. However, it is not clear how well this greater comfort can be translated into either higher intrastate load factors or fare premiums above intrastate fares or a mixture of both.
- Recently, the CAB has directed carriers to phase out domestic youth and family fare discounts in three stages through June 1, 1974, Reference 65. At the time of its original decision in December 1972 the CAB also directed airlines to cancel the

"Discover America" excursion fares. If such action takes place, then the assumption and application of the 13 percent fare dilution in this study can be deleted (or at least reduced) and the ROI would move to the upper end of the viability threshold as described above.

In the case of the California Region the three-percent fare dilution is intentionally conservative. There are indications that this dilution value approximates 1.6 percent.

- One of the primary results of the continuing engineering design and analysis activity was the finding that high bypass ratio, low fan pressure ratio engine technology could be successfully exploited to markedly improve airplane performance, weights and economics. The results of this intensive investigation showed that only small noise penalties, on the order of 1 to 2 db, would occur if the noise suppression rings were deleted from the inlet and exhaust ducts of certain engine families. When all the designs were reevaluated the E150.3000 had a 15,000-pound gross weight reduction reflected by a 9,500-pound lighter airplane in cost weight - a difference of almost 10 percent. The price was reduced by 7.2 percent from $11.3M to $10.5M.
- Military/Commercial commonality studies showed that such an approach is economically feasible and could produce a viable short-haul STOL airplane which could also be stretched into larger payload and longer range CTOL airplanes.
- Current technology will support the development, production and operation of economically viable quiet, turbofan STOL

airplanes for short-haul transportation. However, advances in technology will provide significant economic and operational gains.

1.5 Total System Cost and External Effects

The STOL system affects many more segments of the economy than is commonly realized. The total implications, in terms of total system cost, as seen by various users and contributors to STOL system development and operations were estimated for the aerospace industry, construction industry, regional airlines, the public and the lending institutions and are shown in Table I-5. Estimates were made of the interrelated effects upon the total economic system and are displayed in this report as a gross transaction flow. The indirect benefits in terms of the effects on the gross national product, government receipts and employment were also developed from the generation of the end product - the STOL airplane.

TABLE I-5

THE COSTS OF THE DOMESTIC STOL SYSTEM FOR EACH SEGMENT OF THE ECONOMY

DOLLARS - MILLIONS

	INVESTMENT	OPERATIONS	TOTAL
TRAVELING PUBLIC	—	19,769.4	19,769.4
FEDERAL GOVERNMENT	155.7	173.4	329.1
LESS RECEIPTS - TAXES	—	*3,482.6	*3,482.6
TOTAL	155.7	3,309.2 CR	3,153.5 CR
LOCAL GOVERNMENT	201.9	629.0	830.9
LESS RECEIPTS	—	*1,381.6	*1,381.6
TOTAL	201.9	752.6 CR	550.7 CR
AEROSPACE INDUSTRY	—	*6,623.3	*6,623.3
CONSTRUCTION INDUSTRY	—	* 307.5	* 307.5
FINANCIAL COMMUNITY - DEBT	2,044.3	*1,695.0	349.3
- EQUITY	1,362.8	* 681.4	681.4
TOTAL	3,407.1	2,376.4	1,030.7
DOMESTIC AIRLINE INDUSTRY	2,991.1	13,776.6	16,767.7
LESS RECEIPTS	—	*17,687.6	*17,687.6
TOTAL	2,991.1	3,911.0 CR	919.9 CR
FOREIGN AIRLINE INDUSTRY	2,037.2	578.1	2,615.3

* RECEIPTS

2.0 INTRODUCTION

2.1 General

The Douglas economic analysis supporting the "Study of Quiet Turbofan STOL Aircraft for Short-Haul Transportation" had two primary objectives:

- Determine the economic characteristics of various airplane configurations, and
- Determine the economic characteristics of each STOL transportation system.

The emphasis of these two objectives is upon the characteristics of the airplanes and transportation systems rather than upon precisely defining the specific costs associated with each candidate design or hypothetical transportation system. From the outset

> "it is not intended that this study define actual transport airplanes or dictate the selection of specific lift concepts; the required design studies are to provide a realistic basis for systems analysis and technology assessments." (Reference 60)

Once the resources and interfaces were defined the experience of the other contractors (Detroit Diesel Allison and General Electric Company), the four consulting airlines (Air California, Allegheny, American and United), and the extensive literature provided by previous studies were used to specifically adapt existing methods and models to the analysis of STOL transportation economics. While most of the changes to existing methods were minor, the systematic review assured maximum credibility of the resulting revenue, cost and operational estimates.

This volume contains the complete analytical development incorporating as necessary the integrated results of other study tasks. However, it is recognized that the economic, technical, airport, market and systems analyses issues are interrelated. An overview of STOL transportation must embrace not only the results of this and other contemporary studies, but, also an appreciation of recent general transportation developments.

2.2 Background

Over the past fifteen years, the U.S. transportation system has been rapidly evolving. Cargo containerization has become a way of life for the air, sea, and surface modes. Long-haul passenger transportation has become the province of the airlines; and, short-haul passenger transportation appears to belong to the private automobile. National recognition of the evolution gave rise to the Department of Transportation, charged with the responsibility for creating and implementing national transportation policy. Advanced technology has provided a lever for altering traditional concepts of the relative mix of transportation modes applied to each of the vital movement functions. The high capital costs associated with the extension of high speed mass passenger movement to new or less heavily used routes has suggested STOL airplanes may provide less capital intensive solutions at near minimum operating costs.

Effective new programs for coping with the primary problems of congestion and noise around airports in the U.S. will probably involve new expenditures of both public and private funds. Rational formulation of public policy requires that applicable economic facts and relationships be analyzed, stated and applied to the problem of how to allocate such additional costs among the producers of airplanes, airlines, other users of airplanes, airport operators and the general public through Federal and local government agencies. However, aeronautical advances are subject to a variety of institutional constraints which can be categorized as regulatory and legal, market and financial, and organization and social.

There always is a compelling competition among the various government agencies for available funds. In recent years this competition for available funds has become more intense due to the limitation of such funds. This has created an ordering of priorities, and, an awareness of the broader national objectives is essential in order to exhibit realistic and contributory benefits that can be derived from the STOL System Studies. It is not intended that the economics in this study justify creating a new need or satisfy a want; but, rather to credibly show how to satisfy an existing need on a national level. Also, we are in the latest stage of industrialism in which technologists and their sponsors are being held politically accountable for the effects of their technology. Business has had about fifty years to do as it wished and engineers about twice that long; but, that all appears to be coming to an end. Early industrialism placed a great premium on innovation and the garnering of first order profits without assessing second and third order costs. These technologists are now required to solve their problems in the context that economics was implemented.

The study has focused on the potential market for, the preferred operational concepts, the design characteristics and the economic viability of extensive STOL short-haul passenger operations. In particular, this volume addresses three central issues governing economic viability:

- Operator economics given the market
- The required transportation facilities
- The external economic effects of a set of regional STOL transportation systems.

2.3 Overview

Figure 2-1 illustrates the coordination of the major economic elements between the NASA and Douglas. The study procedures and computer programs remained virtually intact throughout Phase I and Phase II. Phase I was initiated with a comprehensive literature search to identify resource elements and to quantify and validate STOL input data and computational procedures. The principal resource identification issues were the definition of consistent computations of DOCs and IOCs and ROI. The principal interface problems involved specifying a standard design mission profile, defining ground and air maneuver times and determination of STOL block fuel and reserve requirements. After the NASA concurrence, the existing Douglas DOC, IOC and ROI models were modified to incorporate the revised constants as documented in Section 7.4.

Once the airline elements were defined a short-haul economic flow model was developed. This model depicts the gross transactions among the several components of the public and private sectors, Figure 2-2. The public sector transactions are the results of capital and operating requirements at both the federal and local levels, air traffic control and airport facilities

NASA/DOUGLAS COORDINATION

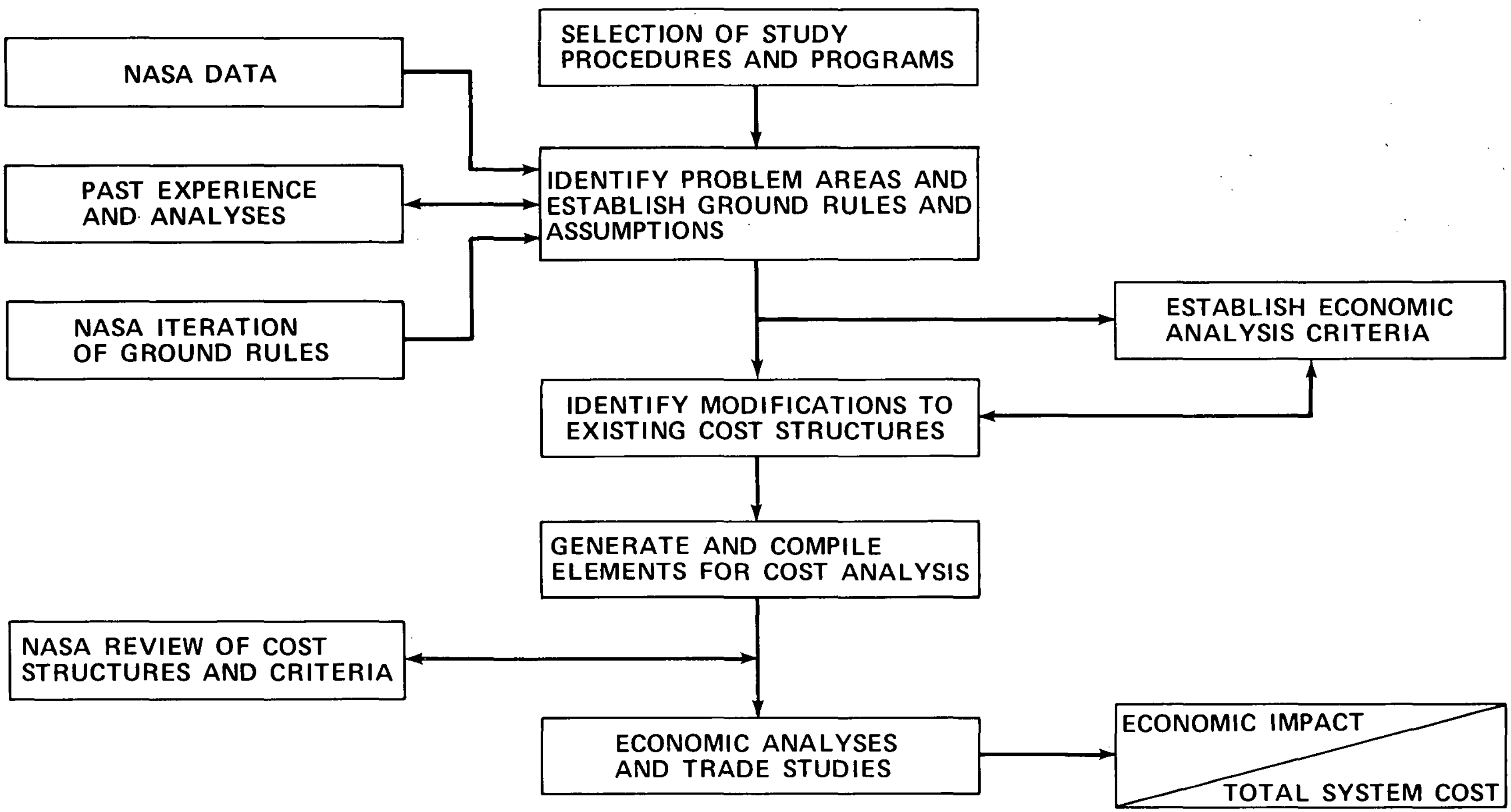


FIGURE 2-1

PR3-STOL-1604

SYSTEM ECONOMICS STRUCTURE

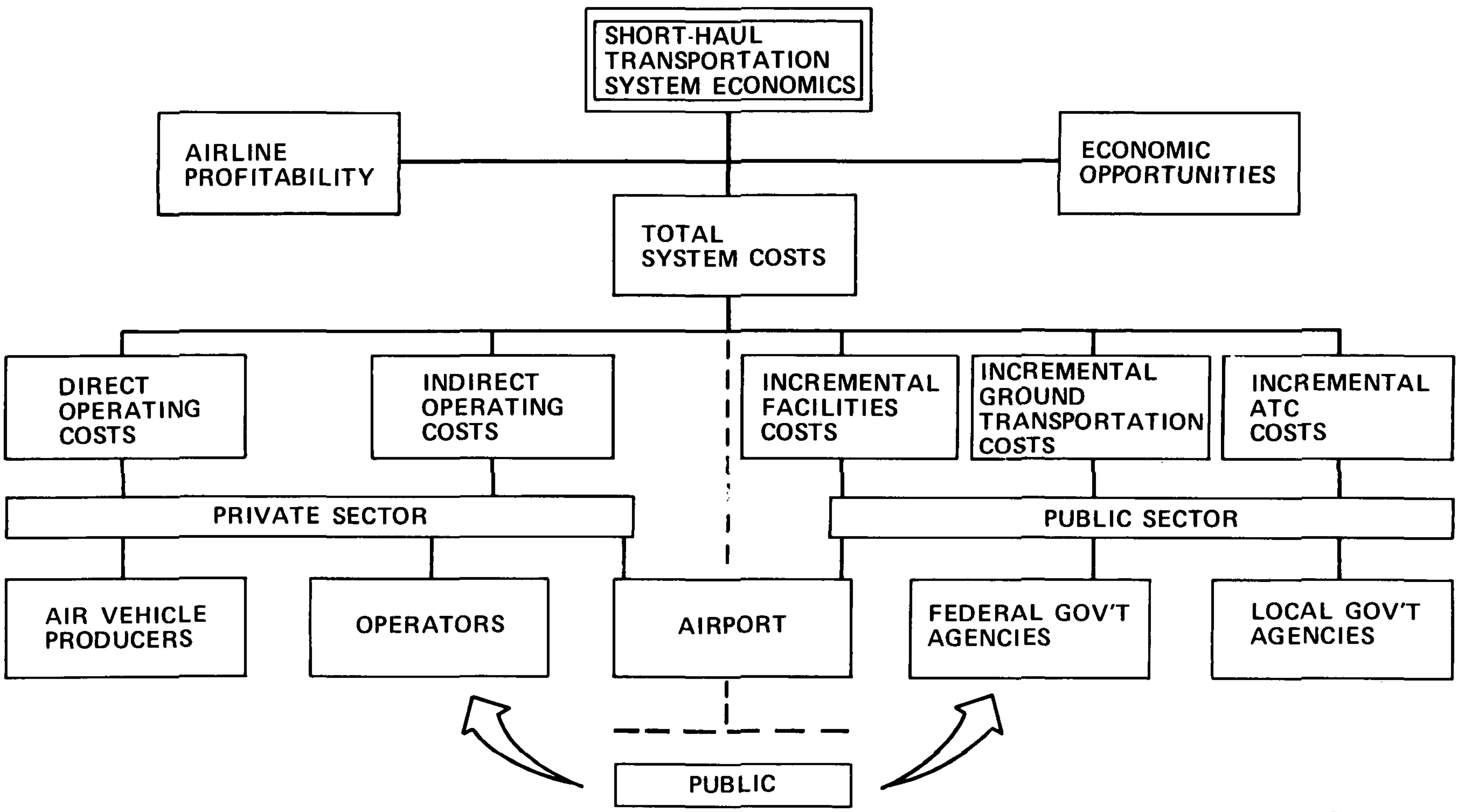


FIGURE 2-2.

PR3-STOL-1614

respectively. Private sector transactions[a] are primarily generated by the airline and the supporting aerospace manufacturing industries. The transaction flow information provides the basis for the total system cost estimate. The transaction data are the primary inputs into the econometric model which calculates the anticipated external efforts.

The transaction flow information treats each component as a "black box", Figure 2-3. Investments are provided to the operating entity, later reduced by debt retirement, and recompensed by dividends and interest. Revenue is provided by the travelling public while wages and salaries are paid to employees. Fees, rentals and taxes flow from the airline to the various government entities.

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[a]There is an important difference between economic and accounting transactions. For example, depreciation is an accounting "transaction" but not an economic one. The economic analogue is composed of the working capital generated by depreciation and/or the repayment, if any, of debt. A similar difficulty exists in comparing public and private investments. Public investments almost always are treated as an instantaneous expenditure. On the other hand private sector investments usually are spread over extended periods using a mixture of cash and debt.

AIRLINE PROFITABILITY

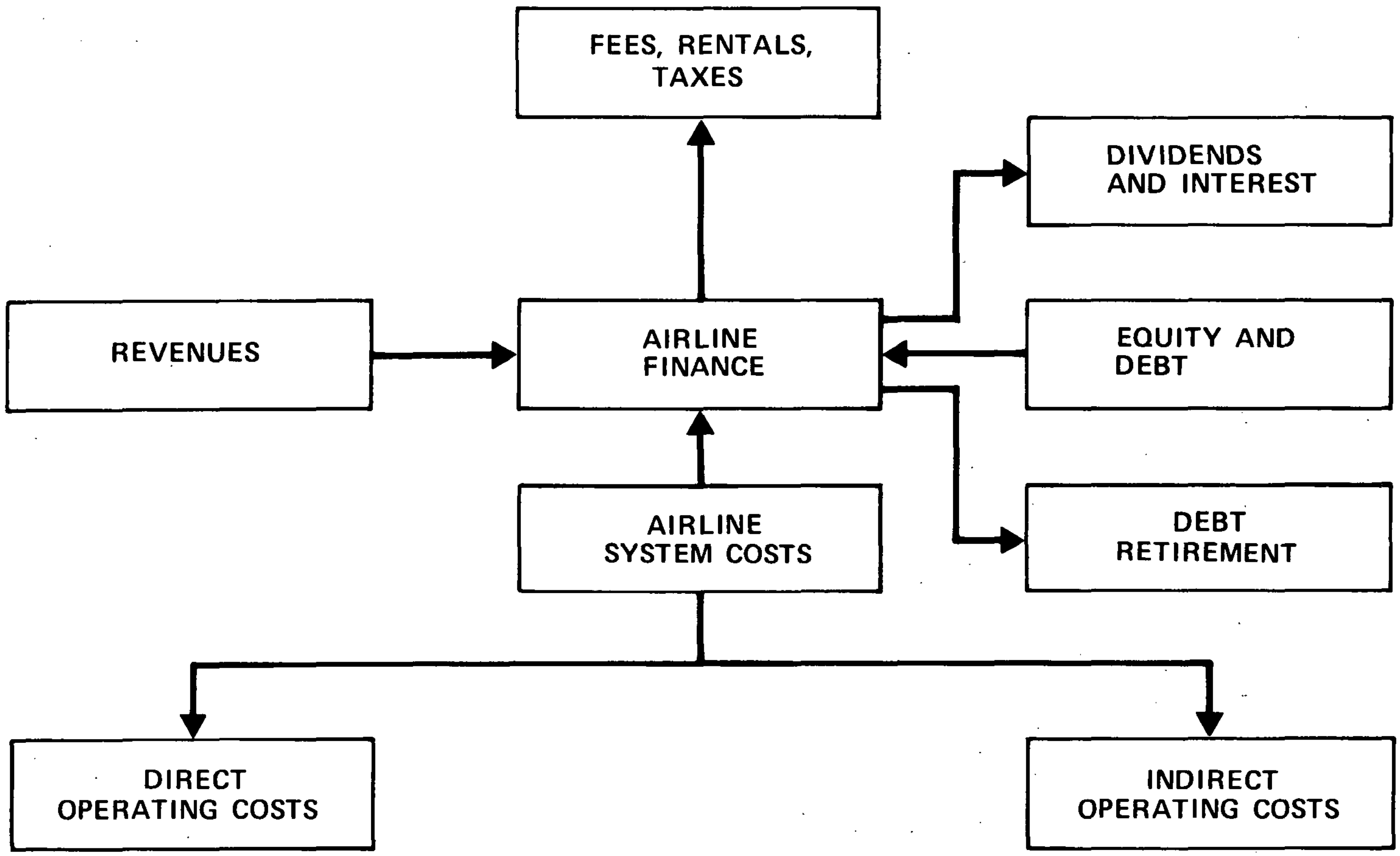


FIGURE 2-3.

PR3-STOL-1603

3.0 ABBREVIATIONS, ACRONYMS & SYMBOLS

A	Allison engine, when used <u>after</u> airplane model designation
A	Augmentor wing, when used <u>before</u> airplane model designation
acft, ACFT	Aircraft
ADAP	Airport And Airway Development Program
ADC	Air data computer
ADF	Automatic direction finder
ADV	Advanced
airp.	Airplane
ALT	Altitude
AP/FD	Automatic pilot/flight director
apkm, APKM	Airplane-kilometer
apm, APM	Airplane-mile
askm, ASKM	Available seat-kilometer
asl, ASL	Average stage length
assm, ASSM	Available seat-statute mile
A/T	Airspeed transducer
ATA	Air Transport Association
ATC	Air traffic control
AW	Augmentor wing
blk, BLK	Block
BPR	Bypass ratio
C	Advanced CTOL, when used <u>before</u> airplane model designation
CAB	Civil Aeronautics Board
CAPDEC	<u>C</u>ommercial <u>A</u>irplane <u>P</u>roduction and <u>De</u>velopment <u>C</u>ost

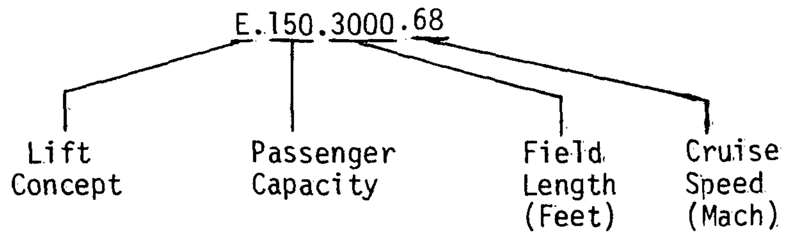
CAT IIIa	Category IIIa
CNTRL	Control
COMM/ADVER	Commissions and advertising
COC	Cash operating cost
CRT	Cathode ray tube
CTOL	Conventional takeoff and landing
CUM	Cumulative
CW	Cost weight
DAC	Douglas Aircraft Company
DME	Distance measuring equipment
DOC	Direct operating cost
E	Externally blown flap, when used <u>before</u> airplane model designation
EADI	Electronic attitude director indicator
EBF	Externally blown flap, when used alone
EBU	Engine build-up unit
ENG	Engine
EPNdB	Effective perceived noise, decibels
EPNL	Effective perceived noise level
EPR	Engine pressure ratio
EXP	Expense
FAA	Federal Aviation Administration
FDAU	Flight data acquisition unit
FED	Federal
flt, FLT	Flight
ft, FT	Feet, foot

G	General Electric engine, when used <u>after</u> airplane model designation
G&A	General and administrative
G.E.	General Electric
GHE	Ground handling equipment
GPE	Ground property and equipment
GS	Glide slope
GSE	Ground support equipment
ha.	Hectare
HF	High frequency
hr, HR	Hour
HSI	Horizontal situation indicator
IFGCS	Integrated flight guidance and control system
ILS	Instrument landing system
IND	Indicator
IOC	Indirect operating cost
K_{1-10}	IOC expense category factors
K_{A-J}	IOC expense category adjustment factors
kg	Kilogram
km	Kilometer
kN	Kilonewton
LAC	Lockheed Aircraft Corporation
lb, LB	Pound
LOC	Localizer
M	Mechanical flap, when used <u>before</u> airplane model designation
M	Million

m	Meter
MAX	Maximum
MEW	Manufacturer's empty weight
MF	Mechanical flap
MIL	Million
min, MIN	Minute
MWE	Manufacturer's weight empty - same as MEW
NASA	National Aeronautics and Space Administration
NAV	Navigation
n. mi., N. MI.	Nautical mile
no., NO.	Number
O	Over-the-wing, when used <u>before</u> airplane model designation
OEW	Operator's empty weight - same as OWE
OWE	Operator's weight empty - same as OEW
P_{72}	Airframe price function for 1972
PA	Public address
PAX	Passenger
$P_{ENGINES}$	Price of engines
PNdB	Perceived noise, decibels
PSA	Pacific Southwest Airlines
PSGR	Passenger
PUC	Public Utilities Commission
qty, QTY	Quantity
RAND	Rand Corporation
RFP	Request for proposal

ROI	Return on investment
ROM	Rough order of magnitude
rpkm, RPKM	Revenue passenger-kilometer
rpsm, RPSM	Revenue passenger-statute mile
R/T	Receiver/transmitter
SCAS	Stability and control augmentation system
SELCAL	Selective call
SFC	Specific fuel consumption
st. mi., ST. MI.	Statute mile
STOL	Short takeoff and landing
SUSYS	Subsystem
TMS	Transmitter mode selector
TOC	Total operating cost
TOGW	Takeoff gross weight
U	Upper surface blowing, when used before airplane model designation
UHF	Ultrahigh frequency
U. S.	United States
USB	Upper surface blowing, when used alone
VHF	Very high frequency
VOR	VHF omnirange
W_{MT}	Weight empty
yr, YR	Year
$	Dollars
¢	Cents
%	Percent

STOL Airplane Model Designation



4.0 RESULTS AND ANALYSES

4.1 Airplane Cost Analysis

4.1.1 Estimating airplane prices. - Costs and prices were developed on a continuous basis to respond to different types of technical and management decisions. They were also used to measure the impact on the major resource categories of the Investment Base and Operations. Proven cost analysis techniques were used to establish a proper economic basis for decision-making. Estimates were derived from a systematic and organized approach to predicting cost behavior in the future, on the basis of what is now known and the expected advancements in the state-of-technology. However, the relationship of technology to cost behavior is more subtle than can be expressed by continuous functions and trend analysis estimates for the candidate systems. These systems were configured (in whole or in part) with current state-of-technology design concepts, materials and manufacturing methods. The resulting cost estimates were derived using standard documented costing techniques having quantified measures of reliability and dependability. The advanced technology elements necessitated application of judgment to modify the existing statistical and engineering analysis techniques (used in current state-of-technology costing) to reflect the anticipated cost impact of advanced technology.

4.1.1.1 STOL airplane price substantiation and derivation. - Substantiating the reasonability of projected airplane program costs and/or prices has been a controversial issue. System procurement history is replete with documented cases of the unreliability of early aircraft system cost estimates. The Douglas Advance Design approach to costing (pricing) the candidate STOL systems originally was selected to minimize gross understatements of probable STOL airplane costs.

This requires the use of a consistent set of computations to determine the relative cost differences among generic designs. In addition, the computations must be derived from historical information to assure correspondence of the calculated costs with the cost levels that would be obtained if the airplanes were actually manufactured. Next, a pricing strategy relating production costs to market prices must be developed which uses the realistic costs in a realistic market size and producer's risk environment. Finally, the resulting prices must be tested against the willingness of the airline operators to procure such equipment.

The test hypothesis is straight forward. The less complex STOL system costs, excluding engines, should approximately overlay the present new airplane market prices again excluding engines. Engine costs must be treated separately for two reasons. One, a larger proportion, per se, of STOL airplane weight and cost must be devoted to propulsion and two, the quiet airplane requirement increases this proportion even more because the installed to uninstalled thrust ratio is degraded due to noise treatment requirements. Following a general discussion of cost per seat trends, the substantiation begins by deriving the current market price trend. Next, this current airplane price trend is related to projected STOL airplane costs. Finally, the airframe cost and weight for current airplanes and the candidate STOL airplanes are shown to be commensurate. Of course, this means moderate STOL airframes incur no great cost penalty. The major penalty falls on the propulsion system to handle field length and the collateral noise criteria.

4.1.1.1.1 Airplane cost model. - The Commercial Airplane Cost and Production Model (CAPDEC-K7CA) used to estimate development and production costs reflects the research results of two organizations. The basic log-linear regression equations relating airplane characteristics, (weight and speed) to resource requirements (engineering, tooling and manufacturing hours and material costs) and program assumptions (production rate, quantity, and Authority to Proceed) were developed by the Rand Corporation. The initial publication followed by several revisions is based upon an analysis of various relationships among some 40 military aircraft programs. (The sample size varies for each relationship because there are significant gaps in the basic data.) This fundamental research could not have been performed by a single manufacturer because the analysis requires access to industry wide proprietary cost accounting data.

The basic model was assessed to determine significant perturbations resulting from Douglas commercial airplane cost experience.

- The most significant restructuring was occasioned by the relative insensitivity of cost to design speed over the high subsonic speed regimes. While the Rand model depicts a general speed influence up to Mach 2 plus, Douglas transport experience centers around the Mach .75 to .85 area.
- Transport production history suggests a flattening of the manufacturing labor and material cost/quantity relationship in the vicinity of 250 units. (A result also noted in Reference 57).
- Recent detailed analysis of transport engineering cost rejects the smooth cost quantity mathematical assumption used by Rand and proposed a higher non-recurring charge and a steeper learning curve slope.

- The rapid evolution (or revolution) of airplane flight test technology and procedures necessitated an updated flight test cost concept. This, in turn, generates changes in the development support equations.

In summary, the results of the original and modified models produce about the same total cost for 250 airplanes, but the distribution of the costs has been changed. The general effect can be seen in Figure 4-1. The exact cost ratio depends upon airplane configuration and program assumptions.

4.1.1.1.2 Price derivation. - During Phase I, when specific market estimates were not available, a conservative pricing point of 20 percent profit over a production run of 300 airplanes was used to provide estimated airplane prices for other program tasks. At that time, it was also thought that the upper limit of the market would be on the order of 300 airplanes. A maximum market of 300 would require high profit incentives to attract an airplane manufacturer. The 20-percent margin was chosen to provide that incentive.

As subsequent studies indicated a market on the order of 800 commercial airplanes, it became apparent that the pricing quantity should be larger. Assuming two manufacturers, this would leave a basic commercial market of 400 airplanes per producer.[a] The existence of a military STOL market provides additional sales potential, for an airplane with a substantial degree of commonality. The existence of this larger potential market sharply reduces the risk of pricing at 400 units. Therefore, a lower percentage incentive should be sufficient to attract at least one entry. And, the pricing strategy was changed from 300 units at 20-percent profit margin to ten percent at 400 units.

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[a]The market reported in Volume IV is summarized in Appendix 7.2 of this volume.

TOTAL COST RATIO vs QUANTITY

$$R = \frac{\text{MODIFIED TOTAL COST}}{\text{ORIGINAL TOTAL COST (RAND)}}$$

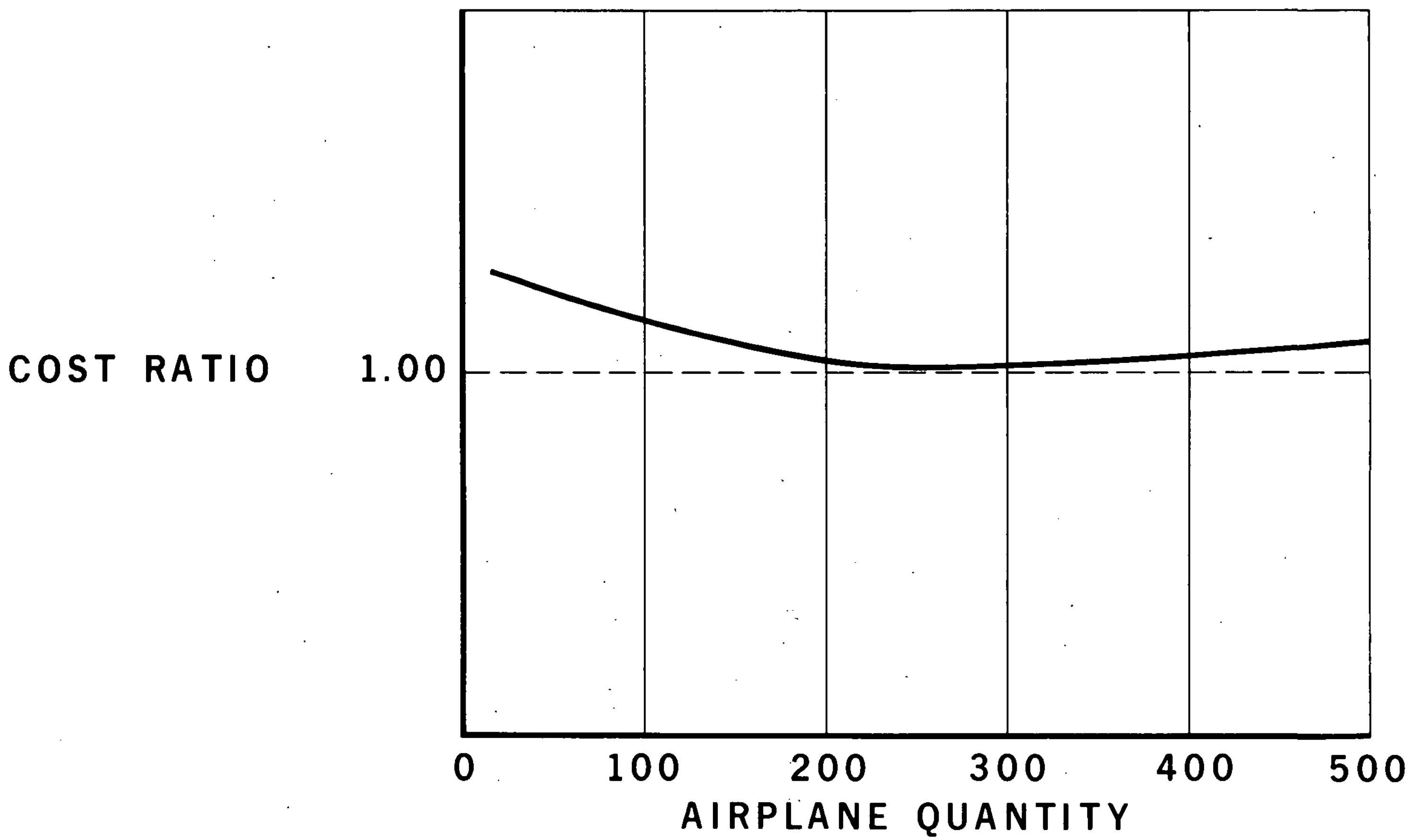


FIGURE 4-1.

PR3-STOL-1615

The effect can be shown in Figure 4-2 which compares the Phase I and Phase II strategy points for the E150.3000.68 airplane.

	STRATEGY POINT			
	PHASE I		PHASE II	
	TOTAL	UNIT	TOTAL	UNIT
TOTAL COST (MILLIONS)	3,492	11.64	4,116	10.29
PROFIT	696	2.32	412	1.03
TOTAL	4,188	13.96	4,528	11.32

The unit price declines by almost 19 percent, the unit profit by 56 percent and the unit cost by 12 percent.

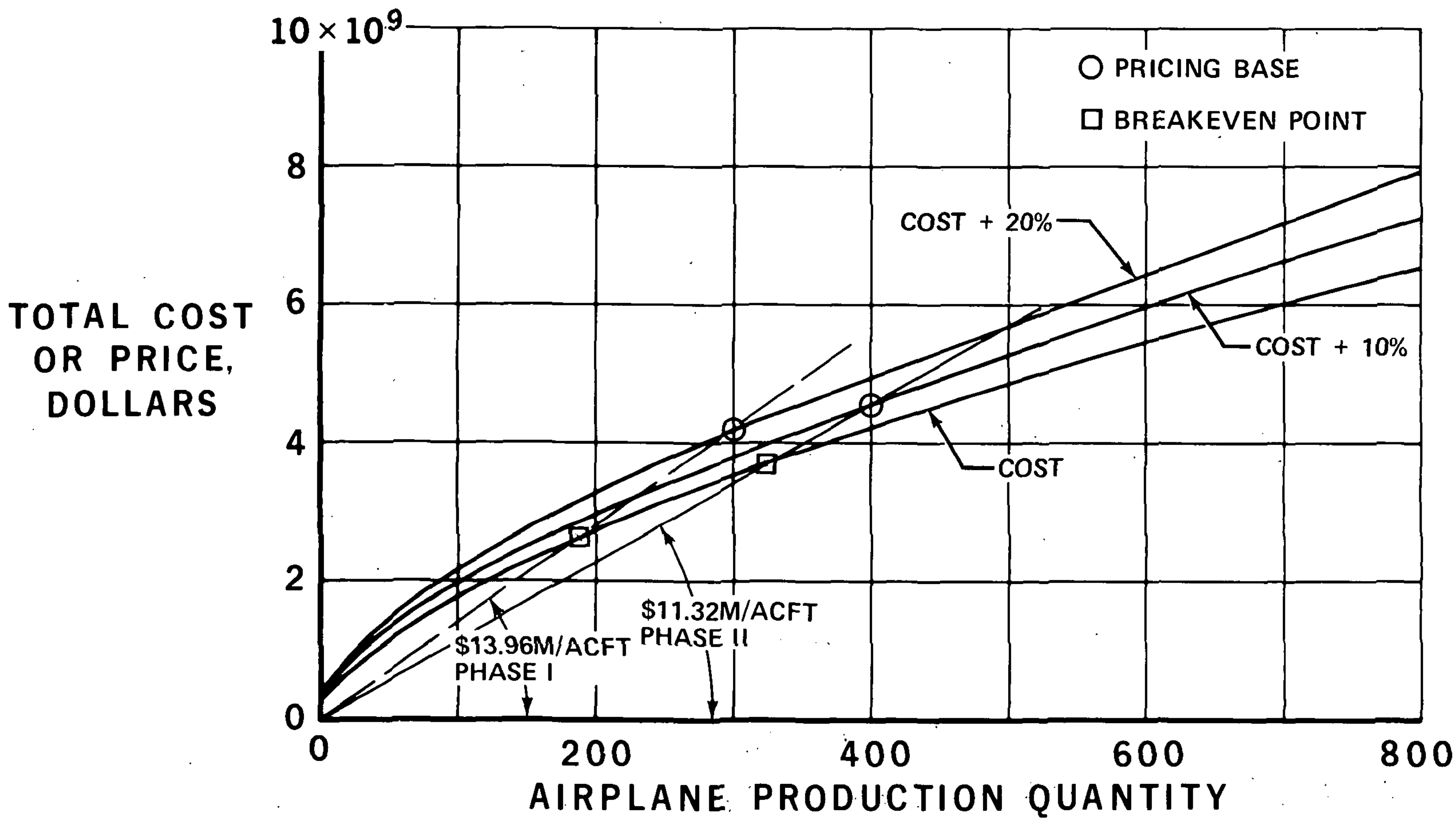
4.1.1.1.3 Price per seat trends. - The unit price of an airplane in terms of price per seat represents a rough index of the potential profitability of an airplane. Recently the price per seat of transport airplanes has ranged from about 15,000 dollars to over one hundred thousand dollars, depending upon the size, range, speed, and field length performance of the airplane. Cost per seat declines with size for a fixed range, increases with range, and increases with speed and short field capability. Other factors influencing the variation are the economic environment of the producer, production rate and the estimated market.

Comparison of the price per seat of the Phase II STOL candidates with the band representing recent market price conditions shows the STOL price per seat data lying above the band. This suggests a rather large premium for quiet STOL performance or, alternatively, overstated cost estimates, Figure 4-3.

The latter conclusion is rapidly dispelled if the data are restricted to "airline" as opposed to general aviation airplanes. The data presented in

COMPARISON OF PHASE I AND PHASE II STRATEGY POINTS

E150.3000.68A[a]

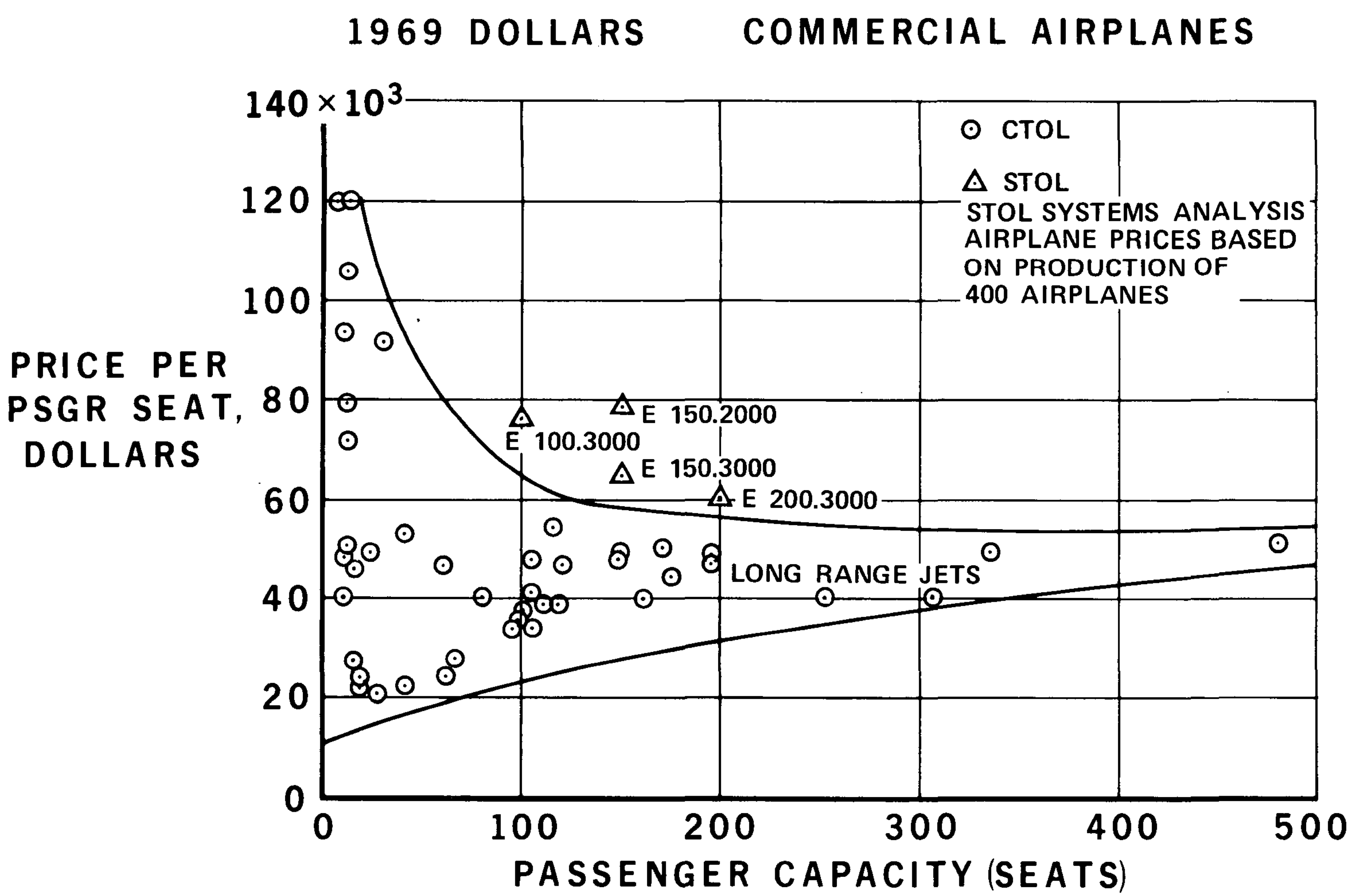


a — SYSTEMS ANALYSIS AIRPLANE

PR3-STOL-1618B

FIGURE 4-2.

AIRPLANE PRICE PER PASSENGER SEAT vs NUMBER OF SEATS



PR3-STOL-1620B

FIGURE 4-3.

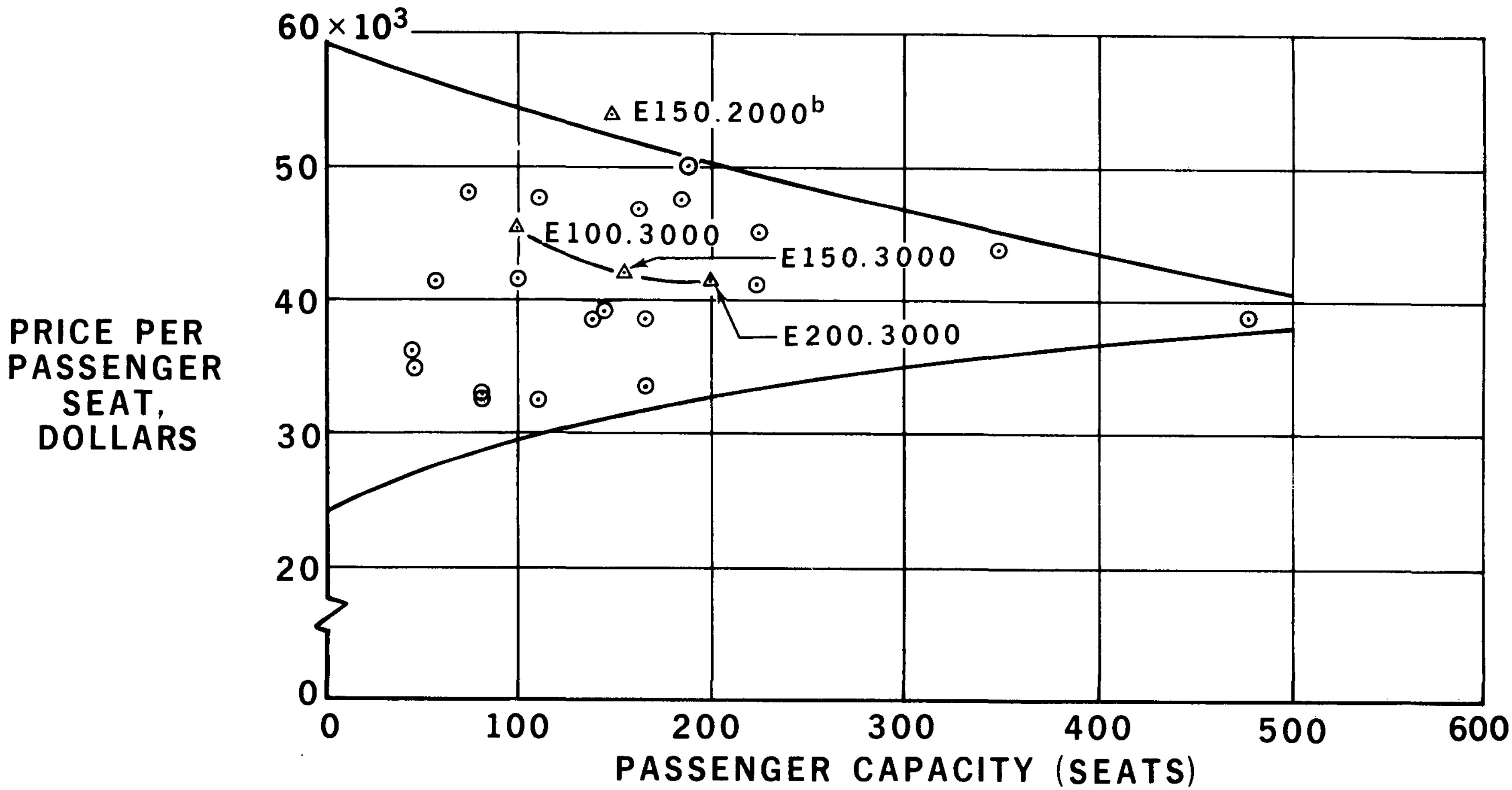
Figure 4-3 has been replotted in Figure 4-4 excluding general aviation airplanes and deleting estimated engine prices. Now only the extremely short field airplanes (2000 ft/610 m) or high technology concepts lie outside the general price per seat band. This points to the general cost commensurability of STOL and current CTOL airframes. However, this approach still suggests a premium, in terms of price per seat, for moderate STOL performance airplanes. Whether this is a performance penalty or pricing penalty can be determined by examining the airplane market in closer detail.

4.1.1.1.4 Current transport airplane market prices. - There are a number of ways to relate the market prices of airplanes to their characteristics; e.g., price versus capacity, price versus productivity, price versus work capability and price versus weight. All of these approaches were presented in Phase I using both domestic and foreign and general aviation and airline airplanes at 1969 market prices, Appendix 7.7. The present analysis considers only domestic airline airplanes and 1972 market prices or their equivalent. The restricted sample, then, eliminates the effects of non-U.S. production practices and economic climate and the effect of governmental subsidy programs.

The resulting plot of 1972 Market Price versus Manufacturer's Empty Weight, Figure 4-5, was developed from a variety of sources. Consequently, there is considerable dispersion around the 1972 price function, P_{72}. The dispersion also arises, in part, from the use of specific prices and MEWs for some airplanes and the use of generic prices and weights in others, e.g., MEW = .936·OEW. The resulting linear price function depicts the nominal price an airline is willing to pay for a transport airplane in 1972. Price and weight transformations of the price function directly lead to a comparison of STOL airframe prices and weights in relation to the 1972 market.

AIRFRAME PRICE[a] PER PASSENGER SEAT vs NUMBER OF SEATS

AIRLINE TYPE AIRPLANES 1969 DOLLARS



a – AIRFRAME PRICE = AIRPLANE PRICE – ENGINE PRICE

b – FOUR SYSTEMS ANALYSIS AIRFRAMES SHOWN

PR3-STOL-1611A

FIGURE 4-4.

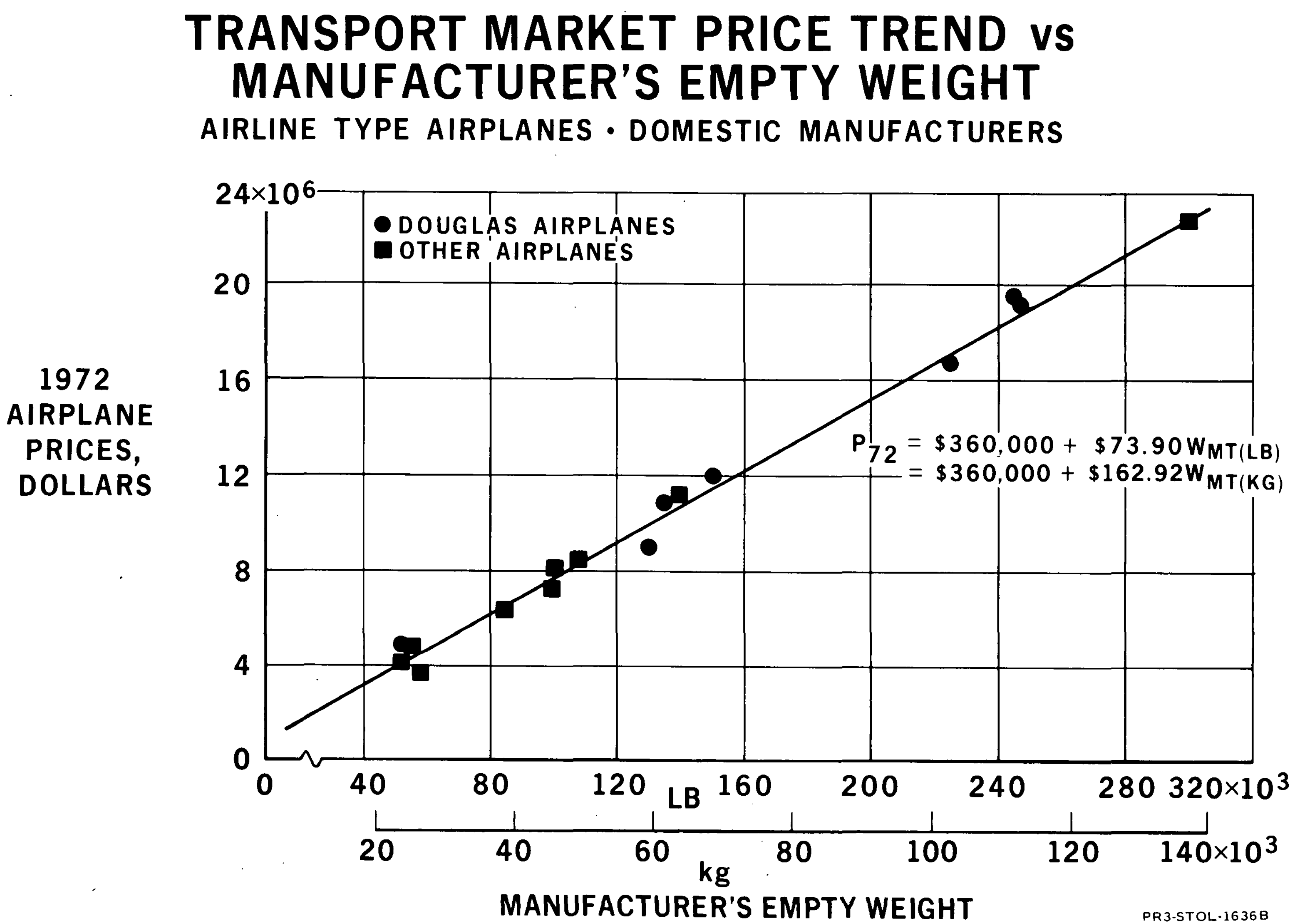

TRANSPORT MARKET PRICE TREND vs
MANUFACTURER'S EMPTY WEIGHT
AIRLINE TYPE AIRPLANES • DOMESTIC MANUFACTURERS
DOUGLAS AIRPLANES
OTHER AIRPLANES
1972
AIRPLANE
PRICES,
DOLLARS
24×10^6
20
16
12
8
4
0
0
40
80
120
160
200
240
280
320×10^3
LB
20
40
60
80
100
120
140×10^3
kg
MANUFACTURER'S EMPTY WEIGHT
P72 = $360,000 + $73.90W MT(LB)
= $360,000 + $162.92W MT(KG)
PR3-STOL-1636B

FIGURE 4-5.

4.1.1.1.5 Phase II STOL airplane unit costs. - During Phase I, the airplane price was assumed to be the average cost of 300 aircraft with a 20 percent profit margin. Naturally, these assumptions provided a price higher than that reflected by the market where the breakeven point, even before it begins to creep due to model changes, is on the order of 300 to 400 aircraft and the anticipated profit at that quantity is far less. The Phase II airplane unit costs are based on 400 airplanes and 10 percent profit.

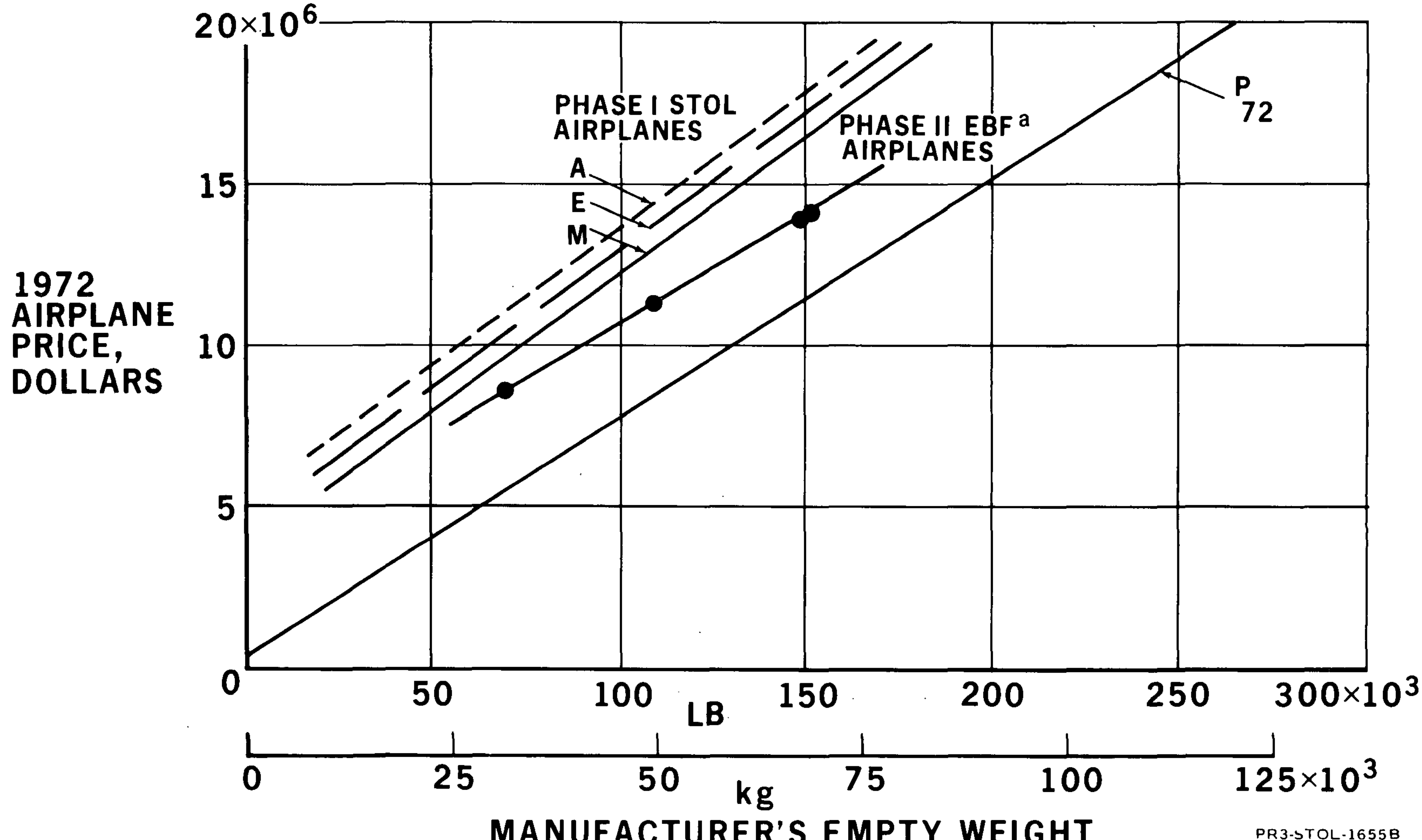
Representative Phase II and Phase I results, in relation to the 1972 price function, P_{72}, explained above are shown in Figure 4-6. The change in ground rules and designs has sharply narrowed the difference between the STOL results and the 1972 price function.

4.1.1.1.6 Airframe price trends. - The final step considers the airframe cost as a function of the airframe weight. The translation is accomplished by subtracting engine prices from airplane prices and concomitantly subtracting engine weight from airplane weight. The results for the Douglas models making up the current market and the STOL candidates are shown in Figure 4-7. Here the EBF airframe costs lie along a slightly shallower line than the transformed P_{72} function. However, the differences between these airplanes and the transformed current market function are well within the error band of the current market, as indicated by the dispersion of the individual DC-8's, DC-9's and DC-10's around the transformed current market function.

Examination of the more modest technology requirements for the 3000 ft (914 m) STOL designs provides no suggestion that the 3000-ft (914 m) STOL airframe should cost more than a current CTOL airframe of the same weight. But, as the field requirements become more stringent and more exotic design concepts are employed, a cost penalty for advanced technology might be expected.

PHASE II STOL AIRCRAFT PRICE vs MANUFACTURERS EMPTY WEIGHT

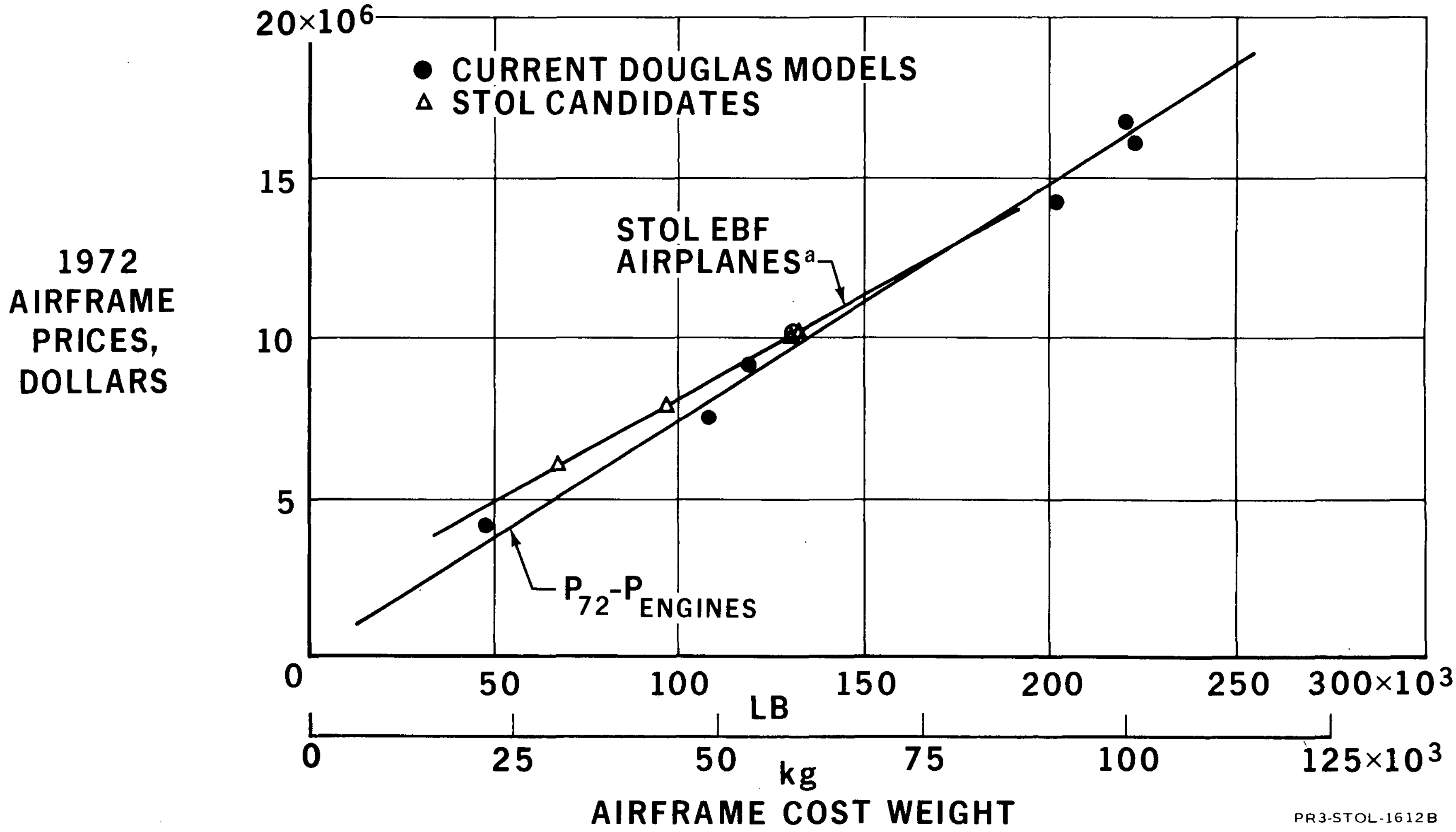
PHASE I PRICES AND 1972 MARKET PRICES



a – SYSTEMS ANALYSIS AIRPLANES

FIGURE 4-6.

1972 AIRFRAME PRICE vs AIRFRAME COST WEIGHT



a — SYSTEMS ANALYSIS AIRPLANES

FIGURE 4-7.

4.1.2 Estimating engine and nacelle prices. - Under their NASA contracts, Detroit Diesel Allison and General Electric provided engine and nacelle estimated prices for the STOL engines used during Phase I (parametric) and Phase II (refined) design studies. The engine cycles generally feature high bypass ratios and high engine thrust to weight ratios compatible with reasonable advances in propulsion technology. The price levels associated with these engines are commensurate with current commercial pricing practices given the postulated technology. Therefore, a procedure was developed to interpolate engine costs and prices from the data obtained by the two contractors.

The engine manufacturer's selling prices and the uninstalled thrusts are tabulated in Table IV-1. The plot of these data, Figure 4-8, shows no simple relationship between pure engine thrust and price because the engine cycles for each lift concept are different. In all cases airplanes based upon the General Electric engines are considerably heavier than those based upon Allison engines. Therefore, only the Allison price data were carried into Phase II. The selling prices include prorated development and production costs including the engine manufacturer's profit, but, excluding the airplane manufacturer's profit.

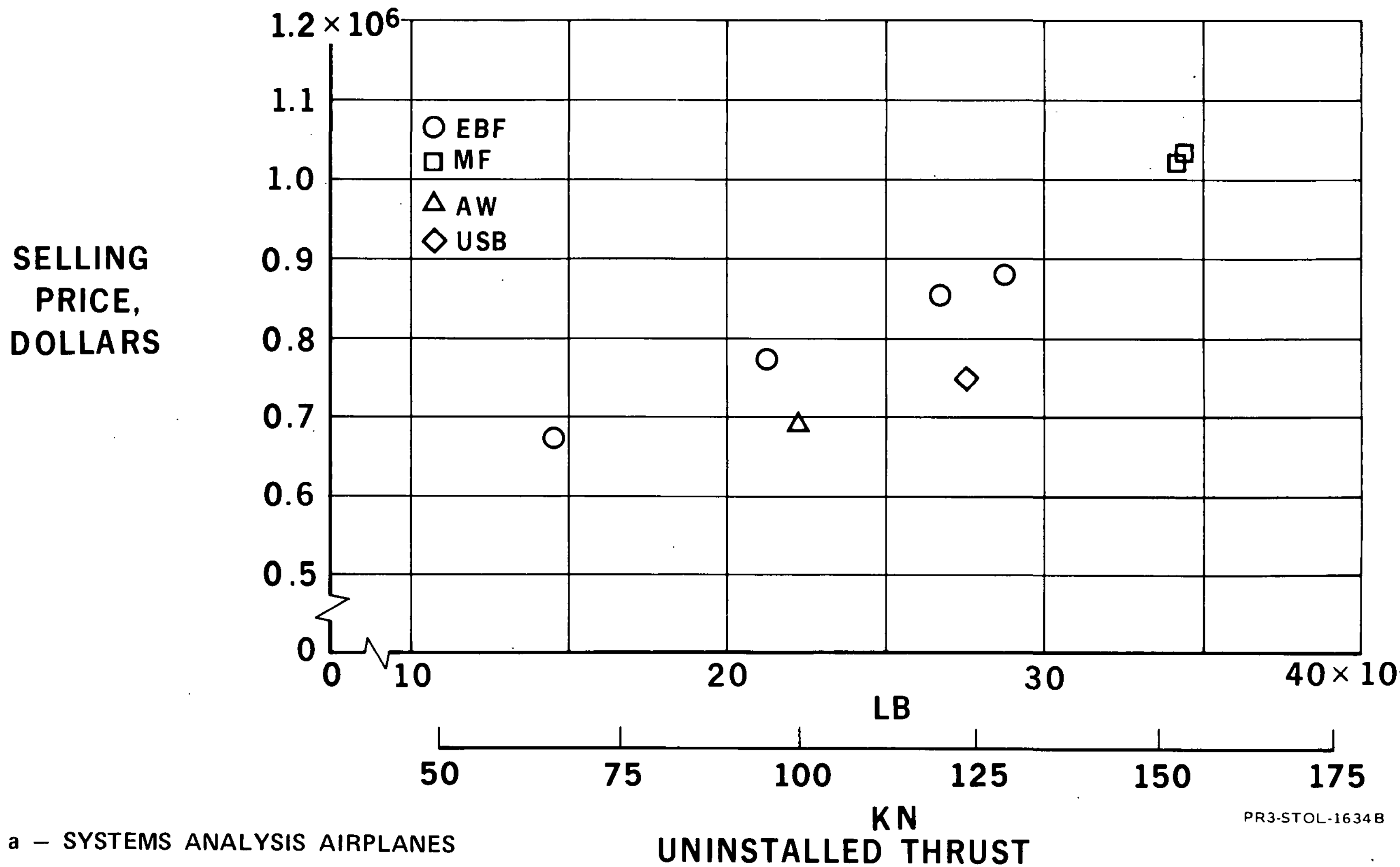
Engine and nacelle cost estimates were made for each engine cycle. The procedure for the Allison PD287-3 engine, used on the EBF airplanes, is illustrated by Figure 4-9. Uninstalled thrust estimates from design were used to establish a reference price for the engine and the nacelle at a fixed quantity. Next the engine and nacelle unit prices were adjusted for quantities, as required during each phase, using the upper right hand cost/quantity curves of Figure 4-9. Finally the nacelle prices were corrected to delete the costs

TABLE IV-1
PHASE II ENGINE THRUST AND PRICE DATA[a]
[Systems analysis airplanes]

FIELD LENGTH (feet/m)	DESIGN PASSENGER CAPACITY- 100	150	200
2000 (610)			
Lift concept	---------	AW	-------
Thrust, lb/kN	---------	22,200/98.7	-------
Price per engine, $M	---------	0.690	-------
Lift concept	---------	EBF	-------
Thrust, lb/kN	---------	26,830/119.3	-------
Price per engine, $M	---------	0.855	-------
Lift concept	---------	USB	-------
Thrust, lb/kN	---------	27,475/122.2	-------
Price per engine, $M	---------	0.750	-------
3000 (914)			
Lift concept	EBF	EBF	EBF
Thrust, lb/kN	14,520/64.6	21,270/94.6	28,790/128.1
Price per engine, $M	0.675	0.775	0.880
Lift concept	---------	MF	--------
Thrust, lb/kN	---------	34,840/155	--------
Price per engine, $M	---------	1.030	--------
4000 (1219)			
Lift concept	---------	MF	--------
Thrust, lb/kN	---------	34,390/153	--------
Price per engine, $M	---------	1.020	--------

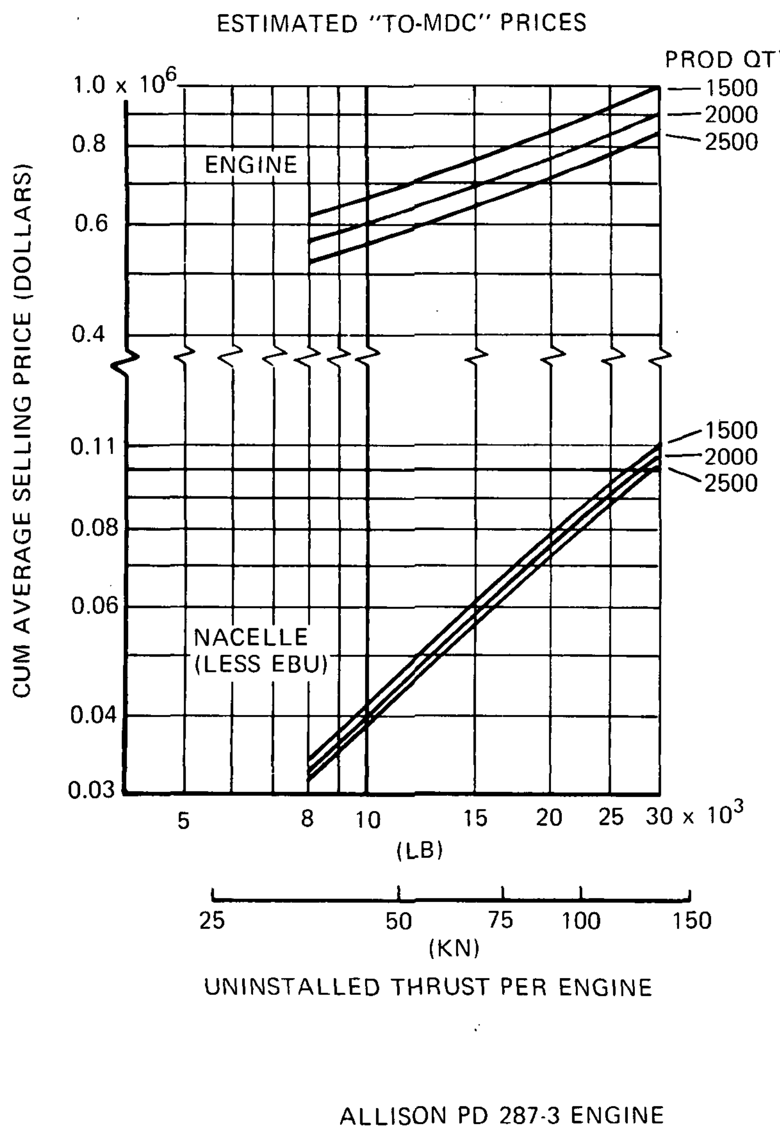
a Uninstalled thrust per engine and engine manufacturer's selling price, in 1972 dollars.
All airplanes were derived by varying thrust to weight ratios and wing loading to optimize takeoff gross weight within the cruise speed and field length constraints. The similarity in the resulting engine thrusts is coincidental.

PHASE II ENGINE SELLING PRICE vs UNINSTALLED THRUST[a]



a — SYSTEMS ANALYSIS AIRPLANES

FIGURE 4-8



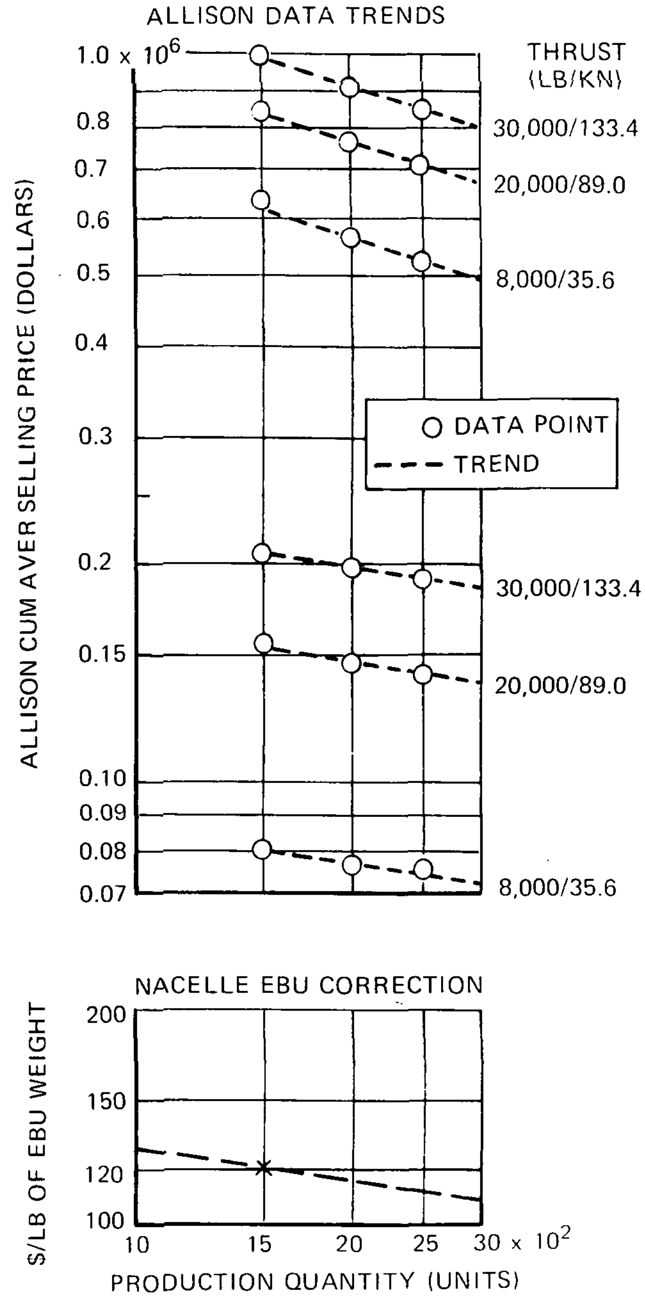


FIGURE 4-9. PRICE-THRUST AND PRICE-QUANTITY TRENDS

of engine buildup, inadvertently included in the original data provided by Allison. The cost/quantity relationship for engine buildup vs quantity is shown in the lower right hand corner of Figure 4-9. The corrected nacelle price versus thrust curve is displayed in the lower left hand corner of the figure. Comparison of corrected nacelle prices versus thrust curves for selected quantities with the original data, Figure 4-10, illustrates the unit price effect of this adjustment.

4.1.3 Estimating avionics prices. - During Phase I, a rough order of magnitude (ROM) estimate was made of the cost of the STOL avionics subsystem based on a general description of the desired functions and/or performance. This amounted to a preliminary avionics subsystem cost (excluding profit) of \$500,000 - with a Phase I 20-percent profit this amounts to a \$600,000 price. In Phase II a baseline avionics subsystem was developed and described in detail. This avionics baseline provides CAT IIIa Fail Operative All Weather Capability (including STOLAND) at a cost level of \$571,235 (excluding Douglas profit at 10%). The equipments and unit costs are shown in Table IV-2. The cost estimates are the result of in-house Douglas estimates for new equipment, and historical procurement records, vendor estimates and quotes for off-the-shelf items.

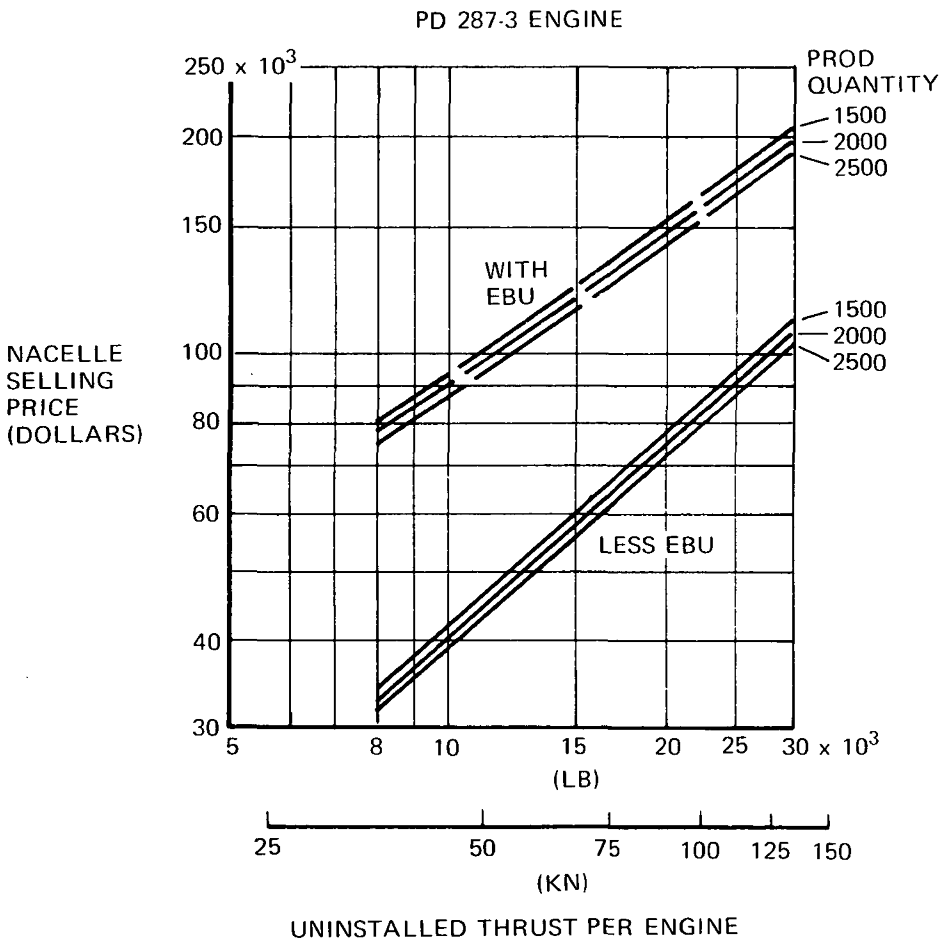


FIGURE 4-10. EFFECT OF EBU ON ALLISON NACELLE PRICES

TABLE IV-2

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
1	IFGGS, INCLUDING:					386,707	
1a	FLT GUIDANCE & CNTRL SUBSYS (SCAS,AP/FD, A/T, TMS,AREA NAV)		SPERRY		(168,207)		
1b	FLT INSTRUMENT SUB-SYSTEM (EADI, HSI, SYMBOL GENERATOR		SPERRY		(52,100)		
1c	ELEVATOR LOAD FEEL SUBSYSTEM		SPERRY		(4,500)		
1d	ATTITUDE & HEADING REF. SUBSYSTEM		SPERRY		(29,850)		
1e	AIR DATA SUBSYSTEM (CRT DISPLAY, ADC)		SPERRY		(75,450)		
1f	SPOILER SUBSYSTEM		SPERRY		(8,600)		
1g	ACTUATORS		SPERRY		(16,000)		
2	HEAD-UP DISPLAY, INCLUDING				(32,000)		

TABLE IV-2. - Continued

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL.	RECURRING UNIT COST	SHIPSET COST	REMARKS
2a	DEFLECTION AMPLIFIER	A05A0149-1	CONDUC-TRON				
2b	PROJECTION UNIT	A05A0152-1	CONDUC-TRON				
2c	CONTROL UNIT	A05A0153-1	CONDUC-TRON				
2d	PHOTO SENSOR	A05A0178-1	CONDUC-TRON				
2e	POWER SUPPLY	B54E0022-1	CONDUC-TRON				
2f	COMBINER ASSY	TBD	CONDUC-TRON				
1a	VHF COMM TRANS-CEIVER	522-4088-001 (618M-2B)	COLLINS	2	3925	7850	ARINC 546
1b	VHF COMM CONTROL PANEL	G3006	GABLES	2	615	1230	
1c	VHF ANTENNA	DMC50-3b	DORNE & MARGOLIN	2	200	400	

TABLE IV-2. - Continued

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
2a	SELCAL DECODER	NA-136	MOTOROLA	1	930	930	
2b	SELCAL CONTROL PANEL	G3009	GABLES	1	130	130	
2c	SELCAL CHIME	3001-1A	GARDIN ELEC. MFG. CO.	1	15	15	
3a	MARKER BEACON RECEIVER	208721-2802 (MKA-28C)	BENDIX	1	575	575	
3b	MARKER ANTENNA	522-0854-003 (37X-2)	COLLINS	1	72	72	
4a	PA AMPLIFIER	522-4538-002 (346D-1B)	COLLINS	2	1092	2184	ARINC 560
4b	ENTERTAINMENT TAPE REPRODUCER	108002-0008	SUND-STRAND	1	4300	4300	ARINC 539A
5a	FLIGHT INTERPHONE AMPLIFIER	G3122(B)	GABLES	1	165	165	
5b	SERVICE INTERPHONE AMPLIFIER	G3122(B)	GABLES	1	165	165	

TABLE IV-2. - Continued

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
5c	AUDIO CONTROL PANEL	G3004(A)	GABLES	4	543	2172	
6a	FLIGHT RECORDER	ED743830-1	HAMILTON STAND-ARD	1	3200	3200	ARINC 573-1
6b	ACCELEROMETER, TRIAXIAL	ED743831	HAMILTON STAND-ARD	1	800	800	
6c	FLIGHT DATA ENTRY PANEL	ED742986-1	HAMILTON STAND-ARD	1	900	900	
6d	FLIGHT DATA ACQUI-SITION UNIT (FDAU)	ED742951-1	HAMILTON STAND-ARD	1	4800	4800	
7a	VOICE RECORDER	103600	SUND-STRAND	1	1500	1500	ARINC 557
7b	VOICE RECORDER CONTROL UNIT	103610-1	SUND-STRAND	1	450	450	
8a	ILS RECEIVER	2070724-3203 (RIA-32)	BENDIX	2	3552	7104	ARINC 570
8b	GS ANTENNA	S41422-5	SENSOR SYSTEMS	2	100	200	

TABLE IV-2. - Continued

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
8c	ILS CONTROL PANEL	1990013-4	BENDIX	1	2000	2000	
9a	VOR RECEIVER	2070750-3301 (RVA-33A)	BENDIX	2	3500	7000	ARINC 579
9b	VOR/DME CONTROL PANEL	G3547(A)	GABLES	2	1000	2000	
9c	VOR/LOC ANTENNA COUPLER	100C0178	DAICO IND.	2	316	632	
9d	ANTENNA COUPLER	100C2035	DAICO IND.	2	104	208	
10a	ATC TRANSPONDER	787-6211-001 (621A-6)	COLLINS	2	3993	7986	ARINC 572
10b	ATC CONTROL PANEL	G3005	GABLES	1	315	315	
10c	ATC ANTENNA, BLADE	DMN150-2	DORNE & MARGOLIN	2	26	52	
11a	RADIO ALTIMETER TRANSCEIVER	2067631-5151 (ALA-51A)	BENDIX	2	6240	12,480	ARINC 552A

TABLE IV-2. - Continued

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
11b	RADIO ALTIMETER INDICATOR	2067635-0703 (INA-51A)	BENDIX	2	1500	3000	
11c	ANTENNA, RADIO ALTIMETER	2070057-0701 (ANA-51D)	BENDIX	4	168	672	
12a	DME INTERROGATOR	522-4209-002 (860E-3)	COLLINS	2	8778	17,556	ARINC 568
12b	ANTENNA, DME	DMN150-2	DORNE & MARGOLIN	2	26	52	
13a	ADF RECEIVER	777-1492-001 (51Y-7)	COLLINS	1	3267	3267	ARINC 570
13b	ADF CONTROL PANEL	787-6366-004 (614B-12)	COLLINS	1	756	756	
13c	ANTENNA, LOOP	792-6010-001 (137A-6C)	COLLINS	1	342	342	
13d	ANTENNA COUPLER, SENSE	622-0346-001 (COLLINS)	COLLINS	1	141	141	
14a	WEATHER RADAR R/T UNIT	2070410-0106 (RDR-1F)	BENDIX	1	10,000	10,000	ARINC 564-1

TABLE IV-2. - Continued

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
14b	CONTROL PANEL, WEATHER RADAR	G2756	GABLES	1	472	472	
14c	INDICATOR, WEATHER RADAR	2070411-0105 (PPI-IL)	BENDIX	1	5000	5,000	
14d	ANTENNA, WEATHER RADAR	2070409-0101 (ANT-IT)	BENDIX	1	6510	6,510	
15a	COLLISION AVOIDANCE SYSTEM	TBD	TBD	1	5000	5,000	ARINC 590
16a	MICROWAVE LANDING GUIDANCE SYSTEM SINGLE	TBD	TBD	2	8000	16,000	COST BASED ON RTCA DO-148 MICROWAVE LANDING SYSTEM STUDY
1a	ATTITUDE INDICATOR, STANDBY	705-7-V9	SFENA	1	2000	2,000	
1b	INVERTER, STATIC	TSG-420-101	SFENA	1	350	350	
2a	COMPASS, STANDBY	C4E	U.S. GAUGE	1	100	100	
3	FUEL FLOW INDICATOR	8DJ180LWC1	G.E.	1	1,756	1,756	

TABLE IV-2. - Continued

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
4	ENGINE N_1 INDICATOR	8DJ202LWAI	G.E.	1	2,917	2,917	
5	ENGINE N_2 INDICATOR	8DJ186LWC1	G.E.	1	1,779	1,779	
6	ENGINE EGT INDICATOR	8DJ185LWB1	G.E.	1	1,784	1,784	
7	ENGINE EPR INDICATOR	8DJ184LWD1	G.E.	1	1,781	1,781	
8	ENGINE OIL PRESSURE INDICATOR	VIL-0C4A	U.S. GAUGE	4	163	652	
9	ENGINE OIL QUANTITY INDICATOR	8DJ172LWDI	G.E.	4	220	880	
10	FUEL FLOW TRANS-MITTER	9-114-02	EDC	4	736	2,944	
11	ENGINE N_1 TACH GENERATOR	9053M20P02	G.E.	4	798	3,192	
12	ENGINE N_2 TACH GENERATOR	9015M78P02	G.E.	4	789	3,192	

TABLE IV-2. - Continued

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
13	ENGINE EPR TRANS- MITTER	ED747599-1	HAMILTON STANDARD	1	1,175	1,175	
14	ENGINE EPR TRANS- DUCER	ED747600-1	HAMILTON STANDARD	4	921	3,684	
15	BRAKE PRESSURE INDICATOR	AGK-10/A-27-51	BENDIX	2	250	500	
16	HYDRAULIC PRESSURE INDICATOR	AGK-10/A-27-51	BENDIX	3	250	750	
17	HYDRAULIC QTY. INDICATOR	9807-47	T.A. EDISON	3	105	315	
18	FLAP/SLAT POSITION INDICATOR	8DJ225WAA1	G.E.	1	1,700	1,700	
19	SURFACE POSITION INDICATOR	520642	WESTON	1	800	800	
20a	CLOCK, ELECTRONIC, DIGITAL	A15580-P1	A.W. HAYDON	2	450	900	
20b	TIME BASE, ELEC- TRONIC	E31832-P1	A.W. HAYDON	1	1,320	1,320	

TABLE IV-2. - Concluded

AVIONICS SUBSYSTEM EQUIPMENT LIST

ITEM NO.	EQUIPMENT DESCRIPTION	PART NO.	VENDOR	QTY PER APL	RECURRING UNIT COST	SHIPSET COST	REMARKS
21a	MASTER WARN & CAUTION CONTROLLER	102300-1	ACTRON	1	3,716	3,716	
21b	MASTER WARN & CONTROL ANNUN.	102100-13	ACTRON	1	3,158	3,158	
22	ALTIMETER, PNEUMATIC, STANDBY	B43617100001	KOLLSMAN	1	1,800	1,800	
23	AIRSPEED IND., PNEUMATIC, STANDBY	WL/246AS/MS/1	SMITH'S		800	800	

TOTAL SUBSYSTEM COST
(EXCL. AIRFRAME MFGR. PROFIT) 571,231

Further analysis of avionics requirements has indicated that the full avionics capability may not be required for some lift concepts. The exact variations have not been specified at this time. Even if the changes resulted in a cost savings of as much as 40 percent of the nominal avionics complement, this would only affect the DOCs by less than eight tenths of one percent. Therefore, the overall results and conclusions of this volume are not sensitive to the probable error.

4.1.4 Airplane cost/price data

4.1.4.1 Phase I characteristics and prices. - Design data for 39 Phase I airplanes are presented in Table IV-3. The corresponding airframe, engine, nacelle and total selling prices are shown in Table IV-4. The 35 Phase I STOL and short-haul mechanical flap airplanes covered a payload range from 50 to 200 passengers and a field length range from 1500 ft (457 m) to 4000 ft (1219 m) plus four advanced CTOL airplanes. Douglas and its airline consultants concurred that the 50 passenger airplanes were too small and noncompetitive on the basis of their direct operating costs. Consequently, the Phase II study concentrated upon the 100 to 200 passenger payload regime. Examination of 1985 route structures in the various markets strongly suggested the 1985 market for 200 passenger STOL airplanes would be too small to provide sufficient incentive to encourage production of this airplane before 1990. Therefore, the baseline payload for Phase II was "pegged" to 150 passengers. Table IV-5 shows the selection of other Phase II designs around the 150 passenger EBF baseline point. Both the augmentor wing and upper surface blowing concepts should be considered if field lengths significantly shorter than 3000 ft. (914 m) are required while the mechanical flap becomes a preferred solution in the vicinity of a 4000-ft (1219 m) field length. A 2000-ft (610 m)

TABLE IV-3

PHASE I AIRPLANE CHARACTERISTICS

AIRPLANE CONFIGURATION	TOGW LB	MWE LB	COST WEIGHT LB	DRY ENG WEIGHT LB	THRUST PER ENG LB	ENGINE BY PASS RATIO	SPEED (MACH) AT ALT.
E50 . 1500 . 70	108,300	79,500	65,800	2,870	20,060	17.4	.70
E100 . 1500 . 70	191,200	138,600	116,128	5,060	35,300	17.4	.70
E200 . 1500 . 70	345,400	244,600	204,180	9,540	65,800	17.4	.70
E50 . 2000 . 70	82,800	58,200	47,585	2,100	14,600	17.4	.70
E100 . 2000 . 70	142,600	98,900	82,668	3,500	24,200	17.4	.70
E150 . 2000 . 70	204,000	140,000	117,755	5,000	34,700	17.4	.70
E200 . 2000 . 70	265,000	180,500	151,845	6,600	45,800	17.4	.70
E50 . 3000 . 70	70,800	47,600	38,220	1,790	12,930	17.4	.70
E100 . 3000 . 70	117,800	78,200	65,328	2,660	18,600	17.4	.70
E200 . 3000 . 70	216,600	141,100	119,285	4,890	34,100	17.4	.70
M50 . 2000 . 70	110,100	82,300	71,480	2,150	13,930	9.1	.70
M100 . 2000 . 70	168,500	121,400	105,930	3,310	21,310	9.1	.70
M200 . 2000 . 70	286,300	198,200	171,500	6,110	37,940	9.1	.70
M50 . 3000 . 71	73,200	50,300	42,245	1,460	9,350	9.1	.71
M100 . 3000 . 74	122,500	81,900	70,028	2,410	15,600	9.1	.74
M200 . 3000 . 74	222,200	145,600	125,505	4,460	28,400	9.1	.74

TABLE IV-3. - Continued

PHASE I AIRPLANE CHARACTERISTICS

AIRPLANE CONFIGURATION	TOGW LB	MWE LB	COST WEIGHT LB	DRY ENG WEIGHT LB	THRUST PER ENG LB	ENGINE BY PASS RATIO	SPEED (MACH) AT ALT
M100 . 4000 . 76	110,400	71,200	60,250	2,180	14,100	9.1	.76
M200 . 4000 . 77	205,150	130,500	111,840	4,100	26,200	9.1	.77
U100 . 2000 . 70	153,500	109,000	93,890	3,220	22,960	14.8	.70
U100 . 3000 . 70	120,900	82,500	71,320	2,340	16,700	14.8	.70
A50 . 1500 . 77	125,500	89,400	77,785	2,350	13,300	2.8	.77
A100 . 1500 .77	204,100	142,300	125,228	3,710	21,700	2.8	.77
A200 . 1500 . 76	371,800	254,200	220,625	7,830	39,500	2.8	.76
A50 . 2000 . 78	96,000	65,200	55,785	1,800	10,300	2.8	.78
A100 . 2000 . 79	162,800	108,600	93,968	3,100	17,400	2.8	.79
A200 . 2000 . 79	294,800	193,000	166,745	6,000	31,500	2.8	.79
A50 . 3000 . 73	77,700	51,300	44,280	1,200	6,940	2.8	.73
A100 . 3000 . 76	131,400	85,100	74,670	2,050	11,730	2.8	.76
A200 . 3000 . 76	239,100	151,700	133,880	3,890	21,340	2.8	.76
C100 . 78. 2[a,b]	129,500	74,740	64,610	3,780	26,500	6.5	.78
C200 . 78 . 2[a,b]	220,800	126,300	112,500	5,770	40,400	6.5	.78

[a]Designed to FAR Part 36 minus 10 PNdB sideline noise level.
[b]Twin-engine designs, all others have four.

TABLE IV-3. - Concluded

PHASE I AIRPLANE CHARACTERISTICS

AIRPLANE CONFIGURATION	TOGW LB	MWE LB	COST WEIGHT LB	DRY ENG WEIGHT LB	THRUST PER ENG LB	ENGINE BY PASS RATIO	SPEED (MACH) AT ALT
C100 . 78 . 4[a]	128,600	73,800	64,090	1,870	13,100	6.5	.78
C200 . 78 . 4[a]	220,700	126,200	112,450	2,880	20,200	6.5	.78
E50 . 2000 . 73[b]	108,200	78,000	63,785	3,000	16,900	13.5	.73
E100 . 2000 . 74[b]	187,100	133,100	107,268	5,900	29,100	13.5	.74
E200 . 2000 . 74[b]	332,000	231,700	180,645	12,200	51,700	13.5	.74
A50 . 2000 . 80[b]	111,700	79,400	66,785	2,600	12,200	2.28	.80
A100 . 2000 . 80[b]	189,200	132,300	109,668	5,100	20,700	2.28	.80
A200 . 2000 . 80[b]	338,200	232,200	187,945	10,500	37,000	2.28	.80

[a] Designed to FAR Part 36 minus 10 PNdB sideline noise level.

[b] **Last 6 airplanes configured with G.E. engines.**

TABLE IV-3

PHASE I AIRPLANE CHARACTERISTICS
[International system of units]

Airplane Configuration	TOGW, kg	MWE, kg	Cost weight, kg	Engine[a] dry weight, kg	Engine[a] thrust, kN	Engine[a] bypass ratio	Max. speed at altitude, Mach number
E50 .1500.70A	49,124	36,061	29,846	1,302	89.2	17.4	0.70
E100.1500.70A	86,727	62,868	52,675	2,295	157.0		
E200.1500.70A	156,671	110,949	92,614	4,327	292.7		
E50 .2000.70A	37,557	26,399	21,585	952	64.9		
E100.2000.70A	64,682	44,860	37,497	1,588	107.6		
E150.2000.70A	92,533	63,503	53,413	2,268	154.3		
E200.2000.70A	120,202	81,873	68,876	2,994	203.7		
E50 .3000.70A	32,114	21,591	17,336	812	57.5		
E100.3000.70A	53,433	35,471	29,632	1,206	82.7		
E200.3000.70A	98,248	64,002	54,106	2,218	151.7		
M50 .2000.70A	49,940	37,331	32,423	975	62.0	9.1	
M100.2000.70A	76,430	55,067	48,049	1,501	94.8		
M200.2000.70A	129,863	89,902	77,791	2,771	168.8		
M50 .3000.71A	33,203	22,816	19,162	662	41.6		0.71
M100.3000.74A	55,565	37,149	31,764	1,093	69.4		0.74
M200.3000.74A	100,788	66,043	56,928	2,023	126.3		0.74
M100.4000.76A	50,076	32,296	27,329	989	62.7		0.76
M200.4000.77A	93,054	59,194	50,730	1,860	116.5		0.77

[a]All airplanes have four engines; data are per engine.

TABLE IV-3. - Continued

PHASE I AIRPLANE CHARACTERISTICS
[International system of units]

Airplane Configuration	TOGW, kg	MWE, kg	Cost weight, kg	Engine[a] dry weight, kg	Engine[a] thrust, kN	Engine[a] bypass ratio	Max. speed at altitude, Mach number
U100.2000.70A	69,626	49,442	42,588	1,460	102.1	14.8	0.70
U100.3000.70A	54,839	37,421	32,350	1,061	74.3	14.8	0.70
A50 .1500.77A	56,926	40,551	35,283	1,066	59.2	2.8	0.77
A100.1500.77A	92,578	64,546	56,802	1,683	96.5		0.77
A200.1500.76A	168,645	115,303	100,074	3,551	175.7		0.76
A50 .2000.78A	43,545	29,574	25,304	816	45.8		0.78
A100.2000.79A	73,845	49,260	42,623	1,406	77.4		0.79
A200.2000.79A	133,719	87,543	75,634	2,721	140.1		0.79
A50 .3000.73A	35,244	23,269	20,085	544	30.9		0.73
A100.3000.76A	59,602	38,601	33,870	930	52.2		0.76
A200.3000.76A	108,454	68,810	60,727	1,764	94.9		0.76
C100.78.2[a]	58,740	33,883	29,306	1,714	117.9	6.5	0.78
C200.78.2[a]	100,153	57,289	55,565	2,617	179.7		
C100.78.4	58,332	33,475	29,071	848	58.3		
C200.78.4	100,108	57,243	55,542	1,306	89.9		

[a]All airplanes have four engines, C100.78.2 and C200.78.2 have two; data are per engine.

TABLE IV-3. - Concluded

PHASE I AIRPLANE CHARACTERISTICS
[International system of units]

Airplane Configuration	TOGW, kg	MWE, kg	Cost weight, kg	Engine[a] dry weight, kg	Engine[a] thrust, kN	Engine[a] bypass ratio	Max. speed at altitude, Mach number
E50 .2000.73G	49,079	35,380	28,932	1,361	75.2	13.5	0.73
E100.2000.74G	84,867	60,373	48,656	2,676	129.4	↓	0.74
E200.2000.74G	150,592	105,097	81,939	5,534	230.0	↓	0.74
A50 .2000.80G	50,666	36,015	30,293	1,179	54.3	2.28	0.80
A100.2000.80G	85,820	60,010	49,744	2,313	92.1	↓	↓
A200.2000.80G	153,405	105,324	85,250	4,763	164.6	↓	↓

[a]All airplanes have four engines, data are per engine.

TABLE IV-4

PHASE I AIRPLANE PRICE SUMMARY

[1972 DOLLARS-MILLIONS]

AIRPLANE CONFIGURATION	AIRFRAME[a]	ENGINES	NACELLES	TOTAL
E50 . 1500 . 70	6.23	4.008	0.728	10.97
E100 . 1500 . 70	9.77	5.200	1.132	16.10
E200 . 1500 . 70	15.49	8.208	1.720	25.42
E50 . 2000 . 70	4.86	3.652	0.592	9.10
E100 . 2000 . 70	7.45	4.324	0.840	12.61
E150 . 2000 . 70	9.91	5.136	1.084	16.13
E200 . 2000 . 70	12.11	5.972	1.344	19.43
E50 . 3000 . 70	4.12	3.512	0.520	8.15
E100 . 3000 . 70	6.24	3.920	0.696	10.86
E200 . 3000 . 70	10.05	5.088	1.080	16.22
M50 . 2000 . 70	6.72	3.024	0.696	10.44
M100 . 2000 . 70	9.09	3.544	1.004	13.64
M200 . 2000 . 70	13.18	4.584	1.736	19.50
M50 . 3000 . 71	4.41	2.696	0.608	7.71
M100 . 3000 . 74	6.57	3.144	0.888	10.60
M200 . 3000 . 74	10.39	4.228	1.408	16.03

[a]Includes avionics.

TABLE IV-4. - Continued

PHASE I AIRPLANE PRICE SUMMARY

[1972 DOLLARS-MILLIONS]

AIRPLANE CONFIGURATION	AIRFRAME [a]	ENGINES	NACELLES	TOTAL
M100 . 4000 . 76	5.88	3.072	0.824	9.78
M200 . 4000 . 77	9.63	3.888	1.320	14.84
U100 . 2000 . 70	7.83	3.672	1.344	12.85
U100 . 3000 . 70	6.33	3.240	1.072	10.64
A50 . 1500 . 77	9.03	2.972	0.760	12.76
A100 . 1500 . 77	12.56	3.604	0.984	17.15
A200 . 1500 . 76	19.61	4.700	1.232	25.54
A50 . 2000 . 78	7.26	2.816	0.560	10.64
A100 . 2000 . 79	10.23	3.364	0.856	14.45
A200 . 2000 . 79	15.70	4.220	1.152	21.07
A50 . 3000 . 73	6.34	2.496	0.384	9.22
A100 . 3000 . 76	8.80	2.856	0.600	12.26
A200 . 3000 . 76	13.20	3.552	0.968	17.72
C100 . 78 . 2	6.47	1.956	0.670	9.10
C200 . 78 . 2	10.14	2.376	0.912	13.43

[a] Includes avionics.

TABLE IV-4. - Concluded

PHASE I AIRPLANE PRICE SUMMARY

[1972 DOLLARS-MILLIONS]

AIRPLANE CONFIGURATION	AIRFRAME [a]	ENGINES	NACELLES	TOTAL
C100 . 78 . 4	6.33	3.000	0.772	10.10
C200 . 78 . 4	9.97	3.504	1.088	14.56
E50 . 2000 . 73	5.63	4.140	1.248	11.02
E100 . 2000 . 74	8.65	5.768	1.800	16.22
E200 . 2000 . 74	13.21	7.648	2.688	23.55
A50 . 2000 . 80	8.33	3.256	0.524	12.11
A100 . 2000 . 80	11.80	4.512	0.680	16.99
A200 . 2000 . 80	17.63	6.300	0.904	24.83

[a] Includes avionics.

TABLE IV-5
PHASE I AND PHASE II AIRPLANE CONFIGURATION MATRIX

FIELD LENGTH / LIFT CONCEPT	NUMBER OF PASSENGERS 50	100	150	200
1500 FT				
EBF	x	x		x
MF				
USB				
AW	x	x		x
2000 FT				
EBF	x,x	x,x	x	x,x
MF	x	x		x
USB		x	○	
AW	x,x	x,x	○	x,x
3000 FT				
EBF	x	x	●	x
MF	x	x	○	x
USB		x		
AW	x	x		x
4000 FT				
EBF				
MF		x	○	x
USB				
CTOL				
2 Engine		x	○	x
4 Engine		x		x

x Phase I ○ Phase II ● Phase II Baseline externally blown flap design and a 3000-ft (914 m) mechanical flap design were selected to provide trend data. The two-engine advanced CTOL design provides a yardstick for comparing STOL and conventional airplanes at a constant technology level.

4.1.4.2 Phase II characteristics and prices. - The Phase II systems analysis airplane characteristics and prices are displayed in Table IV-6. Three configurations were refined from Phase I - E150.2000, E100.3000 and the E200.3000. The percent change in selling price for all three airplanes decline from Phase I to Phase II as shown below:

AIRPLANE CONFIGURATION	PRICE RATIO PERCENT
E150.2000	86.3
E100.3000	81.5
E200.3000	86.8

The principal pricing effect is the change in the strategy point from Phase I (300 airplanes and 20 percent profit) to Phase II (400 airplanes and 10 percent profit). This change reduced the price of the E100.3000 airplane by 18.5 percent at about the same cost weight. Since the other two airplanes grew in weight from Phase I to Phase II, the price change is not as large.

Table IV-7 provides a breakdown of the unit price by major airplane component and the contribution of prorated development and recurring average production costs. All data include an airplane manufacturer's profit of 10 percent.

4.1.4.3 Comparison of Phase I and Phase II prices. - The results of Phase I provided rules of thumb for comparing the selling prices of the various lift concepts for equivalent payload and field length performance. As lift concept

TABLE IV-6

SUMMARY OF PHASE II SYSTEMS ANALYSIS AIRPLANE CHARACTERISTICS AND PRICES

CONFIGURATION	E150 2000 .68	A150 2000 .79	U150 2000 .70	E100 3000 .67	E150 3000 .68 (a)	M150 3000 .71	E200 3000 .70	M150 4000 .76	C150 7500 .80
TOGW - LB	206,200	221,270	232,840	111,700	163,300	178,300	221,400	154,050	159,600
MWE - LB	148,900	144,360	173,540	75,860	110,900	125,340	151,800	103,070	91,000
COST WT - LB	131,236	126,504	156,300	65,562	96,540	112,150	132,906	90,030	80,860
THRUST/ENG - LB	26,830	22,200	27,475	14,520	21,270	34,840	28,790	34,390	29,350
NO. OF ENGINES	4	4	4	4	4	2	4	2	2
ENG DRY WT - LB	3,976	4,024	3,870	2,152	3,150	5,715	4,266	5,640	4,190
ENGINE BPR	17.4	2.8	14.8	17.4	17.4	9.1	17.4	9.1	6.0
SPEED MAX MACH AT ALT	.68	.79	.70	.67	.68	.71	.70	.76	.80
ACQUISITION PRICE DOLLARS, M									
AIRFRAME	9.017	9.268	9.996	5.000	6.931	7.708	9.090	6.317	5.848
NACELLES	0.428	0.536	0.964	0.252	0.352	0.556	0.452	0.546	0.480
ENGINES	3.764	3.036	3.300	2.972	3.412	2.266	3.872	2.244	2.090
AVIONICS	0.628	0.628	0.628	0.628	0.628	0.628	0.628	0.628	0.628
TOTAL UNIT PRICE	$13.837	$13.468	$14.888	$ 8.852	$11.323	$11.158	$14.042	$ 9.735	$ 9.046
PRODUCTION QTY.	400	400	400	400	400	400	400	400	400

[a]BASELINE

TABLE IV-6

PHASE II SYSTEMS ANALYSIS AIRPLANE CHARACTERISTICS AND PRICES
[International system of units]

CONFIGURATION	E150 2000 .68	A150 2000 .79	U150 2000 .70	E100 3000 .67	E150 3000 .68 (a)	M150 3000 .71	E200 3000 .70	M150 4000 .76	C150 7500 .80
TOGW - kg	95,331	100,366	105,614	50,666	74,071	80,875	100,425	69,876	72,393
MWE - kg	67,540	65,480	78,716	34,409	50,303	56,853	68,855	46,752	41,277
COST WT - kg	59,528	57,381	70,896	29,738	43,790	50,870	60,285	40,837	36,677
THRUST/ENG - kN	119.3	98.7	122.2	64.6	94.6	155.0	128.1	153.0	130.6
NO. OF ENGINES	4	4	4	4	4	2	4	2	2
ENG DRY WT - kg	1,803	1,825	1,755	976	1,429	2,592	1,935	2,558	1,900
ENGINE BPR	17.4	2.8	14.8	17.4	17.4	9.1	17.4	9.1	6.0
SPEED MAX MACH AT ALT	.68	.79	.70	.67	.68	.71	.70	.76	.80
ACQUISITION PRICE DOLLARS, M									
AIRFRAME	9.017	9.268	9.996	5.000	6.931	7.708	9.090	6.317	5.848
NACELLES	.428	.536	.964	.252	.352	.556	.452	.546	.480
ENGINES	3.764	3.036	3.300	2.972	3.412	2.266	3.872	2.244	2.090
AVIONICS	.628	.628	.628	.628	.628	.628	.628	.628	.628
TOTAL UNIT PRICE	$13.837	$13.468	$14.888	$ 8.852	$11.323	$11.158	$14.042	$ 9.735	$ 9.046
PRODUCTION QTY.	400	400	400	400	400	400	400	400	400

[a]Phase II baseline configuration.

TABLE IV-7. - PHASE II SYSTEMS ANALYSIS AIRPLANE UNIT ACQUISITION PRICE BREAKDOWN
[1972 dollars]

Airplane Configuration	E150 2000 .68	A150 2000 .79	U150 2000 .70	E100 3000 .67	E150 3000 .68 (a)	M150 3000 .71	E200 3000 .70	M150 4000 .76	C150 7500 .80
Production Qty.	400	400	400	400	400	400	400	400	400
Unit Develop Price - $ M									
Airframe	1.246	1.203	1.433	0.710	0.967	1.081	1.258	0.901	0.838
Nacelle[b]	0.014	0.017	0.022	0.010	0.013	0.021	0.012	0.022	0.022
Engine[b]	0.402	0.339	0.348	0.354	0.380	0.383	0.405	0.373	0.363
Avionics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	1.662	1.559	1.303	1.074	1.360	1.485	1.675	1.301	1.223
Unit Production Price - $ M									
Airframe	7.771	8.065	8.563	4.290	5.964	6.627	7.832	5.416	5.010
Nacelles[b]	0.414	0.519	0.942	0.242	0.339	0.535	0.440	0.524	0.458
Engines[b]	3.362	2.697	2.952	2.618	3.032	1.883	3.467	1.866	1.727
Avionics	0.628	0.628	0.628	0.628	0.628	0.628	0.623	0.628	0.623
SUB-TOTAL	12.175	11.909	13.085	7.778	9.963	9.673	12.367	8.434	7.823
Total Airplane Unit Price - $ M									
Airframe	9.017	9.268	9.996	5.000	6.931	7.708	9.090	6.317	5.848
Nacelles[b]	0.428	0.536	0.964	0.252	0.352	0.556	0.452	0.546	0.480
Engines[b]	3.764	3.036	3.300	2.972	3.412	2.266	3.872	2.244	2.090
Avionics	0.628	0.628	0.628	0.628	0.628	0.628	0.628	0.628	0.628
TOTAL	13.837	13.468	14.888	8.852	11.323	11.158	14.042	9.735	9.046

[a]Baseline
[b]Per airplane basis

design requirements were refined during Phase II, these requirements were reflected in the pricing procedure. The Phase I and Phase II results suggest the prices of mechanical flap and externally blown flap airplanes are commensurate. At the end of Phase I it was concluded that upper surface blowing airplanes were about the same price as the EBF designs; but, the final Phase II results indicated the differential is about ten percent. The augmentor wing appeared to be about 15 percent more expensive during Phase I. Now the two concepts appear to yield about the same price. The results of Phase II suggest the Phase I price differential between EBF and CTOL airplanes was understated.

4.1.4.4 Comparison of systems analysis and final design airplanes. - One of the primary results of the continuing engineering design and analysis activity during Phase II was the finding that high bypass ratio, low fan pressure ratio engine technology could be successfully exploited to markedly improve airplane performance, weights, and economics. The results of this intensive investigation showed that only small noise penalties (an increase of about two EPNdB above 95) would occur if the noise suppression rings were deleted from the inlet and exhaust ducts of certain engine families. The Phase II final design airplanes reflect the results of this acoustic trade study.

The characteristics and unit prices of the Phase II final design airplanes are presented in Table IV-8. In comparing the systems analysis and final design baseline airplanes (E150.3000 See Table IV-9) the 14,270 lb (6,472 kg) gross weight reduction is reflected in a 9,430 lb (4,278 kg) lighter airplane in cost weight terms, a difference of almost 10 percent. After these changes are fully examined the price of the 150-passenger 3000 ft (914 m) field length airplane was reduced by 7.2 percent from $11.3 to $10.5 million. Savings are realized throughout the airplane with the exception of the avionics system which is a function of the operational requirements.

TABLE IV-8

SUMMARY OF PHASE II FINAL DESIGN AIRPLANE CHARACTERISTICS AND PRICES

Airplane type / Field length, ft	E150 2000	A150 2000	U150 2000	E100 3000	E150[a] 3000	M150 3000	E200 3000	M150 4000
Characteristics								
MWE, lb	141,710	146,530	169,380	70,170	99,770	136,290	127,880	104,270
kg	(64,278)	(66,465)	(76,829)	(31,828)	(45,255)	(61,820)	(58,005)	(47,296)
CW, lb	124,610	131,910	150,980	60,560	87,110	122,430	112,330	92,800
kg	(56,522)	(59,833)	(68,483)	(27,469)	(39,512)	(55,533)	(50,952)	(42,093)
Thrust per engine, lb	25,830	19,200	29,490	13,200	18,260	36,990	22,925	32,450
kN	(114.7)	(85.2)	(131.4)	(58.6)	(88.1)	(164.2)	(101.8)	(144.1)
Acquisition prices, $M								
Airframe	8.625	9.595	9.652	4.683	6.370	8.343	7.906	6.516
Nacelles	0.412	0.488	0.992	0.228	0.308	0.578	0.376	0.524
Engines	3.720	2.884	3.412	2.884	3.212	2.332	3.520	2.200
Avionics	0.628	0.628	0.628	0.628	0.628	0.628	0.628	0.628
Total	13.385	13.595	14.684	8.423	10.518	11.881	12.430	9.868

[a]Baseline airplane

TABLE IV-9

E150.3000 PHASE II CHARACTERISTICS AND PRICES
[Systems analysis[a] vs. final design airplane]

Characteristic or price	Configuration -	
	systems analysis (a)	final design
Sideline noise at 500 ft(152 m), EPNdB	95	96
TOGW, lb(kg)	163,300 (74,071)	149,030 (67,599)
MWE, lb(kg)	110,900 (50,303)	99,770 (45,255)
Cost weight, lb(kg)	96,540 (43,790)	87,110 (39,512)
Thrust per engine, lb(kN)	21,270 (94.6)	18,260 (81.2)
No. of engines	4	4
Dry weight per engine, lb(kg)	3,150 (1,429)	2,725 (1,236)
Engine bypass ratio	17.4	17.4
Cruise Mach number	.68	.69
Cruise altitude, ft(m)	25,000 (7,620)	26,000 (7,925)
Acquisition price, M dollars		
Airframe	6.931	6.370
Nacelles	.352	.308
Engines	3.412	3.212
Avionics	.628	.628
Total	11.323	10.518

[a]Baseline for Phase II economic analyses.

4.2 Airline Economics

4.2.1 Costs

4.2.1.1 Direct operating costs. - The methods of computing both the direct and indirect operating costs are based on discussions and agreements among the NASA personnel and both contractors (Douglas and Lockheed). These discussions were initiated at the start of Phase I. The purpose was to formulate a standardized methodology for the evaluation of quiet STOL airplane economics. Initially it was believed that the available methods of computing operating costs would not be adequate in their entirety because of the differences between the operational characteristics of STOL and conventional air transport systems. The approach agreed to is a modification of the 1967 Air Transport Association (ATA) "Standard Method of Estimating Comparative Direct Operating Costs of Turbine Powered Transport Airplanes".

4.2.1.1.1 Modifications to the 1967 ATA method. - At the outset, several changes were made to the 1967 constants to reflect 1972 price levels. In addition, some changes were made so that the ATA method reflected STOL operating procedures, profiles and route peculiarities. This section first covers the changes to reflect 1972 price levels and then the changes to incorporate STOL operating procedures.

4.2.1.1.1.1 Crew costs. - Crew costs were increased 40 percent to incorporate the salary rates established by contract negotiations over the 1967 to 1972 time interval. Although the airplanes may be certifiable with a two-man crew complement, some airlines may choose to operate them with a three-man flight crew.

4.2.1.1.1.2 Fuel costs. - These costs were increased from $0.095 per U. S. gallon to $0.115 per U. S. gallon to reflect timewise escalation of petroleum costs from 1967 to 1972. It is recognized that the nation is facing an energy crisis and that the problem of supply and demand will cause increases in the cost of fuel irrespective of the timewise escalation. However, cost increases resulting from supply and demand have not been included in this study and are significant and warrant further study.

4.2.1.1.1.3 Maintenance costs. - The direct maintenance labor rate was increased from $4.00 to $6.00 per man-hour to reflect timewise escalation for labor; but, the non-dollar coefficients were reduced by 25 percent to incorporate current maintenance experience with jet airplanes.

4.2.1.1.1.4 Maneuver time. - During Phase I, a ten-minute ground and air maneuver time allowance was used to compute block time. The reduction to ten minutes from the ATA standard of 21 minutes, reflected different flight profiles and separate STOL runways at many airports. A more refined analysis in Phase II provided a revised estimate of eight minutes composed as follows:

	Origin	Destination	Total
Air maneuver time, min	1.5	1.5	3.0
Ground maneuver time, min	3.5	1.5	5.0
Total maneuver time, min	5.0	3.0	8.0

4.2.1.1.1.5 Reserve fuel. - The reserve fuel requirements were changed in Phase I from the ATA standards to 200 n. mi. (370 km) at 20,000 ft (6,096 m) enroute to an alternate field, plus 15 minutes holding time at 10,000-ft (3,048 m) altitude at maximum endurance throttle settings. The same reserve fuel requirements were used for the Phase II design mission direct operating costs. However, when realistic regional network operations were structured, actual alternate destinations were considered instead of the arbitrary 200 n. mi. (370 km) distance.

4.2.1.1.1.6 Block fuel. - The direct operating cost comparisons are based on the design point mission, 575 st. mi. (926 km), the 230 st. mi. (370 km) alternate airport requirement, and the eight-minute total maneuver time. The regional direct operating costs were computed using the actual network stage lengths, alternate airports, and the eight minute maneuver time allowance.

4.2.1.1.1.7 Spares. - During Phase I a 25-percent spares factor for engines was used in lieu of the ATA 40 percent. This reduction in spares reflects jet experience and a mature system. In the Phase II regional network analyses, a variable spares factor was employed which relates spares requirements to fleet size as would be observed in actual recommended provisioning practices. A schedule of this variable spares factor as a function of fleet size is shown in Table IV-10.

4.2.1.1.1.8 Utilization. - A standard utilization of 2500 hours per year per airplane specified by the NASA was used throughout the parametric analyses in Phase I and in all Phase II design point studies. The network operating schedule analyses forecast higher utilizations. For example, in the Chicago region the schedule analysis provided a nine-hour utilization per day or 3,285 hours per airplane per year, assuming a fleet size of 35 airplanes and from a maintenance viewpoint a "friction-free system". Subsequent maintenance analysis showed a requirement of 38 airplanes to sustain an ideal 35-airplane schedule. This impacted on the system by reducing

TABLE IV-10

ESTIMATED SPARES REQUIREMENT

AS A FUNCTION OF FLEET SIZE

PER CENT

FLEET SIZE	FOUR ENGINE CONFIGURATION SPARE ENGINES	FOUR ENGINE CONFIGURATION ENGINE SPARES	FOUR ENGINE CONFIGURATION AIRFRAME SPARES	TWO ENGINE CONFIGURATION SPARE ENGINES	TWO ENGINE CONFIGURATION ENGINE SPARES	TWO ENGINE CONFIGURATION AIRFRAME SPARES
10	15.00	8.52	7.21	20.00	9.89	7.21
20	11.25	7.34	6.15	15.00	8.52	6.15
30	10.00	6.72	5.60	11.67	7.81	5.60
40	9.38	6.32	5.24	11.25	7.34	5.24
50	9.00	6.02	4.98	10.00	6.99	4.98
60	8.75	5.79	4.77	10.00	6.72	4.77
70	8.93	5.60	4.61	10.00	6.50	4.61
80	8.75	5.44	4.47	9.38	6.32	4.47
1967 ATA	40		10	40		10
MODIFIED ATA	25		10	25		10

(ENGINE SPARES-MAINTENANCE SPARE PARTS, SPARE ENGINE MODULES, BUILD-UP KITS, ACCESSORIES)

SOURCE: REFERENCE 62

the nine-hour "friction-free" utilization to an average of 8.29 hours per airplane per day for the fleet of 38 airplanes. Therefore, the fleet sizes in each region would have to be increased to provide maintenance rotation of the fleet. The larger fleet size is reflected in the depreciation charged to profit. A second impact of maintenance is the affect upon delays, airplane substitutions and flight cancellations. At times the result of these unanticipated events is to reduce utilization; and, at other times the same daily utilization may be maintained. The gross utilization effect reduced the fleet utilization by some nine percent to the 7.6 hours per day used in the projected financial results. The DOCs presented in this section and the ROIs are based upon 2500 hours utilization, or 6.85 hours per day. The Chicago region financial analysis uses the 7.6 hours per day utilization, 2774 hours per year, obtained as a result of the schedule and maintenance analysis.

4.2.1.1.1.9 Depreciation schedule. - The depreciation schedule was assumed to be 12 years to zero residual.

4.2.1.1.2 Direct operating costs of phase I airplanes. - Phase I direct operating costs for the design mission are shown in Figure 4-11. The various lift concepts and short-haul mechanical flap airplanes are presented separately, first the EBF, then the AW, the MF, the USB, and finally the advanced CTOL airplanes. The three airplanes with General Electric engines are plotted to overlay the Allison powered airplanes for both the EBF and AW lift concepts. A tabulation of Phase I direct, indirect and total operating costs is presented later in Section 4.2.1.2.5 as Table IV-17.

4.2.1.1.3 Phase II direct operating costs. - Application of the Phase II direct operating cost procedure for the design point mission provides

PHASE I DIRECT OPERATING COSTS

CENTS PER AVAILABLE SEAT ST MILE

1. VARIATIONS SHOWN FOR 50, 100, 150, 200 PASSENGERS
2. VARIATIONS SHOWN FOR 2000, 3000, 4000-FT FIELD LENGTHS
3. DESIGN MISSION 575 ST MILES
4. MANEUVER TIME 10 MIN
5. UTILIZATION 2500 HR/YR/AIRPLANE

ALLISON ENGINES ○ △ □ ◇ ◊
GENERAL ELECTRIC ENGINES ⌘

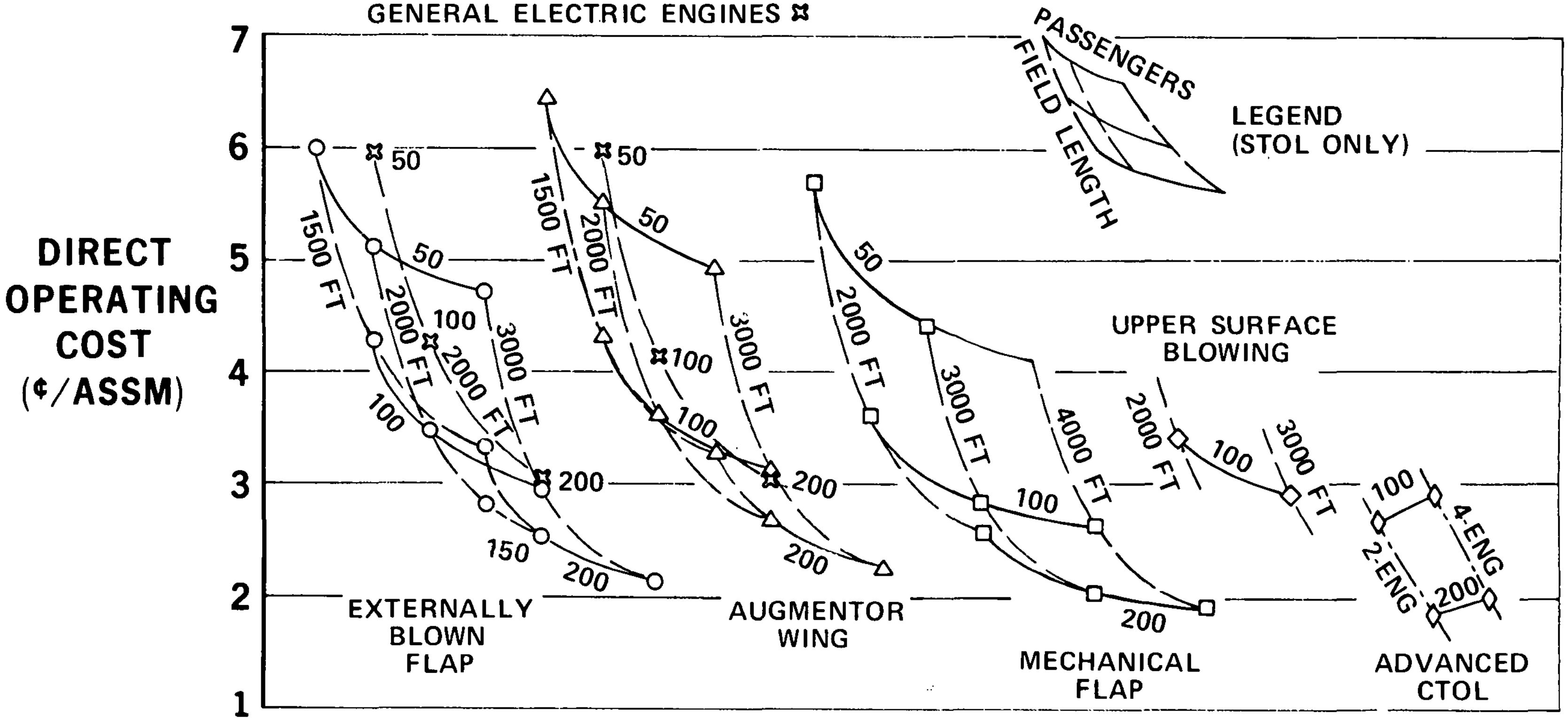
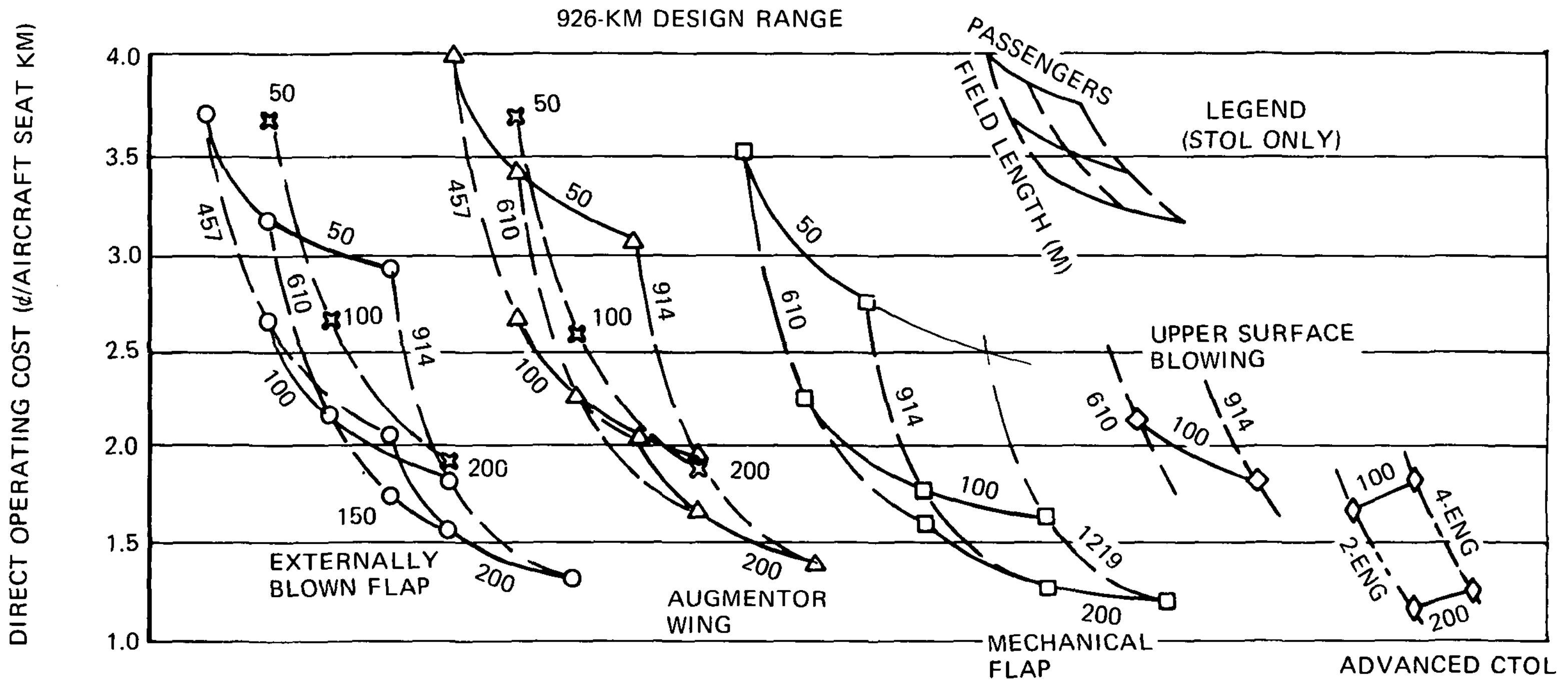


FIGURE 4-11.

PR3-STOL-1624



[a]OPEN SYMBOLS REPRESENT ALLISON ENGINES; (⌘) ARE GENERAL ELECTRIC

FIGURE 4-11. PHASE I DIRECT OPERATING COSTS[a] comparative direct operating cost estimates for the nine Phase II systems analysis airplanes. The breakdown by direct operating cost element for the design point mission is shown in Table IV-11. These results are readily translatable into cost per block hour, cost per airplane-mile or airplane-kilometer (dollars) and cost per available seat-mile or seat-kilometer (cents) as shown in the lower part of the table.

A 2000-ft (610 m) field length design increases the DOC per airplane-mile or airplane-kilometer by about 19 percent compared to the 3000-ft (914 m) design, while a 4000-ft (1,219 m) field length design reduces cost per airplane-mile (-km) by about 13 percent, Figure 4-12. The advanced CTOL airplane has about the same cost per airplane-mile (-km) as the 4000-ft (1,219 m) mechanical flap airplane - primarily the result of the higher maneuver times associated with congested CTOL operations. The 13-minute increase in total maneuver time attributed to CTOL essentially negates its faster cruise speed advantage. Within the 3000-ft (914 m) design group, the 100-passenger EBF airplane has a 22 percent higher cost per available seat-mile (seat-km) than its 150-passenger counterpart while the 200-passenger EBF airplane costs about 10 percent less on the same basis. (See Figure 4-13).

4.2.1.1.4 Direct operating cost sensitivity. - The direct operating cost sensitivity to field length is better described by Figure 4-14. Over the field length spectrum of 2000 to 4000 ft (610 to 1,219 m), DOC's as measured by cost per available seat-mile or seat-kilometer at the 575 st. mi. (926-km) design mission drop from about 2.5¢/assm (1.56¢/askm) to about 1.8¢/assm (1.1¢/askm) or about 28 percent. Obviously, these would continue to decline at a decreasing rate until the STOL maneuver time assumptions no longer hold as indicated by the break in the DOC curve.

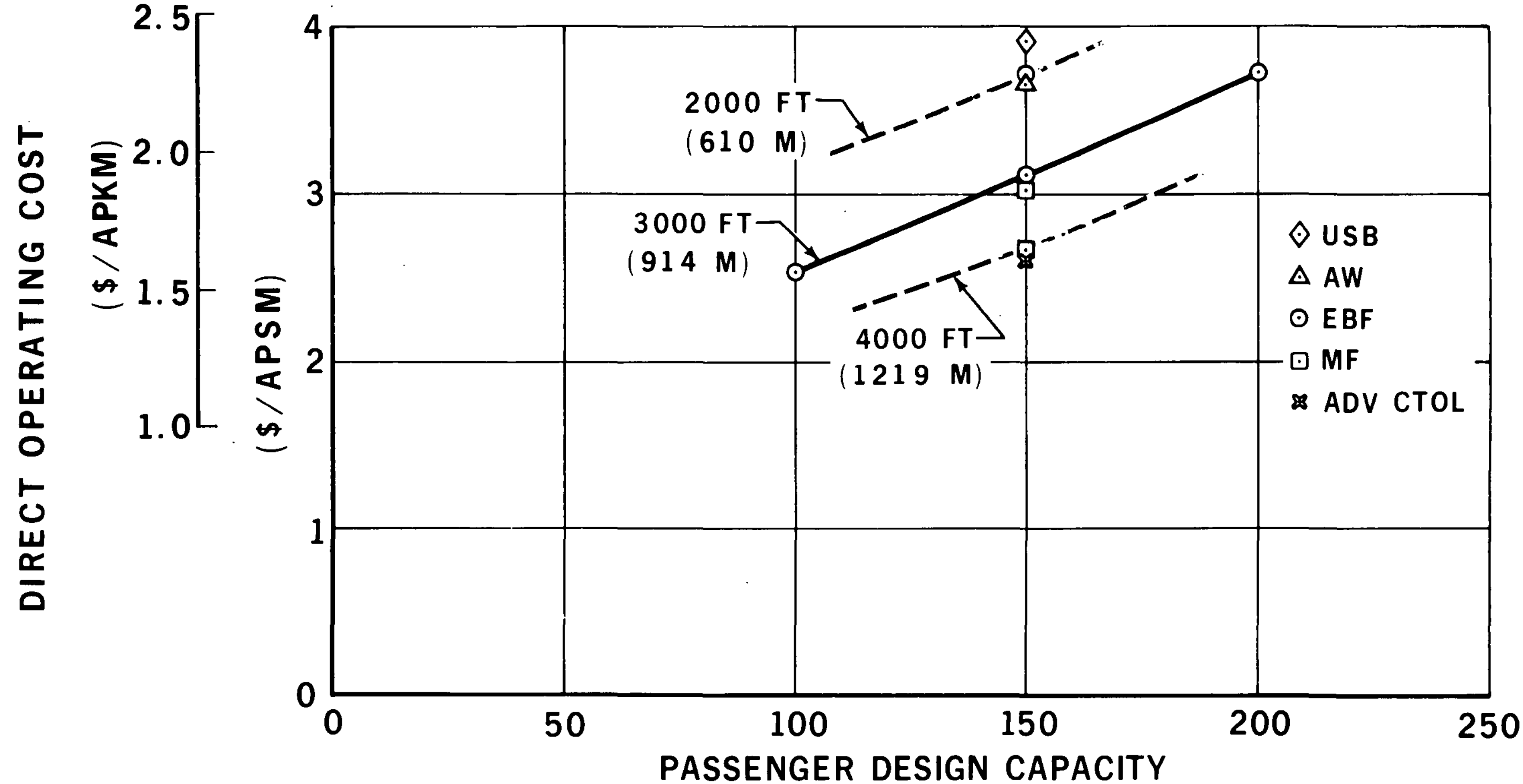
TABLE IV-11
PHASE II DIRECT OPERATING COSTS - BY RESOURCE ELEMENT[a]
[575-st. mi. (926-km) design range]

DOC COST ELEMENT		SYSTEMS ANALYSIS AIRPLANES								
		E150. 2000. 68A	E100. 3000. 67A	E150. 3000. 68A	E200. 3000 70A	M150. 3000 71A	M150. 4000. 76A	A150. 2000. 79A	U150. 2000. 70A	C150. 7500. 80 (b)
Flying oper.,	$/cycle									
Crew,		295	287	289	290	288	278	277	298	300
Fuel and oil,		316	172	247	326	272	241	458	335	233
Insurance,		160	103	130	160	128	108	147	173	109
Subtotal,		771	562	666	776	688	627	882	806	642
Depreciation,										
Airplane,		669	431	543	665	532	451	610	719	452
Spares,		94	65	79	94	69	61	82	96	61
Subtotal,		763	496	622	759	601	512	692	815	513
Maintenance,										
Airframe labor,		83	49	65	83	73	61	78	95	55
Engine labor,		52	38	46	54	31	30	45	53	26
Subtotal,		135	87	111	137	104	91	123	148	81
Airframe material,		79	46	62	79	69	58	80	91	53
Engine material,		153	121	138	155	91	88	118	134	80
Subtotal,		232	167	200	234	160	146	198	225	133
Applied burden,		243	156	199	246	186	163	221	266	146
Maintenance Subtotal		610	410	510	617	450	400	542	639	360
TOTAL COST,		2144	1468	1798	2152	1739	1539	2116	2260	1515
DOC totals,	$/blk hr	1479	1006	1249	1515	1216	1107	1556	1559	1010
	$/airp.-mile	3.72	2.55	3.12	3.74	3.02	2.67	3.67	3.92	2.63
	$/airp.-km	2.31	1.58	1.94	2.32	1.88	1.66	2.28	2.44	1.63
	¢/assm	2.48	2.55	2.08	1.87	2.01	1.78	2.45	2.62	1.75
	¢/askm	1.54	1.58	1.29	1.16	1.25	1.11	1.52	1.63	1.09

[a]Data are for 2500 blk hrs /year utilization, at 1972 price levels.
[b]Data are for 575 st. mi. (926 km); design range is 1381 st. mi. (2222 km).

DIRECT OPERATING COST[a]

DOLLARS PER AIRPLANE MILE (KM) vs PASSENGER DESIGN CAPACITY
DESIGN POINT RANGE 575 ST MI (926 KM)



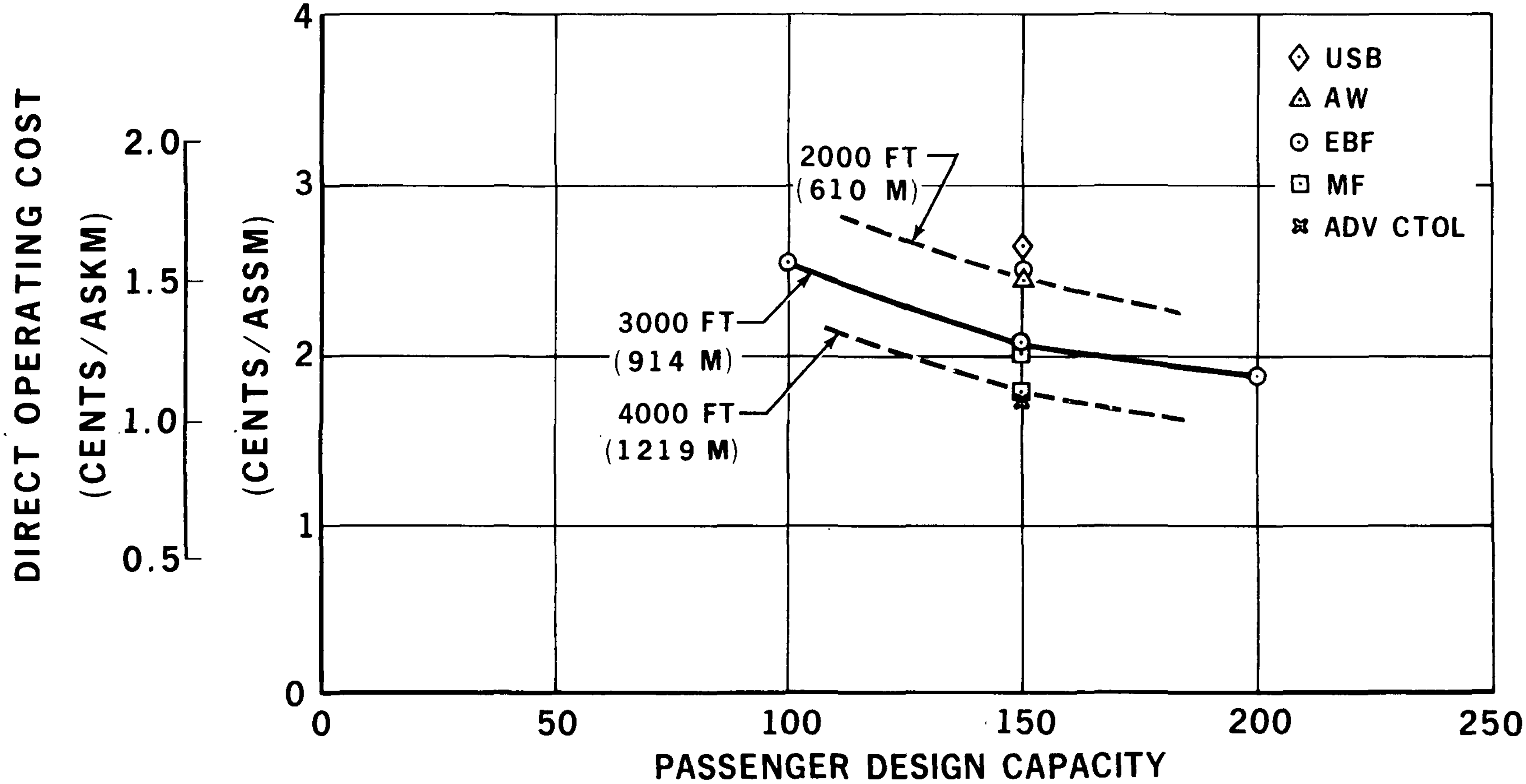
a – SYSTEMS ANALYSIS AIRPLANES

PR3-STOL-1626B

FIGURE 4-12

DIRECT OPERATING COST[a]

CENTS/ASSM (CENTS/ASKM) vs PASSENGER DESIGN CAPACITY
DESIGN POINT RANGE 575 ST MI (926 KM)



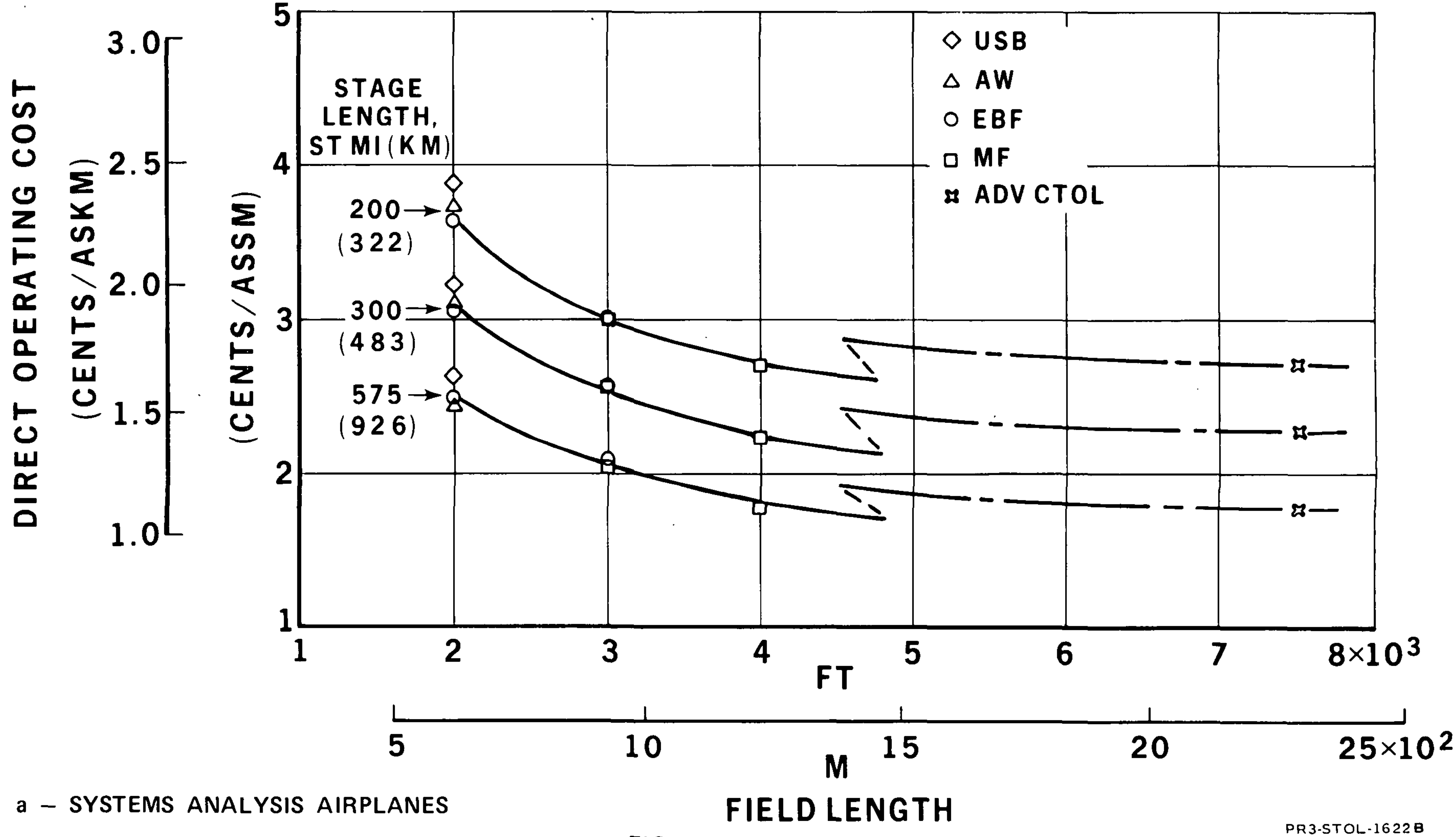
a — SYSTEMS ANALYSIS AIRPLANES

PR3-STOL-1627B

FIGURE 4-13

DIRECT OPERATING COST[a]

CENTS/ASSM (CENTS/ASKM) vs FIELD LENGTH AT SELECTED STAGE LENGTHS



a – SYSTEMS ANALYSIS AIRPLANES

PR3-STOL-1622B

FIGURE 4-14

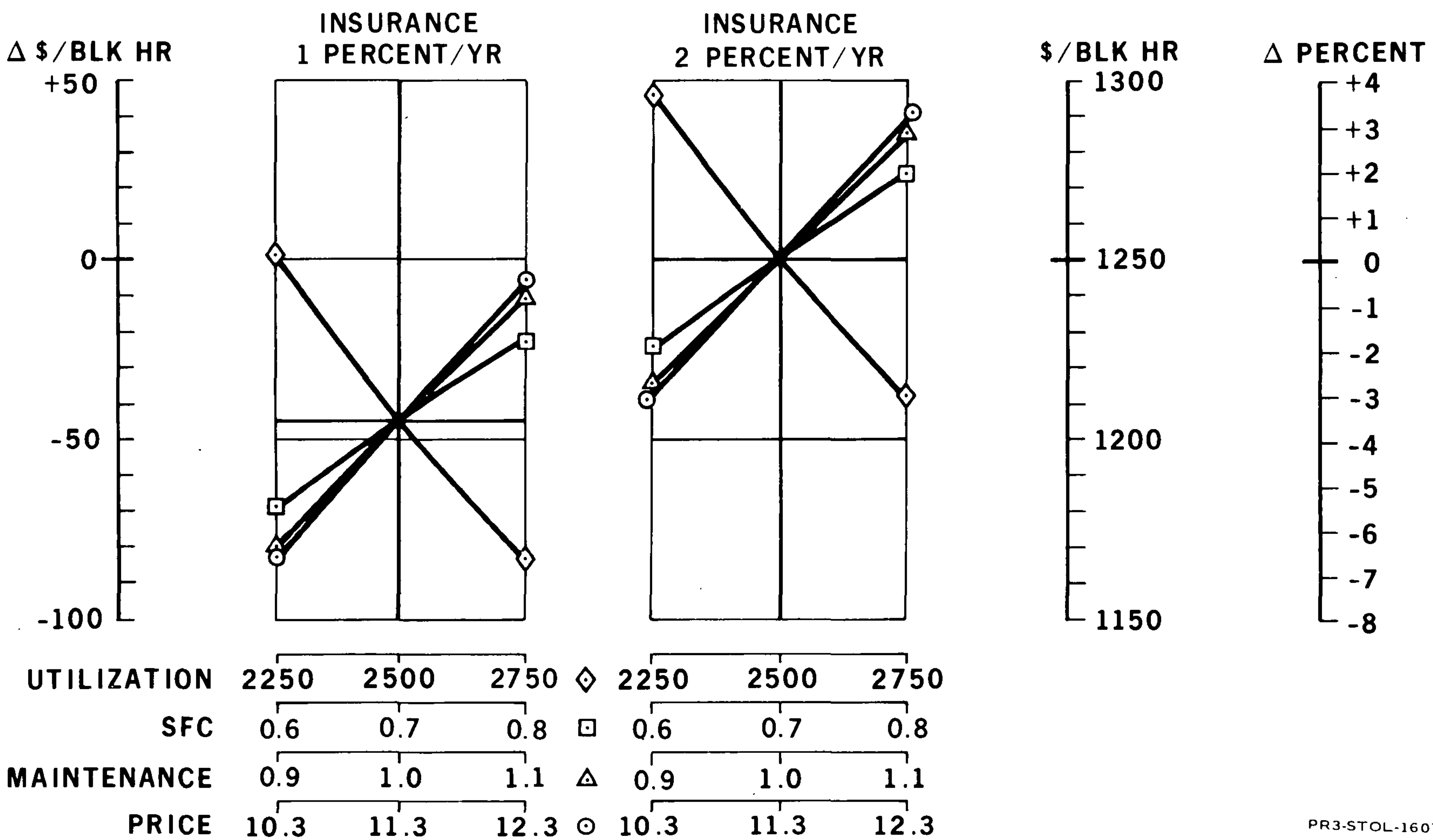
At some field length CTOL maneuver time assumptions are necessary to sustain frequency operations. At that point a new DOC envelope begins which declines with increasing field length and which passes through the advanced CTOL DOC points shown. Shorter stage lengths yield DOC curves approximately parallel to the design point DOC curve. The 200-st. mi. (322-km) stage length, about 35 percent of the design mission, produces a DOC about 50 percent greater than the stage length of the design point mission.

The sensitivity to the primary design, procedural, and pricing variations is shown in Figure 4-15. As STOL systems mature and successful operating experience accumulates the hull insurance rate should approach the nominal one-percent level representative of many operations. This change would reduce the systems analysis E150.3000 direct operating cost per block hour by about $44 or 3.5 percent as shown in Figure 4-15. The largest impact would probably be noticed in the depreciation, as a result of varying utilization rates. The figure is based upon 2500 hours per year or about 6 2/3 hours per day. At schedule - derived "friction-free" utilizations, the DOC's could drop by $50 per block hour or four percent. Initial price variations on the order of $1 million produce a four-percent change in DOC, the same change as produced by a total maintenance variation of 10 percent. The sensitivity to SFC is less; a 16 percent variation in SFC results in a two-percent change in direct operating cost.

4.2.1.1.5 Comparison of phase I and phase II DOC's. - Phase I adopted a STOL strategy point of a 300 airplane run and 20 percent profit. In Phase II this was changed to 400 airplanes and 10 percent profit. The total maneuver time of 10 minutes in Phase I was changed to 8 minutes for Phase II. These

DIRECT OPERATING COST SENSITIVITIES

Δ $/BLOCK HR • E150.3000.68[a] • STAGE LENGTH 575 ST MI (926 KM)



a – SYSTEMS ANALYSIS AIRPLANE

FIGURE 4-15

PR3-STOL-1607B

changes and the differencies in design criteria between the parametric and systems analysis airplanes resulted in a direct operating cost reduction of about 13 percent, as follows:

	DOC, ¢/assm (¢/askm)	
	Phase I	Phase II
E150.2000	2.84 (1.76)	2.48 (1.54)
E100.3000	2.96 (1.84)	2.55 (1.58)
E200.3000	2.14 (1.33)	1.87 (1.16)

4.2.1.1.6 Baseline systems analysis and final design direct operating cost. - The smaller E150.3000 final design airplane provides a reduction in direct operating cost over all ranges. At the 575-st. mi. (926-km) design point its direct operating cost is $149 per cycle or 8.2 percent less than the cost per cycle of the systems analysis design. The difference is spread almost equally among flying operations, depreciation, and maintenance. In turn, the cost per available seat-mile (seat-km) is reduced to 1.91¢/assm (1.19¢/askm) as shown in Table IV-12.

TABLE IV-12

E150.3000 PHASE II DIRECT OPERATING COST COMPARISON[a]
[Systems analysis[b] vs. final design airplane]

DOC cost element		Configuration - systems analysis	Configuration - final design
Flying operations,	$/cycle		
Crew,		289	282
Fuel and oil,		247	208
Insurance		130	119
Subtotal,		666	609
Depreciation			
Airplane,		544	496
Spares,		78	72
Subtotal,		622	568
Maintenance,			
Airframe labor,		65	60
Engine labor,		46	41
Subtotal,		111	101
Airframe material,		62	57
Engine material,		138	128
Subtotal		200	185
Applied burden		199	182
Maint. subtotal		510	468
Total Cost		1798	1649
DOC totals,	$/blk hr	1249	1163
	$/airp.-mile	3.12	2.86
	$/airp.-km	1.94	1.78
	¢/assm	2.08	1.91
	¢/askm	1.29	1.19

[a]At 575-st.mi. (926-km) design range, 2500 block hours annual utilization.

[b]Baseline for Phase II economic analyses.

4.2.1.2 Indirect Operating Costs (Reference 9)

4.2.1.2.1 Indirect operating cost model. - The indirect operating cost model used in this study is based on the past efforts of Boeing, Douglas and Lockheed to develop a standard method of computing IOCs. This combined effort is documented in Reference 10. The method predicts the cost for ten indirect activities by relating historical airline indirect costs to certain operational parameters. The activities and parameters used in predicting the costs are reported in Appendix 7.3 of this report. The related factors and constants are contained in Appendix 7.4. The factors K_1 through K_{10} were derived from the indirect expense summary submitted annually to the Civil Aeronautics Board by each of the carriers. A breakdown of the IOC elements are given in Table IV-13.

4.2.1.2.2 Modifications to IOC Cost Model. - Factors based on the cost data from the domestic trunk carriers were not completely applicable to this study because of the unique operational characteristics and assumptions made for the STOL system. During Phase I several modifications were made to the constants in the IOC equations. System expense estimates were reduced by about 25 percent because it is anticipated the STOL system would use only one airplane type. When the number of airplane models are reduced the cost of maintaining ground property and equipment would be reduced. Airplane control cost was reduced by 20 percent because the regional STOL systems could use a centralized organization for the flight planning, crew scheduling and meteorology functions. Passenger ground service costs were reduced by 35 percent. The lower constants based on Pacific Southwest Airlines (PSA) experience represent an efficient short-haul service level rather than the

Table IV-13

INDIRECT OPERATING COST CATEGORIES

Item I.	System Expense
	o Direct maintenance, ground property and equipment o Maintenance burden, ground property and equipment o Depreciation, ground property and equipment
Item II.	Local Expense
	o Airplane handling costs o Landing fees o Other airplane servicing o Direct maintenance, ground property and equipment o Depreciation, ground property and equipment o Maintenance burden, ground property and equipment o Servicing and administration
Item III.	Airplane Control Expense
Item IV.	Cabin Attendant Expense
Item V.	Food and Beverage Expense
Item VI.	Passenger Ground Service
	o Passenger handling expense o Reservations and sales, except commissions
Item VII	Cargo Handling Expense
Item VIII	Other Passenger Expense
	o Other passenger service o Passenger commissions o Advertising and publicity, passenger allocation
Item IX	Other Cargo Expense
	o Freight commissions o Freight allocations
Item X.	General and Administrative Expense

more extensive service provided trunk passengers. A comparison with the base values are shown on Table IV-14.

During Phase II an extensive review of the Phase I indirect formulation was undertaken. Inspection of the operating results of short-haul carriers (Allegheny, Air California and PSA) did not provide conclusive evidence to substantiate further reductions of IOC estimates. Therefore, the Phase I method was used without further changes throughout Phase II. The IOCs for the Phase I and Phase II airplanes are displayed in Tables IV-15 and IV-16.

On balance, the IOC estimates appear to be conservative projections of regional STOL expense after the regional systems have matured. During the early years the estimates may be a little optimistic because lower traffic levels would not fully absorb certain expenses, viz the cost of promotional and general management activities.

Table IV-14

INDIRECT OPERATING COST FACTOR COMPARISON

Factor	1970 Actual (11 Domestic Trunks)	1972 Estimate (11 Domestic Trunks)	1972 Estimate STOL
K_1	.48	.54	.41
K_2	1.27	1.43	1.43
K_3	18.39	20.66	16.53
K_4	18.98	20.00	20.00
K_5	-	1.00	0.20
K_6	5.00 (PSA 3.25)	5.62 (PSA 3.65)	3.65
K_7	62.68	70.43	70.43
K_8	.0044	.0044	.0044
K_9	.0086	.0086	.0086
K_{10}	.06	.06	.06

TABLE IV-15

PHASE I - SUMMARY OF INDIRECT OPERATING COSTS[a]

[1972 dollars]

AIRPLANE CONFIGURATION	IOC- ¢/assm	IOC- ¢/askm
E50.1500.70A	1.87	1.16
E100.1500.70A	1.68	1.04
E200.1500.70A	1.56	.94
E50.2000.70A	1.69	1.05
E100.2000.70A	1.50	.93
E150.2000.70A	1.44	.89
E200.2000.70A	1.41	.88
E50.3000.70A	1.60	.99
E100.3000.70A	1.41	.88
E200.3000.70A	1.32	.82
M50.2000.70A	1.87	1.16
M100.2000.70A	1.58	.98
M200.2000.70A	1.44	.89
M50.3000.71A	1.60	.99
M100.3000.74A	1.41	.88
M200.3000.74A	1.32	.82
M100.4000.76A	1.37	.85
M200.4000.77A	1.29	.80
U100.2000.70A	1.53	.95
U100.3000.70A	1.42	.88

AIRPLANE CONFIGURATION	IOC- ¢/assm	IOC- ¢/askm
A50.1500.77A	1.97	1.22
A100.1500.77A	1.70	1.06
A200.1500.76A	1.58	.98
A50.2000.78A	1.76	1.09
A100.2000.79A	1.55	.96
A200.2000.79A	1.44	.89
A50.3000.73A	1.63	1.01
A100.3000.76A	1.44	.89
A200.3000.76A	1.35	.84
E50.2000.73G	1.86	1.15
E100.2000.74G	1.66	1.03
E200.2000.74G	1.52	.94
A50.2000.80G	1.86	1.15
A100.2000.80G	1.64	1.02
A200.2000.80G	1.52	.94
C100.78.2[b]	1.46	.91
C200.78.2[b]	1.34	.83
C100.78.4[b]	1.47	.91
C200.78.4[b]	1.35	.84

[a]At 575-st. mi. (926-km) design range.

[b]Data for 575-st. mi. (926-km) range; design range is 1381 st. mi. (2222 km).

TABLE IV-16
PHASE II INDIRECT OPERATING COSTS - BY RESOURCE ELEMENT[a]
[575-st. mi. (926-km) design range]

IOC COST ELEMENT		SYSTEMS ANALYSIS AIRPLANES								
		E150. 2000. 68A	E100. 3000. 67A	E150. 3000. 68A	E200. 3000. 70A	M150. 3000. 71A	M150. 4000. 76A	A150. 2000. 79A	U150. 2000. 70A	C150. 7500. 80 (b)
System expense,	$/cycle	55	36	45	56	42	37	50	60	33
Local expense,		295	160	234	316	255	220	302	333	228
Aircraft control,		17	17	17	17	17	17	17	17	17
Cabin attendants,		87	58	86	114	86	84	82	87	90
Food and beverage,		26	17	26	34	26	25	24	26	27
Passenger handling,		329	219	329	438	329	329	329	329	329
Cargo/baggage handling,		63	42	63	84	63	63	63	63	63
Other passenger expense,		228	152	228	304	228	228	228	228	228
Other cargo expense,		0	0	0	0	0	0	0	0	0
General and administration,		139	94	124	156	123	115	142	145	115
TOTAL COST		1239	795	1152	1519	1169	1118	1237	1288	1130
IOC TOTALS,	$/blk hr	855	545	800	1070	817	804	910	888	753
	$/airp.-mile	2.15	1.38	2.00	2.64	2.03	1.94	2.15	2.24	1.96
	$/airp.-km	1.34	.86	1.24	1.64	1.26	1.20	1.33	1.39	1.22
	¢/assm	1.43	1.38	1.33	1.32	1.35	1.29	1.43	1.49	1.31
	¢/askm	.89	.86	.83	.82	.84	.80	.89	.93	.81

[a]Data reflect 1972 price levels.
[b]Data are for 575 st. mi. (926 km); design range is 1381 st. mi. (2222 km).

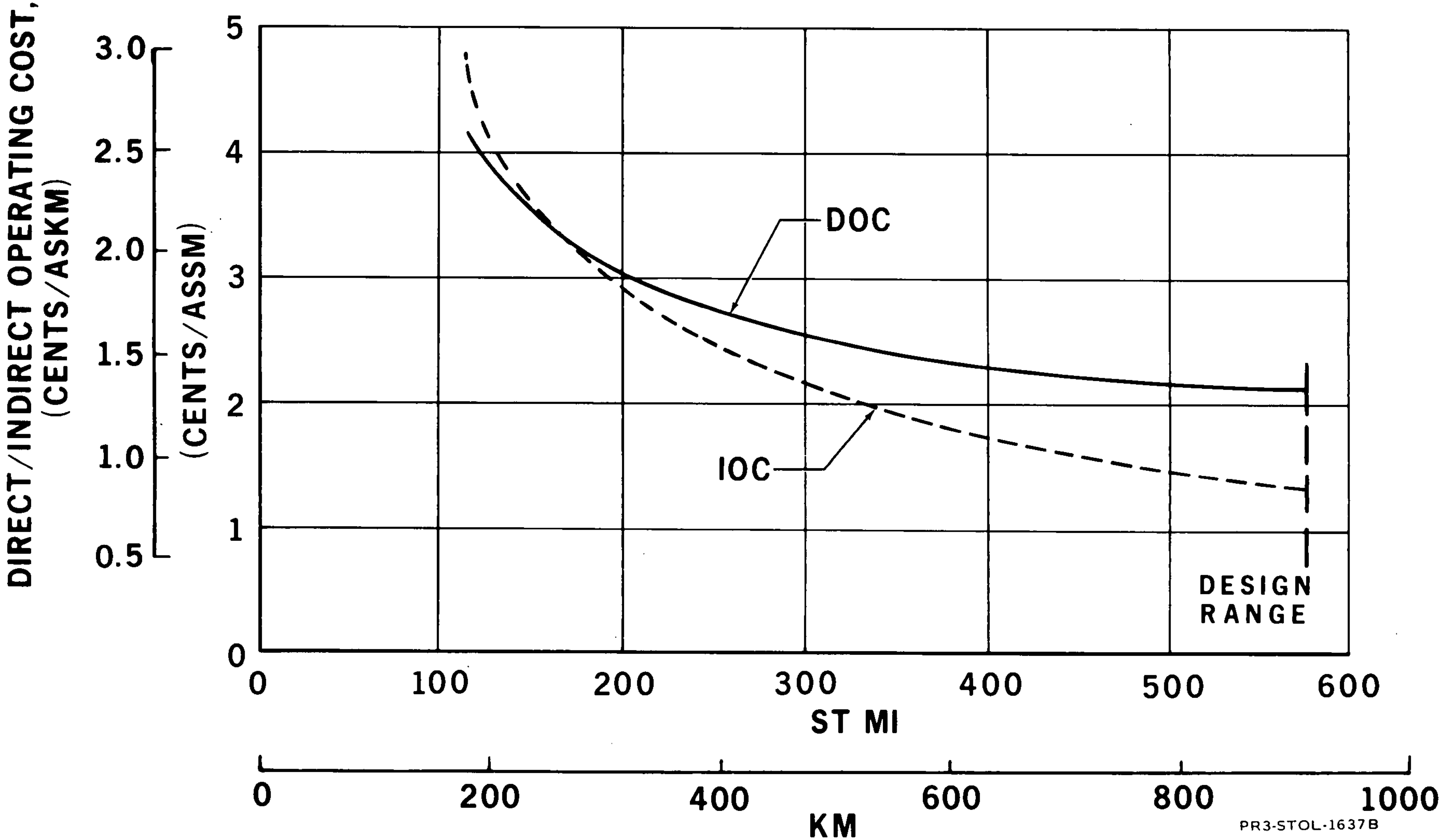
4.2.1.2.3 Direct and indirect operating expense. - The shapes of the direct and indirect operating cost curves, while similar, are conditioned by the relation of the stage length variable cost coefficient. The direct operating cost function has positive stage length coefficients in the equation for each element - Figure 4-16. The indirect operating cost function has zero valued stage length coefficients in four of the ten subsidiary equations. Therefore, the trend of the indirect operating cost function is steeper than the trend of the direct operating function. As discussed later, this has an important effect on the development of nondiscriminatory ticket price versus stage length fare structures.

The comparison is even more striking when considering the indirect to direct operating cost ratio as a function of stage length, Figure 4-17. Here the ratio varies from 1.16 at 115 st. mi. (185 km) to .63 at 575 st. mi. (926 km), the design range - a variation of almost 50 percent. Maintaining a network stage length balance during a regional STOL system's early evolution is necessary for financial stability. This balance between short and long stage length service is, therefore, an important airline management objective during the formative years.

4.2.1.2.4 Indirect operating cost sensitivities. - The largest component of indirect operating cost is passenger handling expense. This element and the related elements of other passenger expense and baggage handling - cargo handling is excluded - comprise almost 60 percent of total indirect operating costs. These elements would be the critical indirect costs which must be controlled to achieve financially successful STOL systems. For example, a change of 10 percent in these elements increases indirect cost by about 5.5 percent, Figure 4-18, for a total cost increase of about 2.5 percent at a

OPERATING COST vs STAGE LENGTH

E150.3000.68[a]   400 AIRPLANE QUANTITY

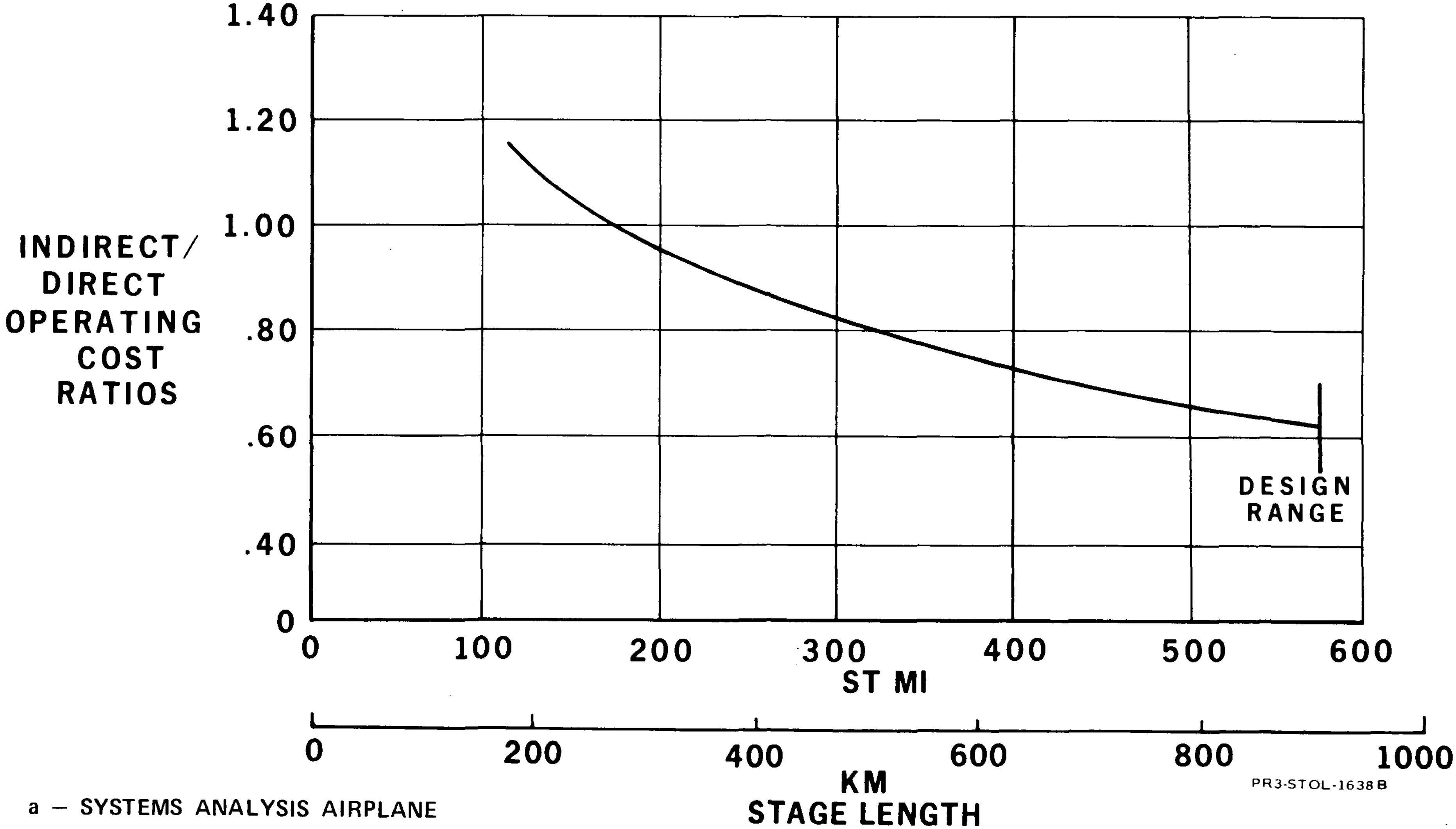


a – SYSTEMS ANALYSIS AIRPLANE

FIGURE 4-16

INDIRECT/DIRECT OPERATING COST RATIO vs STAGE LENGTH

E150.3000.68[a]   400 AIRPLANE QUANTITY



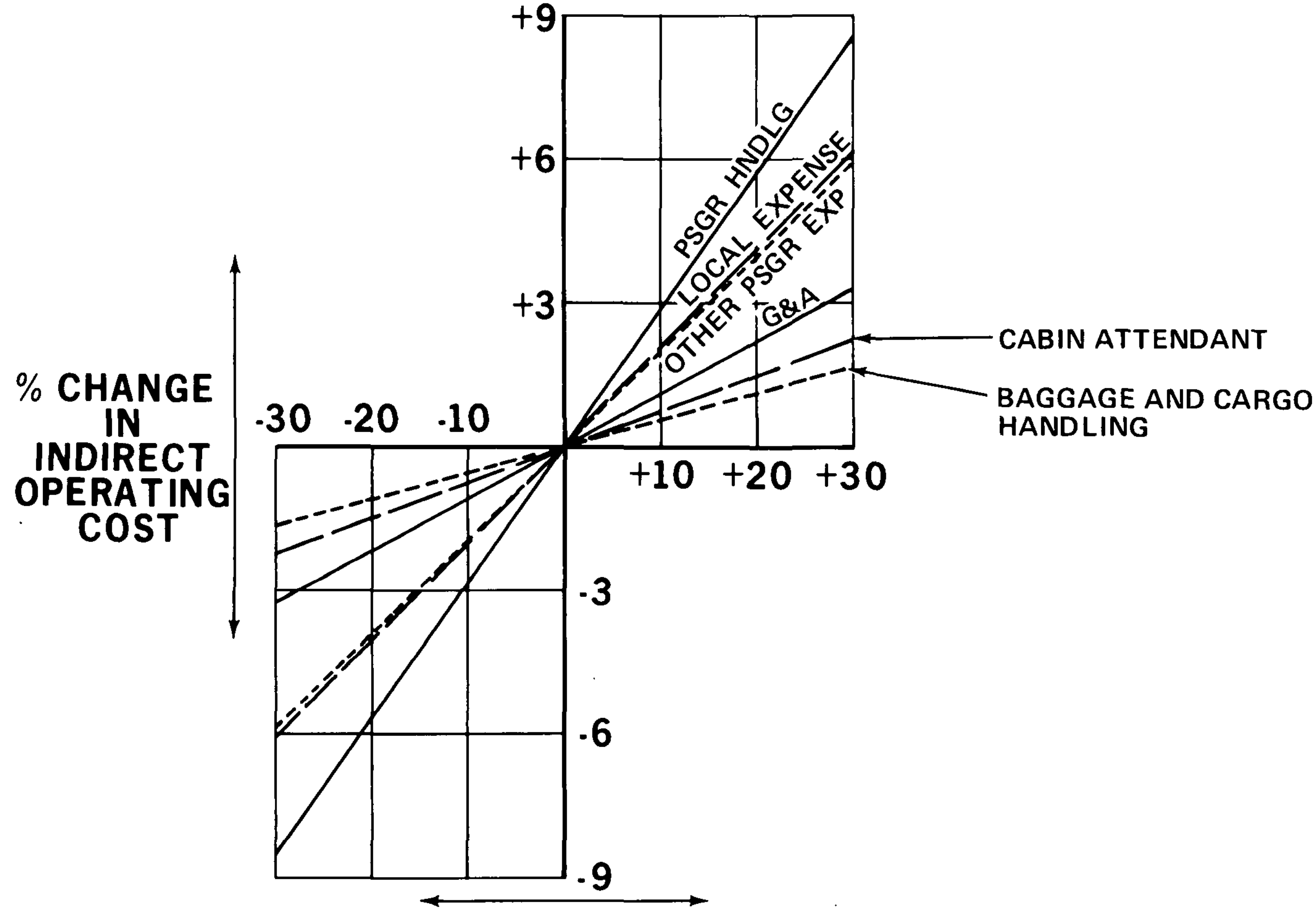
a — SYSTEMS ANALYSIS AIRPLANE

FIGURE 4-17

I.O.C. SENSITIVITY ANALYSIS

E150.3000.68 AT 575 ST. MI. (926 KM)[a]

COMPONENTS SHOWN ACCOUNT FOR 92.4% OF TOTAL I.O.C. ON A CYCLE (TRIP) BASIS.



a – SYSTEMS ANALYSIS AIRPLANE

PR3-STOL-1617B

FIGURE 4-18

representative 575-st. mi. (926-km) stage length. In turn, this would reduce operating profit by a little over 15 percent. The other major controllable expenses are general and administrative expenses. All of these "controllable" categories can roughly be measured by employee productivity - passengers per employee. Good short haul operating results depend upon raising this performance index to above 2000 as opposed to the less than 1000 value observed for current trunk operators. Naturally, there is a balance between the service offered and travellers' propensity to choose STOL flights. This may be the most critical management variable in the STOL transportation industry.

4.2.1.2.5 Phase I and Phase II total operating costs. - The total operating costs for 39 Phase I airplanes and the 9 Phase II systems analysis airplanes are shown in Tables IV-17 and IV-18. These costs are the sum of the airplane direct and indirect operating costs with the DOC and IOC components itemized for each of the Phase II systems analysis designs.

4.2.1.2.6 Private/public sector financial interfaces. - Some of the airline indirect operating costs are important direct revenue sources for the public sector's local support of airline operations. The principle financial interfaces are property taxes on facilities, landing fees, and rents of publicly owned aircraft and passenger facilities.

An estimate of the magnitude of these expenses was made using References 10 and 63 as a basis. Landing fees over the 1964 to 1969 time period amounted to 38 cents per passenger while passenger terminal leases and rentals were estimated at 25 percent of passenger handling expenses or 57.5 cents per passenger. The long term expense growth between 1967 and 1972 was estimated at 18.1 percent using cost growth data presented in Reference 64.

TABLE IV-17

PHASE I - SUMMARY OF DIRECT AND INDIRECT OPERATING COSTS[a]
[1972 dollars]

AIRPLANE CONFIGURATION	DOC		IOC		TOC	
	¢/assm	¢/askm	¢/assm	¢/askm	¢/assm	¢/askm
E50 .1500.70A	6.01	3.73	1.87	1.16	7.88	4.89
E100.1500.70A	4.27	2.65	1.68	1.04	5.95	3.69
E200.1500.70A	3.33	2.07	1.56	.97	4.89	3.04
E50 .2000.70A	5.12	3.18	1.69	1.05	6.81	4.23
E100.2000.70A	3.46	2.15	1.50	.93	4.96	3.08
E150.2000.70A	2.84	1.76	1.44	.89	4.28	2.66
E200.2000.70A	2.55	1.58	1.41	.88	3.96	2.46
E50 .3000.70A	4.72	2.93	1.60	.99	6.32	3.92
E100.3000.70A	2.96	1.84	1.41	.88	4.37	2.72
E200.3000.70A	2.14	1.33	1.32	.82	3.46	2.15
M50 .2000.70A	5.69	3.53	1.87	1.16	7.56	4.69
M100.2000.70A	3.63	2.26	1.58	.98	5.21	3.24
M200.2000.70A	2.58	1.60	1.44	.89	4.02	2.49
M50 .3000.71A	4.43	2.75	1.60	.99	6.03	3.74
M100.3000.74A	2.84	1.76	1.41	.88	4.25	2.64
M200.3000.74A	2.06	1.28	1.32	.82	3.38	2.10
M100.4000.76A	2.64	1.64	1.37	.85	4.01	2.49
M200.4000.77A	1.91	1.19	1.29	.80	3.20	1.99
U100.2000.70A	3.43	2.13	1.53	.95	4.96	3.08
U100.3000.70A	2.92	1.81	1.42	.88	4.34	2.69

[a]At 575-st. mi. (926-km) design range.

TABLE IV-17. - Concluded

PHASE I - SUMMARY OF DIRECT AND INDIRECT OPERATING COSTS[a]
[1972 dollars]

AIRPLANE CONFIGURATION	DOC		IOC		TOC	
	¢/assm	¢/askm	¢/assm	¢/askm	¢/assm	¢/askm
A50 .1500.77A	6.45	4.01	1.97	1.22	8.42	5.23
A100.1500.77A	4.33	2.69	1.70	1.06	6.03	3.75
A200.1500.76A	3.27	2.03	1.58	.98	4.85	3.01
A50 .2000.78A	5.50	3.42	1.76	1.09	7.26	4.51
A100.2000.79A	3.62	2.25	1.55	.96	5.17	3.21
A200.2000.79A	2.67	1.66	1.44	.89	4.11	2.55
A50 .3000.73A	4.93	3.06	1.63	1.01	6.56	4.07
A100.3000.76A	3.13	1.94	1.44	.89	4.57	2.83
A200.3000.76A	2.25	1.40	1.35	.84	3.60	2.24
E50 .2000.73G	5.94	3.69	1.86	1.15	7.80	4.84
E100.2000.74G	4.26	2.65	1.66	1.03	5.92	3.68
E200.2000.74G	3.06	1.90	1.52	.94	4.58	2.84
A50 .2000.80G	5.96	3.70	1.86	1.15	7.82	4.85
A100.2000.80G	4.12	2.56	1.64	1.02	5.76	3.58
A200.2000.80G	3.05	1.89	1.52	.94	4.57	2.83
C100.78.2[b]	2.67	1.66	1.46	.91	4.13	2.57
C200.78.2[b]	1.85	1.15	1.34	.83	3.19	1.98
C100.78.4[b]	2.93	1.82	1.47	.91	4.40	2.73
C200.78.4[b]	2.01	1.25	1.35	.84	3.36	2.09

[a]At 575-st. mi. (926-km) design range.
[b]Data for 575-st. mi. (926-km) range; design range is 1381 st. mi. (2222 km).

TABLE IV-18

PHASE II SYSTEMS ANALYSIS AIRPLANES - OPERATING COST SUMMARY
[575-st. mi. (926-km) design range]

Cost dimension	E150 2000 .68	A150 2000 .79	U150 2000 .70	E100 3000 .67	E150 3000 .68	M150 3000 .71	E200 3000 .70	M150 4000 .76	C150 7500 .80 (a)
Dollars/cycle									
DOC	2144	2116	2260	1468	1798	1739	2152	1539	1515
IOC	1239	1237	1288	795	1152	1169	1519	1118	1130
TOC	3383	3353	3548	2263	2950	2908	3671	2657	2645
Dollars/airp.-st.mi.									
DOC	3.72	3.67	3.92	2.55	3.12	3.02	3.74	2.67	2.63
IOC	2.15	2.15	2.24	1.38	2.00	2.03	2.64	1.94	1.96
TOC	5.87	5.82	6.16	3.93	5.12	5.05	6.38	4.61	4.59
Dollars/airp.-km									
DOC	2.31	2.28	2.44	1.58	1.94	1.88	2.32	1.66	1.63
IOC	1.34	1.34	1.39	.86	1.24	1.26	1.64	1.20	1.22
TOC	3.65	3.62	3.83	2.44	3.18	3.14	3.96	2.86	2.85
Cents/assm									
DOC	2.48	2.45	2.62	2.55	2.08	2.01	1.87	1.78	1.75
IOC	1.43	1.43	1.49	1.38	1.33	1.35	1.32	1.29	1.31
TOC	3.91	3.88	4.11	3.93	3.41	3.36	3.19	3.07	3.06
Cents/askm									
DOC	1.54	1.52	1.63	1.58	1.29	1.25	1.16	1.11	1.09
IOC	.89	.89	.93	.86	.83	.84	.82	.80	.81
TOC	2.43	2.41	2.56	2.44	2.12	2.09	1.98	1.91	1.90

[a]Data are for 575 st. mi. (926 km); design range is 1381 st. mi. (2222 km).

Over the same period load factors declined to 49.3 percent from 57.2 percent. The joint effect of load factor declines and cost growth would increase total indirect operating cost from $10.22 to $14.00 per passenger for domestic trunk carriers. The landing fees, leases, and rentals would grow an equivalent percentage to $1.30 per passenger, 9.3 percent of the 1972 trunk IOC average of $14.00 per passenger, or 11.8 percent of the STOL IOC estimate of $11.00 per passenger presented in the summary.

4.2.1.2.7 Systems analysis and final design indirect operating costs. - While the final design E150.3000 reduces the direct operating costs by about 8 percent compared to its systems analysis predecessor, the change to indirect operating costs is, as would be anticipated, much smaller. It amounts to about 2.5 percent at the 575-st. mi. (926-km) design range. The indirect operating cost changes at a very slow rate in response to changes in direct operating cost because it is traffic sensitive rather than design sensitive. The components of total operating cost at the design range for the systems analysis and final design airplanes are as follows, in ¢/assm (¢/askm):

	DOC	IOC	TOC
Systems analysis airplane	2.08 (1.29)	1.33 (.83)	3.41 (2.12)
Final design airplane	1.91 (1.19)	1.30 (.81)	3.21 (2.00)

In terms of TOC, the E150.3000 final design is about 6% lower than that of the systems analysis configuration. This relative difference remains at about 5-6%, even at shorter stage lengths. The two components of TOC for the Phase II baseline airplane are shown as a function of average stage length in Figure 4-19.

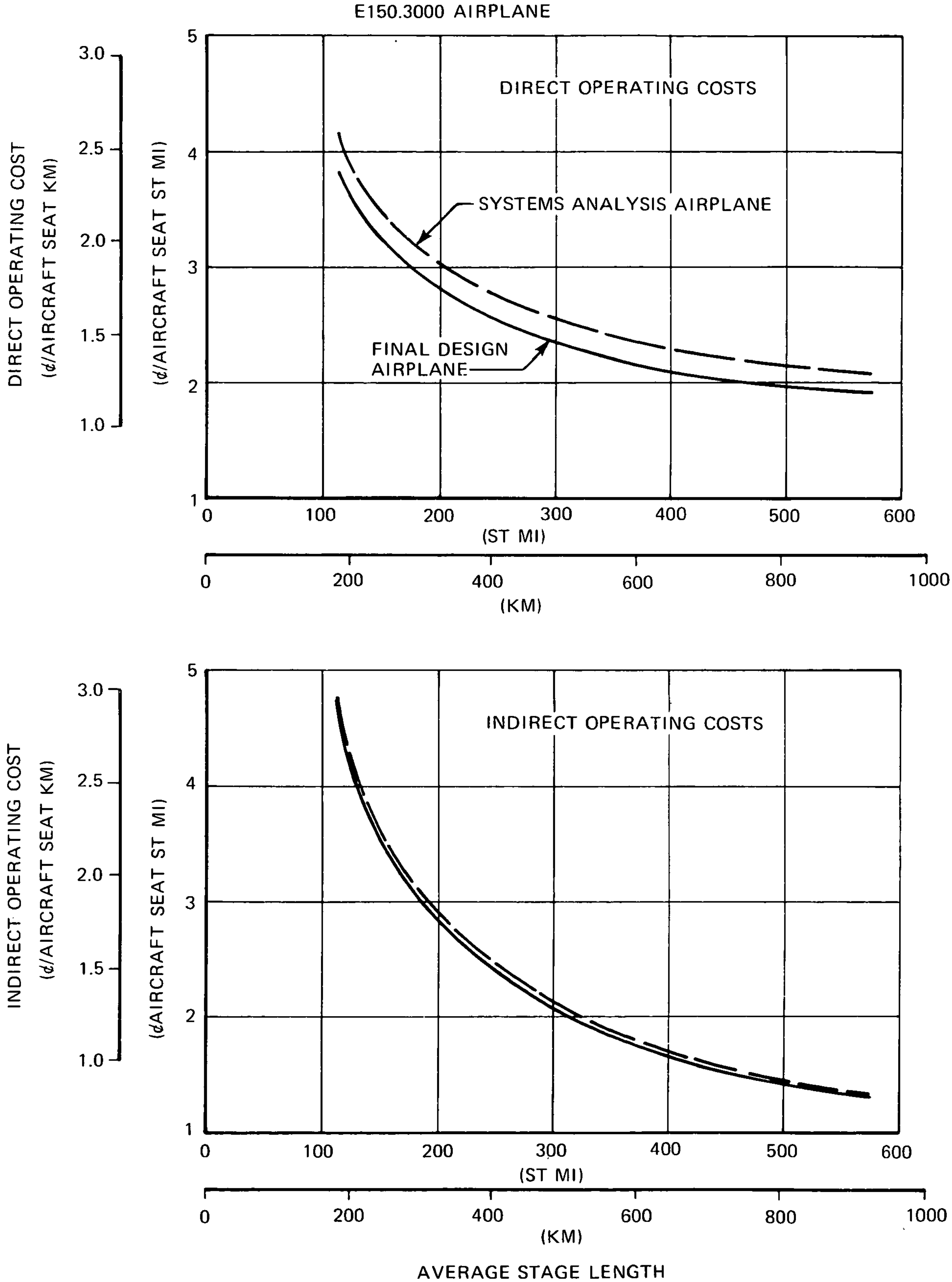


FIGURE 4-19. PHASE II SYSTEMS ANALYSIS AND FINAL DESIGN OPERATING COSTS

4.2.2 Revenues

4.2.2.1 Phase I fare levels. - The Phase I studies were directed toward three objectives: parametric analyses of candidate concepts, determination of STOL passenger demand, and preliminary analyses of STOL regional systems. Since return on investment was a primary guideline for concept selection a constant fare structure was required for the analysis of all the candidates. In a similar vein, the determination of the potential STOL market required the use of a constant reference fare structure. The CAB jet coach fare structure, Table IV- 9 , in effect at that time provided the necessary constant reference for both these purposes. Return on investment for the various candidates could be ranked using this constant fare and the modal split analyses could proceed parametrically using fare multiples of 1.00, 1.25, and 1.50 of the aforementioned fare structure.

At the same time it was recognized that the regulatory agency or agencies would look to operator performance in determining fare levels for the STOL system. Accordingly for the preliminary regional analyses a cost generated fare level of DOC + IOC + 10 percent + 8 percent federal tax was used. This fare structure was competitive with the CAB fares and provided some interesting rates of return. An alternative California intrastate fare structure was examined which was considerably lower than either the cost generated or CAB fare structures. The results showed that the intrastate structure was too low to provide investment incentive at the service levels and seating densities postulated. The total regional revenue used during Phase I was increased above the CAB yields to account for incidentals (beverage sales).

TABLE IV-19

JET COACH FARE FORMULA FOR PHASE I OF STUDY

1. Coach Fare = $9.00 Station/Fixed Cost + Distance Cost

   Distance Cost =

   $0.06 per mile ($.037/km) for trips 500 miles (805 km) and under

   $0.056 per mile ($.035/km) for trips 501 to 1000 miles (806-1609 km)

   $0.052 per mile ($.032/km) for trips 1001 to 1500 miles (1610-2414 km)

   $0.050 per mile ($.031/km) for trips 1501 to 2000 miles (2415-3219 km)

   $0.043 per mile ($.03/km) for trips 2001 to 2500 miles (3220-4023 km)

2. Resulting dollars value rounded to nearest dollar

3. Apply federal tax of 8 percent and round up

4. Divide by 1.08 (federal tax)

5. Round to nearest cent

6. Multiply by 1.06 (new fare increase granted May 1971)

7. Multiply by 1.08 (federal tax)

8. Round to nearest dollar (ticket price with federal tax included)

4.2.2.2 Phase II revenues. - Implementation of CAB Phase 7, Table IV-20, current jet coach fare levels occurred during Phase II. At NASA direction the Phase 7 fare structure was adopted for airplane design mission and regional system studies. The Phase 7 fare structure yields about 9 percent more per passenger mile than the initial fare structure. Prior to receipt of the fare structure deviation several alternative fare structure formulations were derived. Since these were directed toward a more comprehensive analysis they are reported in Section 5.3 of this report. Of particular significance is the similarity of the CAB Phase 7 structure and the cash operating cost based fare structure for stage lengths up to about 200 st. mi. (320 km). At longer stage lengths sharp convergence (See Figure 7-1) of the fare structures was observed.

The final regional system financial analyses during Phase II used the CAB Phase 7 fare structure plus a \$0.375 increment per passenger for beverage sales. The \$0.375 was derived from a unit price of \$1.50 per drink. About 25 percent of the passengers purchase beverages during stage lengths similar to the regional STOL networks. Since short turnaround times militate against belly pit cargo and mail carriage, potential receipts and costs from this source were excluded from both the revenue and cost estimates. There exists, therefore, an opportunity for the STOL regional operators to increase net revenue by operating low passenger load factor/high cargo load factor operations during off peak hours. Evaluation of these short haul mixed and cargo operations has been deferred by mutual NASA, DAC, LAC agreement.

TABLE IV-20
CAB PHASE 7 DOMESTIC JET COACH FARES
[From Ref. 41]

DISTANCE INTERVAL		TICKET PRICE		DISTANCE INTERVAL		TICKET PRICE	
ST. MI.	km	BASE, $	WITH FED. TAX, $	ST. MI.	km	BASE, $	WITH FED. TAX, $
1 - 8	2 - 13	0	0	492 - 500	791 - 805	43.52	47.00
9 - 24	14 - 39	11.11	12.00	501 - 508	806 - 818	43.52	47.00
25 - 41	40 - 66	12.04	13.00	509 - 526	819 - 847	44.44	48.00
42 - 58	67 - 93	12.96	14.00	527 - 544	848 - 876	45.37	49.00
59 - 74	94 - 119	14.81	16.00	545 - 562	877 - 905	46.30	50.00
75 - 91	120 - 147	15.74	17.00	563 - 580	906 - 934	47.22	51.00
92 - 108	148 - 174	17.59	19.00	581 - 594	935 - 956	48.15	52.00
109 - 124	175 - 200	18.52	20.00	595 - 615	957 - 990	49.07	53.00
125 - 141	201 - 227	19.44	21.00	616 - 633	991 - 1019	50.00	54.00
142 - 158	228 - 254	20.37	22.00	634 - 651	1020 - 1048	51.85	56.00
159 - 174	255 - 280	21.30	23.00	652 - 669	1049 - 1077	52.78	57.00
175 - 191	281 - 307	22.22	24.00	670 - 687	1078 - 1106	53.70	58.00
192 - 208	308 - 335	23.15	25.00	688 - 705	1107 - 1135	54.63	59.00
209 - 224	336 - 361	24.07	26.00	706 - 723	1136 - 1164	56.48	61.00
225 - 241	362 - 388	25.00	27.00	724 - 741	1165 - 1193	57.41	62.00
242 - 258	389 - 415	25.93	28.00	742 - 758	1194 - 1220	58.33	63.00
259 - 274	416 - 441	26.85	29.00	759 - 776	1221 - 1249	59.26	64.00
275 - 291	442 - 469	29.63	32.00	777 - 794	1250 - 1278	60.19	65.00
292 - 308	470 - 496	30.56	33.00	795 - 812	1279 - 1307	61.11	66.00
309 - 324	497 - 522	31.48	34.00	813 - 830	1308 - 1336	62.96	68.00
325 - 341	523 - 549	32.41	35.00	831 - 848	1337 - 1365	58.81	69.00
342 - 358	550 - 576	33.33	36.00	849 - 866	1366 - 1394	64.81	70.00
359 - 374	577 - 602	34.26	37.00	867 - 883	1395 - 1421	65.74	71.00
375 - 391	603 - 629	35.19	38.00	884 - 901	1422 - 1450	66.67	72.00
392 - 408	630 - 657	36.11	39.00	902 - 919	1451 - 1479	67.59	73.00
409 - 424	658 - 682	37.04	40.00	920 -937	1480 - 1508	69.44	75.00
425 - 441	683 - 710	37.96	41.00	938 - 955	1509 - 1537	70.37	76.00
442 - 458	711 - 737	38.89	42.00	956 - 973	1538 - 1566	71.30	77.00
459 - 474	738 - 763	40.74	44.00	974 - 991	1567 - 1595	72.25	78.00
475 - 491	764 - 790	42.59	46.00	992 - 1000	1596 - 1609	73.15	79.00

4.2.3 Return on Investment

4.2.3.1 Phase I. - Phase I ROIs were calculated using the discounted cash flow method and the CAB fare structure in effect at that time (Table IV-19). This fare structure is referenced because it is relatively close to the Phase 7 fare structure, the difference being about 6 percent at 575 st. mi. (926 km). The data in Table IV-21 depict the ROIs calculated using the discounted cash flow method over the entire 12-year life, operating at the design range of 575 st. mi. (926 km), unfinanced (excluding debt financing and interest) and with ticket purchases as the only source of revenue. The results clearly show that the 50- and 100-passenger airplanes are too small to be profitable in the 1985 market.

4.2.3.2 Phase II. - In this phase the higher CAB fare structure (Phase 7) was used at the request of the NASA and the ROI data calculated for both the design-range stage length and for the six regional networks. The data for the nine systems analysis airplanes are presented in Table IV-22. A comparison of Phase I and Phase II airplanes shows that the Phase II systems analysis design rules have improved the ROIs at the design mission of 575 st. mi. (926 km) as indicated below:

	Phase I ROI %	Phase II ROI %
E150.2000	5.58	8.8
E100.3000	4.92	8.9
E200.3000	13.97	17.9

Both the Phase I and Phase II ROIs were calculated on an incremental airplane basis. The load factors and operating cost structures are typical of the full operating level rather than the initial phase-in period.

TABLE IV-21

PHASE I RETURN ON INVESTMENT[a]
[Percent]

AIRPLANE TYPE ENGINE MFGR. LIFT CONCEPT	DESIGN PASSENGER CAPACITY	FIELD LENGTH, ft(m) 1500 (457)	2000 (610)	3000 (914)	4000 (1219)	7500 (2286)	8500 (2591)
STOL							
ALLISON							
EBF	50	-16.77	-12.51	-9.74	---	---	---
	100	-6.43	.25	4.92	---	---	---
	150	---	5.58	---	---	---	---
	200	1.05	8.53	13.97	---	---	---
MF	50	---	-15.50	-7.62	---	---	---
	100	---	-1.86	6.08	8.35	---	---
	200	---	7.86	15.12	17.78		
USB	100	---	-0.09	5.01	---	---	---
AW	50	-17.87	-14.36	-10.37	---	---	---
	100	-7.06	-1.30	3.19	---	---	---
	200	1.07	7.36	12.45	---	---	---
GENERAL ELECTRIC							
EBF	50	---	-16.30	---	---	---	---
	100	---	-6.41	---	---	---	---
	200	---	3.25	---	---	---	---
AW	50	---	-15.79	---	---	---	---
	100	---	-5.23	---	---	---	---
	200	---	3.31	---	---	---	---
ADV CTOL[b]							
2 ENGINES	100	---	---	---	---	9.24	---
4 ENGINES	100	---	---	---	---	17.39	---
2 ENGINES	200	---	---	---	---	---	4.54
4 ENGINES	200	---	---	---	---	---	14.72

[a]At 575-st. mi. (926-km) stage length.
[b]Data for 575-st. mi. (926-km) range; design range is 1381 st. mi. (2222 km).

TABLE IV-22

PHASE II SYSTEMS ANALYSIS AIRPLANES - RETURN ON INVESTMENT[a]

[Percent]

CONFIGURATION	DESIGN RANGE, st. mi./km (575/926)	ROI FOR GIVEN REGION (Average Stage Length-st. mi./km)					
		CALIFORNIA (309/497)	CHICAGO (319/513)	NORTHEAST (296/476)	SOUTHERN (342/550)	SOUTHEAST (406/653)	NORTHWEST (333/536)
E150.2000.68A	8.8	12.2	12.1	12.2	17.4	11.9	9.5
A150.2000.79A	9.9	--	12.5	--	--	--	--
U150.2000.70A	6.9	--	8.5	--	--	--	--
E100.3000.67A	8.9	13.1	13.0	13.2	18.4	12.8	10.4
E150.3000.68A	14.8	20.3	20.3	20.5	26.8	19.9	16.8
E200.3000.70A	17.9	23.9	23.9	24.0	30.8	23.4	21.0
M150.3000.71A	15.8	20.9	20.5	20.9	27.2	20.4	17.4
M150.4000.76A	20.7	26.6	26.5	27.2	34.7	26.7	22.7
C150.7500.80	25.5	--	23.6 [b]	--	--	--	--

[a] Based on CAB Phase 7 jet coach fares.

[b] Based on a CTOL network with ASL = 291 st. mi. (468 km)

The procedures and computer programs which are used by Douglas on a routine basis for its customer airlines were applied to the STOL study. Return on investment was an important measure in the system evaluation and selection process. ROI analyses based on the discounted cash flow method involved a three-step process: (1) an investment base was estimated for each situation in which a configuration was evaluated; (2) the cash flow generated by the STOL operation for the selected situation was determined by establishing the economic life of the airplane and forecasting annual revenue and cost; and (3) ROI was determined by establishing the interest rate which equates all future cash flows with the value of the initial investment. Douglas utilized its computer program G9AC and N5AC for deriving ROI.

The return on investment model focuses on an airplane as an investment increment, and determines the projected average annual rate of return identifying the investment base in current dollars which represents the total cost per airplane, including such elements as airplane price, price of spares and ground support equipment, start-up costs, and capitalized interest resulting from the operator making predelivery payments. To derive the ROI, all future cash flows accruing to the aircraft were discounted at whatever interest rate that equates these flows with the investment base.

4.2.3.3 Baseline systems analysis and final design ROIs. - Refining the E150.3000 design to incorporate new acoustic and other design criteria has a major influence on the calculated ROIs for the baseline E150.3000 airplane in the six regions and at the design range. Figure 4-20 compares the results on a region for region basis. Geometric analysis of the two data sets shows the gross effect is to raise the discounted cash flow return on investment

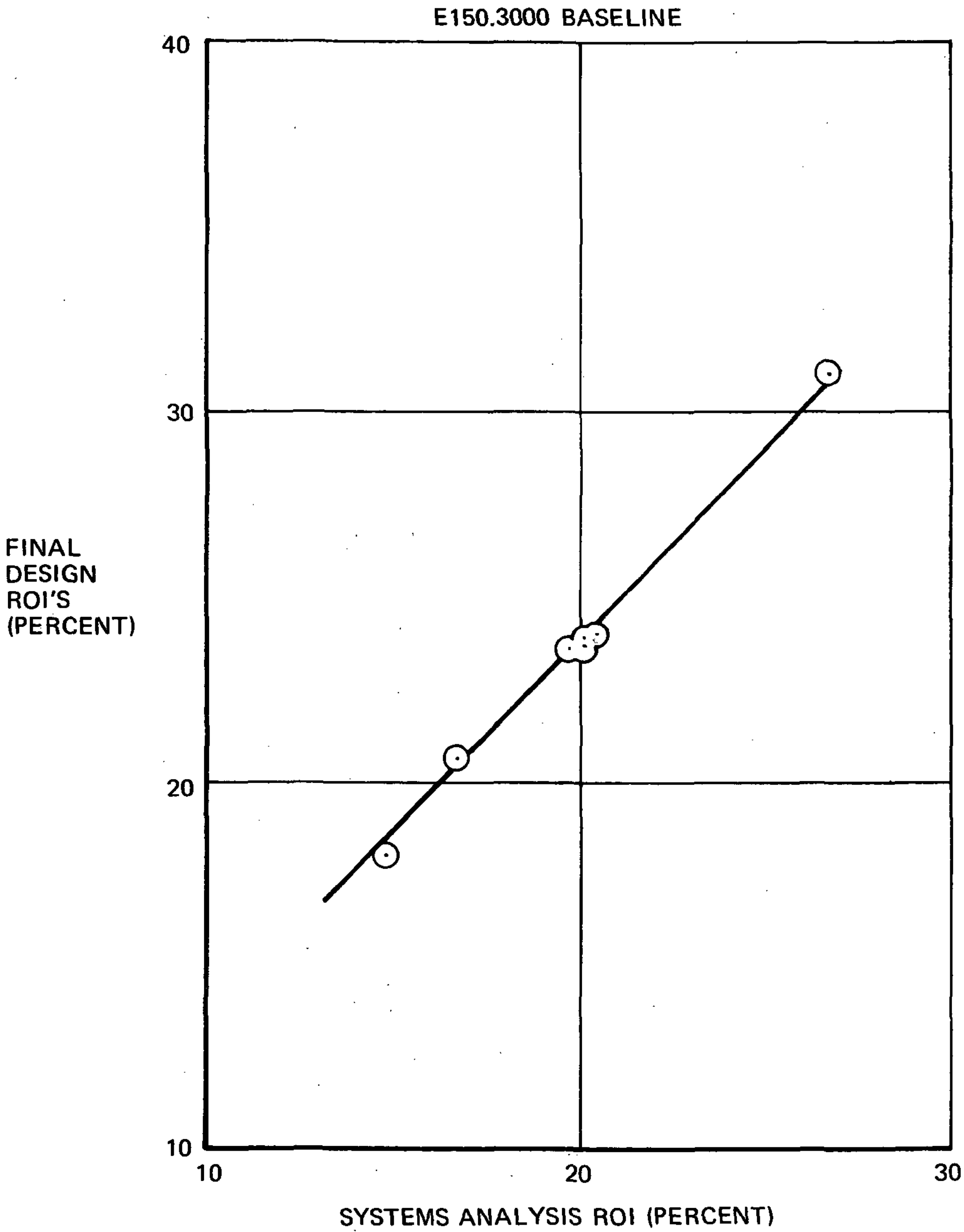


FIGURE 4-20. SYSTEMS ANALYSIS AND FINAL DESIGN ROI'S

at all segment lengths by approximately three and three-quarters percent before consideration of the fare dilution factor developed in the next section.

4.2.4 Finance

4.2.4.1 Chicago region system context

4.2.4.1.1 Background. - Service in the Chicago region STOL system was assumed to begin with a fleet of 19 E150.3000 airplanes delivered over the first year. The route structure would grow over the next six years reaching maturity in the seventh year of operation. The initial fleet would increase from 19 to 38 airplanes including approximately three airplanes for maintenance purposes. Operations in this region would be conducted by an autonomous subsidiary of an existing commercial airline. The postulated separate organizational entity was assumed to provide an organization dedicated to profitable STOL operations over short route segments. Initial financing would be provided by the parent company.

4.2.4.1.2 Initial financial parameters. - Chicago region operations and financial results are traced over the first 10 years, 5/6 of the life of the first group of STOL airplanes delivered. This "planning horizon" was chosen to avoid the issues of second generation STOL airplane selection and introduction. The primary analysis focused upon a feasible financial structure based on a combined long term debt and equity-to-operating assets ratio of 1.14, $220 million equity and $330 million long term debt versus $482.9 million of operating assets - airplane, spares, ground equipment and facilities. The initial debt/equity ratio was 1.5. This changed through time as early losses are compensated by later profits. The initial interest rate of 8.5%

was chosen to be representative of long term interest rates for pioneering operations in the airline industry. The financial results were simulated without debt retirement although partial retirement can be observed by examining airline operating history. Nevertheless in the real world absolute levels tend to remain constant, or increase, as operations are expanded with new routes and airplane types. What actually happens is that older issues often are refinanced as they become due thereby maintaining the absolute debt level.

4.2.4.1.3 Initial operating parameters. - The revenue computations for the detailed analysis were based on the CAB Phase 7 fares without yield dilution to simplify the problem. However load factors were matured with route development. The airplanes operate over a 12 city-pair network achieving a 7.6 hour per day utilization after an analysis of maintenance requirements and maintenance (not weather) caused flight cancellations. The Chicago network and STOL maneuver time estimates provide an average block speed of 353 mph (568 km/hour) over the 319 st. mi. (513 km) average stage length. The average stage length provides a direct operating cost (DOC) of $3.35 per airplane-st. mi. ($2.08 per airplane-kilometer).

4.2.4.1.4 Method of analysis. - The results of operating based on these initial parameters were simulated using the Douglas Airline Simulation Program, Appendix 7.5. The program was applied using a 12-year straight line depreciation period for financial results and double declining balance depreciation for seven years with a five percent residual for income tax determination. Predelivery payments of 30% of the airplane price are spread over a 21-month period from order placement to three months before delivery. The imputed interest on such payments is amortized. The present investment tax credit provision has not been used implying a 48 percent income tax rate over the initial 10 years of operations. In order to confine the simulation to airplane operations the excess cash, above that required for operations, has not been reinvested.

4.2.4.1.5 Perturbations. - After the pro forma financial results have been presented and discussed two major variations in the parameters will be presented. It is recognized that the $550 million capital structure is much larger than would really be necessary, and that the no-dilution assumption generates overly optimistic results. Additional data is presented covering a $300 million capitalization - 13 percent yield dilution case.

4.2.4.2 Pro forma results

4.2.4.2.1 Introductory phase load factors. - During the early years the load factors of the regional STOL systems would be determined by the market maturation rates of the individual routes and the ability of the respective managements to develop the market. As the systems mature, load factors would approach the factors determined by the market analysis. While precise estimates of these early transient load factors are necessarily imprecise the operating experience of other airlines can be used to make some approximate estimates.

The information in Reference 61 suggests an 18-month period from the inception of service along a new route until the ultimate load factor is achieved. During the sixth month of new route service a 50 percent load factor can be expected. A linear load factor relation for the Chicago Region provides an initial route value of 43 percent increasing to 60.7 percent in 18 months. A distributed airplane delivery schedule naturally leads to a distributed route development process. During the initial period, some routes are mature while others are still new. As additional airplanes are added to the fleet, new routes would be added making the fleet average load factor vary with time increasing until the fleet level is fairly well saturated and then dropping as additional frequencies and routes are added to utilize the expanding fleet.

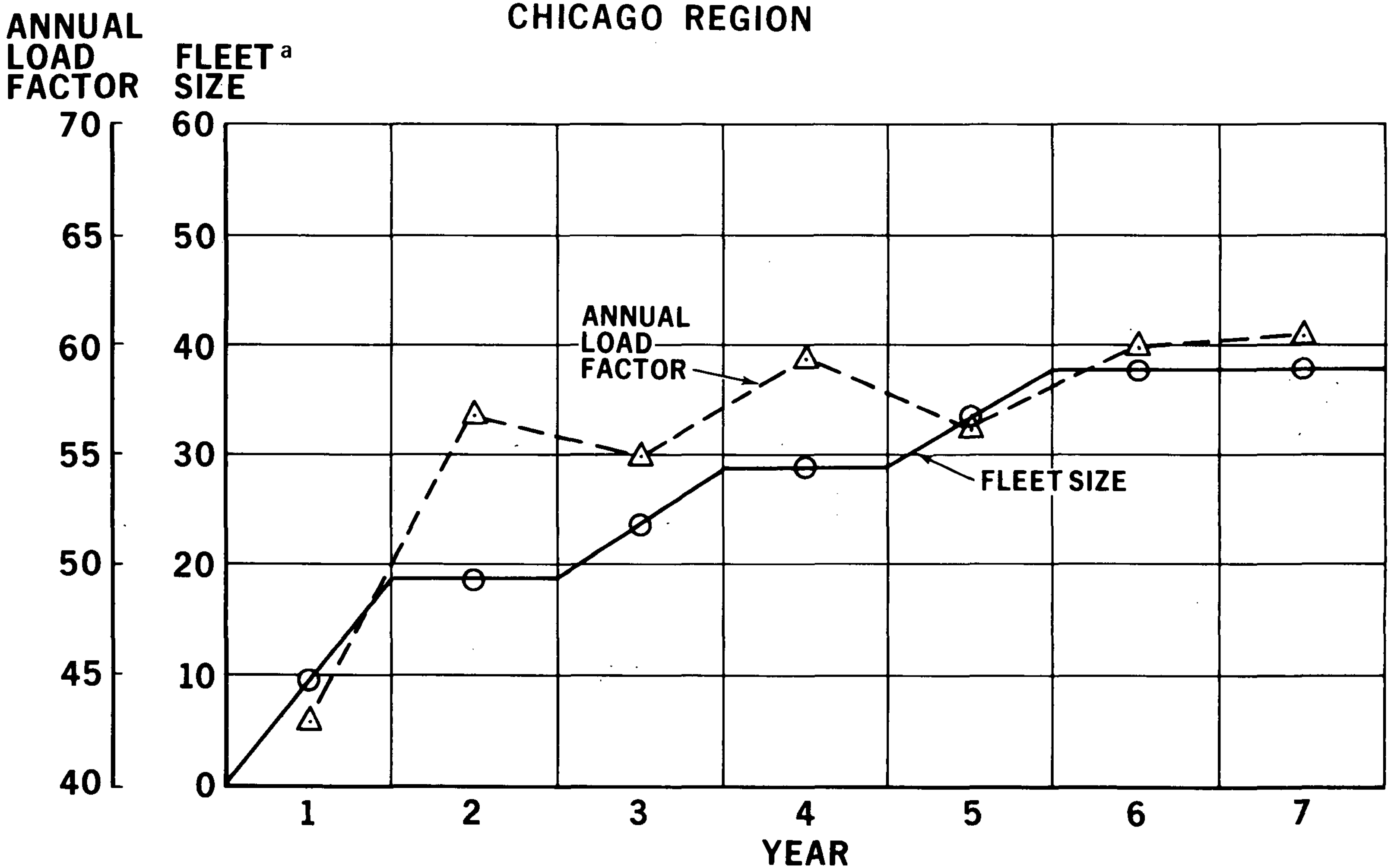
Application of the load factor growth relation and the fleet growth distribution patterns to the Chicago Region is shown in Figure 4-21.

4.2.4.2.2 <u>Operating costs during the initial years</u>. - Direct operating costs as expressed by the modified ATA method would be little affected during the early period. The major impact during the early years probably would be seen in higher than normal delay and cancellation rates and therefore in reduced revenue and higher maintenance cost per block hour. The magnitude and duration of these transients depend upon a number of factors, mostly undocumented.

On the other hand, the early indirect operating cost picture is far less random. There are significant fixed indirect operating costs incurred in anticipation of system growth. For example, airline general office staff should grow at a much lower rate than revenue because the corporate offices and their cadre staffs are required at the very outset of operations. As the scale of operations grows the indirect costs which at first were under-absorbed would approach the steady state levels predicted by the indirect operating cost equations, Appendix 7.3. Access to detailed accounts (Air California) during this study provided a breakdown of fixed and variable cost which may be used to estimate the magnitude of deviation from the ultimate cost levels as a function of time. Naturally the indirect cost adjustment is affected by the scale of operations as illustrated by the estimate for the Chicago region.

FLEET SIZE AND LOAD FACTOR VS TIME

CHICAGO REGION



a — E150.3000 AIRPLANE

PR3-STOL-1616A

FIGURE 4-21

YEAR	AVERAGE AIRPLANES OPERATED	IOC ADJUSTMENT FACTOR
1	9.5	1.081
2	19.0	1.008
3	24.0	1.030
4	29.0	1.001
5	33.5	1.013
6	38.0	1.001
7	38.0	1.000

4.2.4.2.3 10-year income statement. - Annual revenues increase from $60 million during the first years of operation to $339.5 million during the 10th year. At that point the system would be carrying 10.5 million passengers per year, Table IV-23. The direct operating expenses increase from $23 million during the first year, when an average of 9.5 airplanes were operating, to a level of $92.9 million in the sixth year. Depreciation increases as the fleet expands to 38 aircraft during the first five years. Indirect costs increase with systems development but at a slower rate. The combination of increasing load factors, expanding routes and system maturation lead to a steady improvement in operating income from a negative $2.5 million to a plateau of about $98 million in the seventh year. Interest expense is constant over the period because the long term debt was assumed to be refinanced at or before maturity. Accelerated depreciation shelters operating profits and conserves cash flow during the formative years rising to $34 million per annum in the 9th year. The non-perturbed simulation forecasts very optimistic profit results commencing the fourth year.

TABLE IV-23

TEN YEAR COMPARATIVE INCOME STATEMENT

CHICAGO REGION

	1972 DOLLARS - MILLIONS									
	12-31-80	12-31-81	12-31-82	12-31-83	12-31-84	12-31-85	12-31-86	12-31-87	12-31-88	12-31-89
PASSENGER REVENUE	59.243	157.541	192.016	251.003	274.358	330.559	335.534	335.534	335.534	335.534
INCIDENTALS	0.708	1.877	2.288	2.991	3.269	3.939	3.998	3.998	3.998	3.998
TOTAL OPERATING REVENUE	60.131	159.418	194.304	253.994	277.626	334.498	339.531	339.531	339.531	339.531
DIRECT OPERATING EXPENSE	23.217	46.434	53.653	70.873	81.870	92.867	92.867	92.867	92.867	92.867
FLEET DEPRECIATION	8.307	16.613	20.996	25.380	29.306	33.233	33.233	33.233	33.233	33.233
AMORTIZATION - FLEET	0.142	0.285	0.360	0.435	0.502	0.427	0.285	0.210	0.135	0.067
TOTAL DIRECT OPERATING COSTS	31.666	63.332	80.010	96.687	111.679	126.528	126.385	126.310	126.235	126.168
INDIRECT OPERATING EXPENSES	30.895	57.719	73.610	87.533	102.095	114.329	114.329	114.329	114.329	114.329
GROUND AND OTHER DEPRECIATION	0.029	0.057	0.067	0.076	0.076	0.076	0.076	0.076	0.076	0.076
TOTAL INDIRECT OPERATING COSTS	30.924	57.776	73.677	87.609	102.171	114.405	114.405	114.405	114.405	114.405
TOTAL OPERATING EXPENSES	62.590	121.108	153.686	184.296	213.850	240.933	240.790	240.715	240.640	240.573
OPERATING INCOME	- 2.548	38.309	40.618	69.698	63.777	93.565	98.741	98.816	98.891	98.959
INTEREST EXPENSE	28.050	28.050	28.050	28.050	28.050	28.050	28.050	28.050	28.050	28.050
LESS CAPITALIZED INTEREST	2.231	1.241	1.303	1.117	0.894	0.000	0.000	0.000	0.000	0.000
INTEREST EXPENSE NET	25.819	26.809	26.747	26.933	27.156	28.050	28.050	28.050	28.050	28.050
TOTAL NON-OPERATING INCOME	-25.819	-26.809	-26.747	-26.933	-27.156	-28.050	-28.050	-28.050	-28.050	-28.050
NET INCOME BEFORE TAX	-28.277	11.500	13.871	42.764	36.621	65.515	70.691	70.766	70.841	70.909
INCOME TAX (PER COMPUTATION OF TAX)	-13.573	5.520	6.658	20.527	17.578	31.447	33.932	33.968	34.004	34.036
NET INCOME	-14.704	5.980	7.213	22.237	19.043	34.068	36.759	36.798	36.838	36.873

4.2.4.2.4 Sources and applications of funds. - Inherent in Table IV-24 are the excess capitalization assumption and undiluted yield figures used in the non-perturbed analysis. At no time is the operating entity even forced to consider short term borrowings. All major cash requirements for the acquisition of operating assets in the first, third, and fifth years are adequately covered by the initial capitalization structure of $550 million. Even the progressively-increasing equity capital charges by the parent company, from three percent in the first two years to seven percent in the last two years, occasion no working capital shortage, Table IV-24.

4.2.4.2.5 Balance sheet. - The cumulative affect of the simulated operations is most clearly illustrated by tracing the cash-and-equivalents account and the retained earnings account across the 10-year period, Table IV-25. Depreciation contributes 266.8 million, most of which has been converted into cash and other equivalents plus short-term government securities. Accumulated retained earnings, after dividend payments to the parent of $110 million, rise to over $111 million.

4.2.4.2.6 Operating ratios. - Several results are particularly significant in the subsequent comparison of the non-perturbed and perturbed results. The breakeven load factor, the return-on-investment ratio approximating the CAB short form, and the return on stockholders equity are computed in the conventional way. The latter two financial ratios are based on annual data as is usually presented by investment services rather than in discounted cash flow terms, Figure 4-22. (The 10th-year return on investment is extrapolated from the calculated data because the program miscalculates the result when the run is terminated before the 15-year capability of the program.) The data presented here will also be displayed in the next section and compared to the perturbed results.

TABLE IV-24

TEN YEAR STATEMENT OF SOURCES AND APPLICATIONS OF FUNDS
CHICAGO REGION

	1972 DOLLARS - MILLIONS									
	12-31-80	12-31-81	12-31-82	12-31-83	12-31-84	12-31-85	12-31-86	12-31-87	12-31-88	12-31-89
SOURCES OF FUNDS										
NET INCOME	-14.704	5.980	7.213	22.237	19.043	34.068	36.759	36.798	36.838	36.873
DEPRECIATION AND AMORTIZATION	8.478	16.955	21.423	25.891	29.885	33.736	33.591	33.519	33.444	33.376
INTEREST AND EXPENSE NET	25.819	26.809	26.747	26.933	27.156	28.050	28.050	28.050	28.050	28.050
DEFERRED FEDERAL INCOME TAX	12.576	17.983	16.782	14.583	12.343	10.133	4.476	-2.482	-7.924	-10.649
PROCEEDS FROM ISSUANCE OF LONG TERM DEBT	330.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
PROCEEDS FROM ISSUANCE OF COMMON STOCKS	220.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL SOURCES OF FUNDS	582.168	67.728	72.165	89.645	88.426	105.987	102.879	95.885	90.408	87.649
APPLICATIONS OF FUNDS										
INTEREST PAYMENTS	28.050	28.050	28.050	28.050	28.050	28.050	28.050	28.050	28.050	28.050
DIVIDENDS PAYMENTS	6.600	6.600	8.800	8.800	11.000	11.000	13.200	13.200	15.400	15.400
PREDELIVERY PAYMENTS	78.376	11.323	21.514	10.191	10.191	0.000	0.000	0.000	0.000	0.000
DELIVERY PAYMENTS	151.925	0.000	80.232	0.000	71.766	0.000	0.000	0.000	0.000	0.000
GROUND PROPERTY AND FACILITIES	0.685	0.000	0.230	0.000	0.000	0.000	0.000	0.000	0.000	0.000
INCREASE IN DEFERRED CHARGES	1.425	0.000	0.750	0.000	0.675	0.000	0.000	0.000	0.000	0.000
TOTAL APPLICATION OF FUNDS	267.560	45.973	139.575	47.041	121.682	39.050	41.250	41.250	43.450	43.450
CHANGE IN CASH	314.608	21.755	-67.410	42.604	-33.256	66.937	61.269	54.635	46.958	44.199
BALANCE AVAILABLE AT END OF YEAR	314.608	336.363	268.952	311.557	278.301	345.237	406.866	461.501	508.459	552.658

TABLE IV-25

TEN YEAR COMPARATIVE BALANCE SHEET
CHICAGO REGION

	1972 DOLLARS - MILLIONS									
	12-31-80	12-31-81	12-31-82	12-31-83	12-31-84	12-31-85	12-31-86	12-31-87	12-31-88	12-31-89
CASH AND EQUIVALENTS	314.608	336.363	268.952	311.557	278.301	345.237	406.866	461.501	508.459	552.658
PREDELIVERY PAYMENTS	11.667	24.231	10.501	21.809	0.002	0.002	0.002	0.002	0.002	0.002
PROPERTY AND EQUIPMENT										
FLIGHT EQUIPMENT	221.363	221.363	338.142	338.142	442.801	442.801	442.801	442.801	442.801	442.801
LESS ACCUMULATED DEPRECIATION	8.307	24.920	45.916	71.296	100.602	133.835	167.068	200.300	233.533	266.765
NET	213.057	196.443	292.226	266.846	342.198	308.966	275.733	242.501	209.268	176.035
OTHER PROPERTY AND EQUIPMENT	0.685	0.685	0.915	0.915	0.915	0.915	0.915	0.915	0.915	0.915
LESS ACCUMULATED DEPRECIATION	0.029	0.086	0.152	0.228	0.305	0.381	0.457	0.533	0.610	0.686
NET	0.656	0.599	0.762	0.686	0.610	0.534	0.457	0.381	0.305	0.229
TOTAL PROPERTY AND EQUIPMENT	213.713	197.043	292.988	267.532	342.808	309.500	276.190	242.882	209.573	176.264
DEFERRED CHARGES	1.282	0.997	1.387	0.953	1.125	0.698	0.413	0.203	0.068	0.000
TOTAL ASSETS	541.271	558.634	573.829	601.850	622.235	655.436	683.470	704.587	718.101	728.924
SENIOR DEBT LIABILITIES	329.998	329.998	329.999	329.999	329.998	329.999	329.999	329.999	329.999	329.999
DEFERRED INCOME TAX	12.576	30.559	47.341	61.925	74.267	84.400	88.875	86.393	78.469	67.820
TOTAL LIABILITIES	342.574	360.558	377.340	391.923	404.266	414.398	418.874	416.392	408.468	397.819
STOCKHOLDERS EQUITY										
CAPITAL STOCK AND CAPITAL SURPLUS	220.000	220.000	220,000	220.000	220,000	220.000	220.000	220,000	220.000	220.000
PAID-IN CAPITAL	220.000	220.000	220.000	220,000	220.000	220.000	220.000	220.000	220.000	220.000
RETAINED EARNINGS	-21.304	021.924	-23.511	-10.074	- 2.031	21.037	44.597	68.195	89.633	111.105
TOTAL STOCK HOLDERS EQUITY	198.696	198.076	196.489	209.926	217.969	241.037	264.506	288.195	309.632	331.105
TOTAL LIABILITY AND EQUITY	541.271	558.634	573.829	601.850	622.235	655.436	683.470	704.587	718.101	728.924

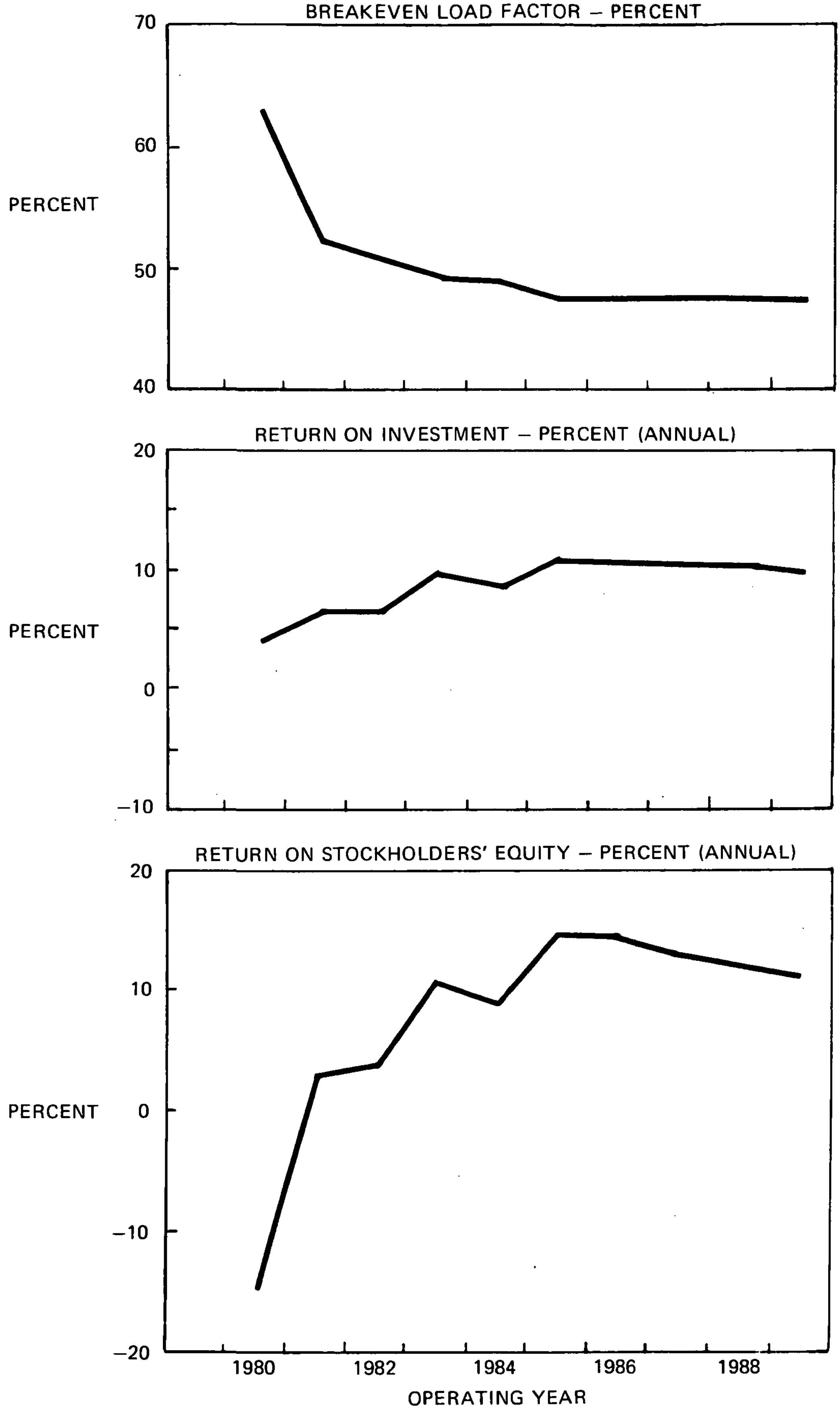


FIGURE 4-22. SELECTED OPERATING AND FINANCIAL RATIOS

4.2.4.3 Chicago region revision

4.2.4.3.1 Initial financial and operating parameters. - The results reported earlier used a capital base of $550 million - $220 million equity and $330 million debt and a yield dilution factor of 1.00, i.e. no yield dilution due to promotional fares.

4.2.4.3.2 Available cash and net profits. - The available cash estimates for the earlier case suggested that the operating entity was overcapitalized. Accordingly additional runs were made with initial capitalizations of $250 million and $300 million. The $300 million (.62 capitalization-to-operating assets ratio) case was chosen because it provides a minimum current asset to estimated 30 day liabilities ratio of .5 occurring at the end of 1984. Even this ratio probably dictates sporadic short term financing until well into 1985 when the available cash jumps from $13 to $68 million, Figure 4-23.

The aggregate net profits for this case build to the $19.5 million level providing a net profit to revenue ratio of 6.6 percent, as opposed to almost 11 percent for the pro forma case. Even the lower result would be a stellar performance in the short haul market.

The total effect of the revised calculations is to reduce profits to a more realistic level and simultaneously to limit cash and equivalents accumulation to levels which might be desired in anticipation of further growth or reequipment requirements.

4.2.4.3.3 Operating and financial ratios. - The changes in the initial capital and yield parameters do not materially affect annual ROIs or returns on stockholders equity. Although net operating profit and net profit have

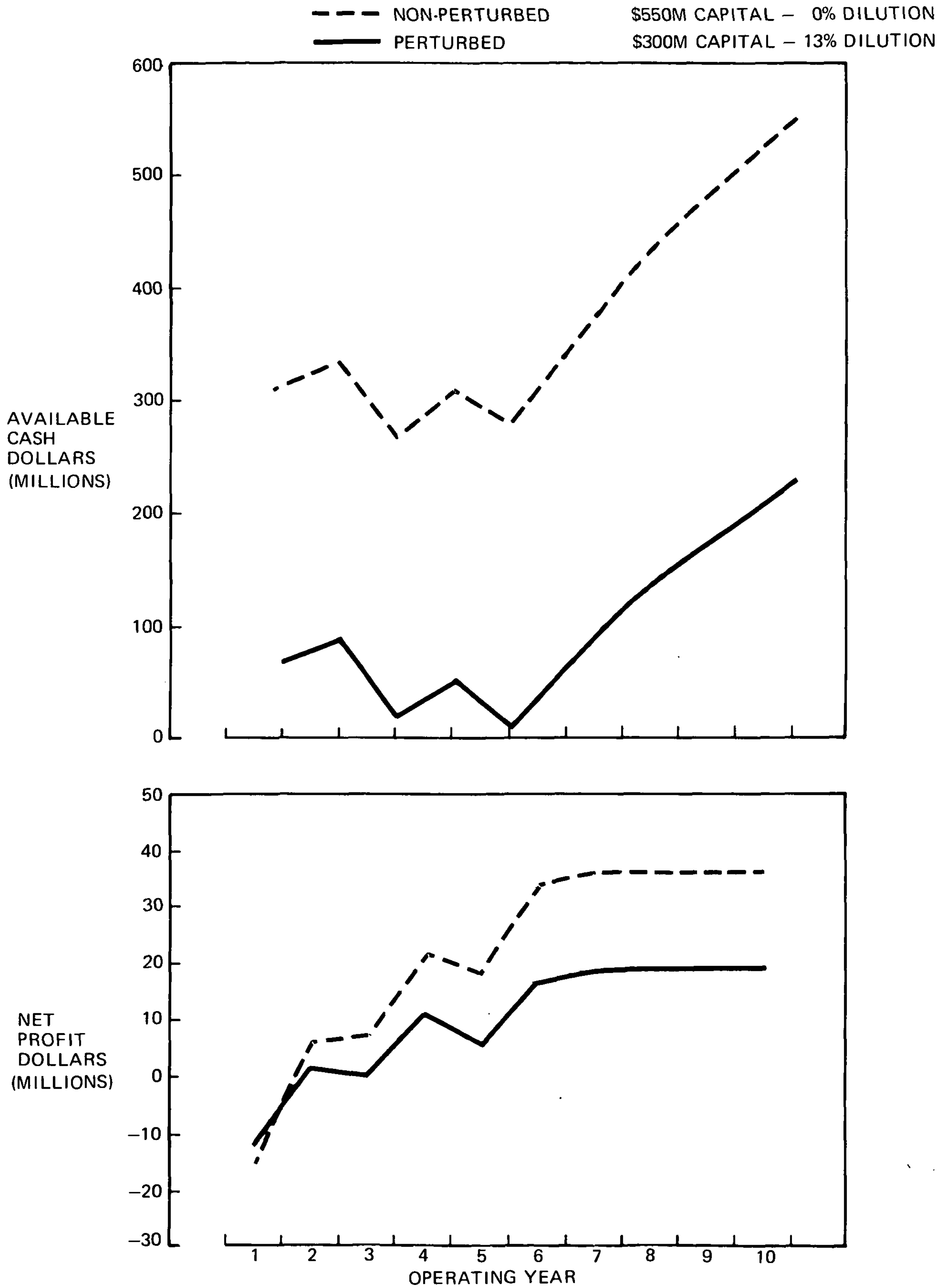


FIGURE 4-23. AVAILABLE CASH AND NET PROFIT

been sharply reduced by the dilution parameter, the compensating adjustment in initial capital has maintained the levels of these ratios. However, a material change is observed in the breakeven load factor, Figure 4-24. The 5-percent increase, in absolute terms, to 53 percent raises operating risk. Ordinarily breakeven load factors in the 45 to 50 percent range are desired. The higher figure is directly dependent upon the dilution factor. This 13 percent was calculated from recent (1971) short-haul operating results and may or may not be representative of longer-term trends. Nevertheless the 13 percent appears to be consistent with the overall domestic yield dilution pattern.

4.2.4.3.4 Viability criterion. - The long-run viability of a proposed project cannot be determined by any single measure. Over the long run a project must have sufficient returns to equity to either induce the investment and/or to maintain it once it has been made. The determination therefore must consider not only the desired return and alternative projects but also the premium returns for accepting risk.

The discounted cash flow method as applied here adequately depicts the relative worth of alternative airplane designs but fails to consider alternative non-aircraft opportunities and risk. As such it cannot discriminate, per se, between viable and non-viable projects. The CAB has established a 12.35 percent annual return on investment as sort of an upper limit goal for ratemaking. The 12.35 percent presumably (by fiat) reflects the risks and alternatives available to airline growth capital. Projects which fall significantly below, say below 50 to 60 percent, of the 12.35 percent level cannot attract or maintain the necessary equity.

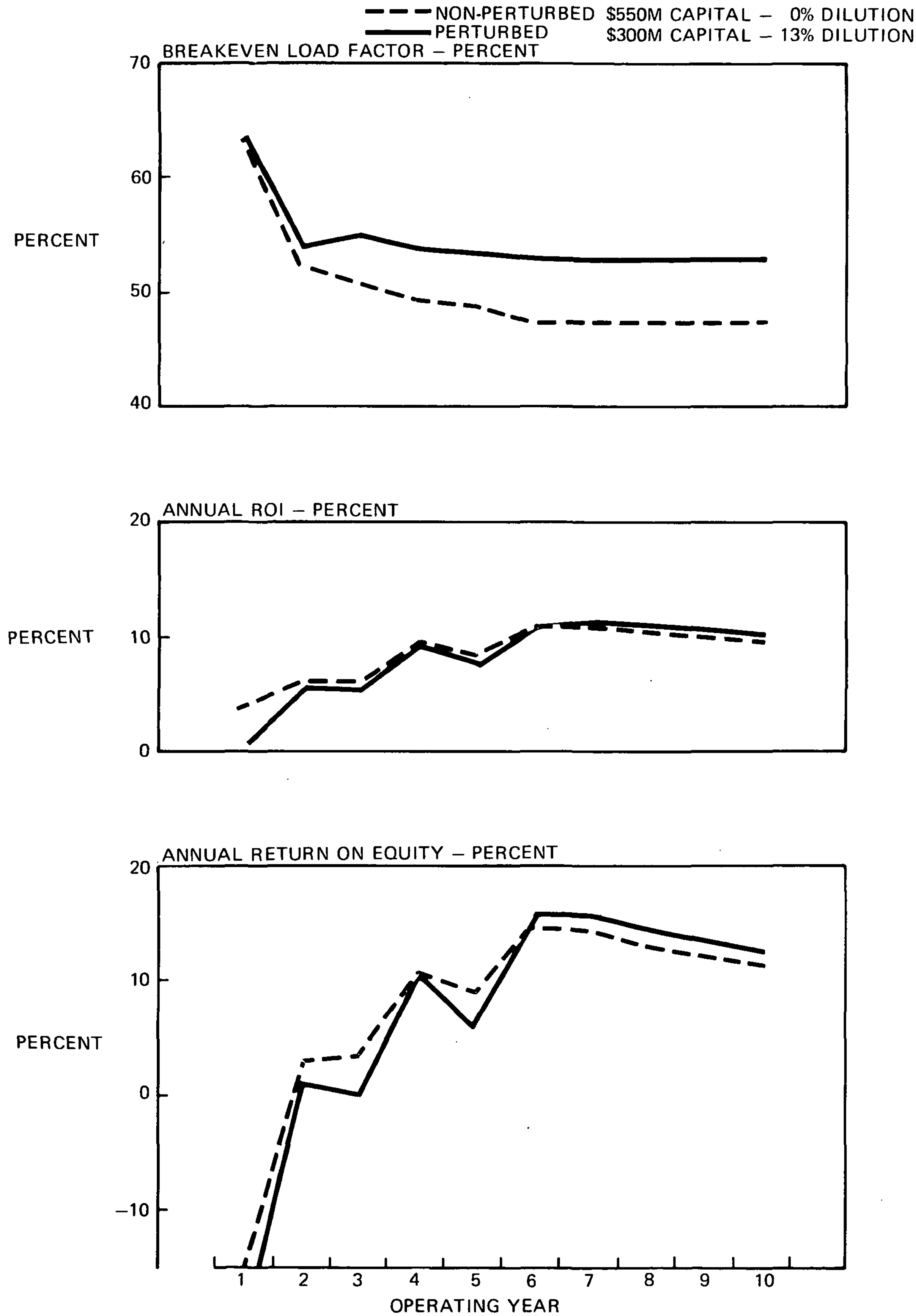


FIGURE 4-24. SELECTED OPERATING AND FINANCIAL RATIOS

Consideration of the Chicago region annual results permits discrimination between viable and not viable projects. The E150.3000 systems analysis airplane had a discounted cash flow ROI of 20.3 percent ignoring fare dilution. The diluted Chicago results show a 10.4 percent annual ROI or a 12.54 percent return on stockholders equity. (The latter reflects the leverage exerted by the interest on long term debt - 8.5 percent). On the other hand, suppose the CAB goal of 12.35 percent is realized. This would increase net operating income by 20 percent, i.e. 12.35/10.4. After debt service this would provide almost 17 percent return on stockholders equity.

4.2.5 Subsidy

4.2.5.1 The role of subsidy. - Governmental subsidies traditionally have been used to either encourage the development of new industries or to temporarily support existing industries which are vital to the functioning of the economy. There is an important distinction. The first is the result of deliberate public policy while the second is a reaction to the occurrence of unforeseen circumstances. Since the financial forecasts show STOL transportation to be viable at the Phase 7 fare levels, subsidies would only be necessary to induce investment in STOL transportation systems.

4.2.5.2 Investment incentive threshold. - Large investments in innovative private sector enterprises usually are undertaken with the hope of greater profits than might be realized by more conservative investments. The question here is, "Are the projected rates of return large enough to attract private capital in the absence of early subsidy?" Stated more concretely, "Can a conservative 12 percent discounted cash flow, based on the revised analysis, attract the necessary capital in view of less favorable results during the first five years?" Since U. S. industrial annual return on investment is in the neighborhood of 20 percent pretax, 12 percent after tax, there isn't a clear incentive reward to induce airline investment in STOL systems. On the other hand the ROI results could range between 12 percent and the 20 percent result obtained at zero dilution and a constant 60.7-percent load factor. Since each airline has its own return on investment threshold, there is no sharp criteria for determining whether or not the upper ROI is significantly better than alternative opportunities.

4.2.5.3 Inducing STOL investment. - Under these conditions, the required investments would be forthcoming under only three sets of circumstances. In the first case, an overwhelming public reaction against the noise nuisance of existing airline operating practices would force the investment by enacting legislation to abate the nuisance. In the second case, subsidy payments during the early years could reduce the risk sufficiently to induce the necessary investment. In the third case, the investments might be undertaken defensively to bar the entry of new operators.

The first set of circumstances could well arise. The history of public agitation provides no indication of the extent or persistence of public opposition to near airport nuisance. There is now, to be sure, a significant public reaction primarily demanding noise abatement. Whether or not the noise abatement programs presently under way will ameliorate the public's agitation cannot be foreseen with any certainty. Further, there is no assurance that a more favorable climate once attained would, indeed, persist.

The likelihood of the third case emerging as a pattern seems small. The magnitude of the requisite investment and the necessary degree of private and governmental cooperation probably effectively preclude this situation as a real impetus.

On balance, it appears that an effective STOL implementation policy might require subsidies over a portion of the first five years of operation.

4.2.5.4 Subsidy estimates. - With 13 percent yield dilution, the Chicago region generates $5.602 million after tax profit over the first five years. The (reduced) $300 million initial capitalization represents $120 million of equity and $180 million of long term equity. A ten-percent return on equity over the first five operating years would provide a very significant improvement in discounted cash flow ROI. The same ten-percent would provide roughly a $60-million profit goal. This suggests a subsidy on the order of $50 million spread over several operating years would be more than sufficient for the Chicago region. Further speculation suggests a maximum national subsidy on the order of $60 million per year might be required to implement regional STOL systems in all except the California region. The exact amount would depend upon management ability, the market nature of the individual regions and routes, and the investment thresholds of the various potential parents. The California region is discussed separately in Section 4.5.

4.2.6 Airline Organization Structure - A pivotal consideration to the implementation of a new STOL airline is its organization and management structure. This is evident from an examination of the passenger/employee productivity ratios of the domestic trunks, regional carriers and other carriers such as the two California operators- Pacific Southwest Airlines (PSA) and Air California. The NASA RFP does not constrain or limit the study to integrating the STOL airplanes into a mixed fleet with an existing carrier. On the contrary, the RFP explicity encourages consideration of a separate airline and corporate accounting system. This would imply development of an organization that is unburdened by allocations from a system that is operated within a rigid framework of established precedent, habits, institutional constraints and operators not geared specifically to short-haul systems. An example of this is the ability of two short-haul operators in the California market to perform profitably at fares about 50 percent of the CAB jet coach formula and without subsidy.

From a practical standpoint, the complexities of large STOL regional systems necessarily imply the need for specific knowledge and understanding and experienced management and operating personnel. These prerequisites can best be attained by operating the regional STOL systems by autonomous subsidiaries (or divisions) of existing major airlines. The autonomous function is therefore a separate profit center with full accountability and responsibility with commensurate authority.

A functional organization of such an airline structure is shown in Figure 4-25. This structure models work elements into management categories or levels that represent a workable and effective organization. Such organization is unburdened by large and separate support entities. The number of

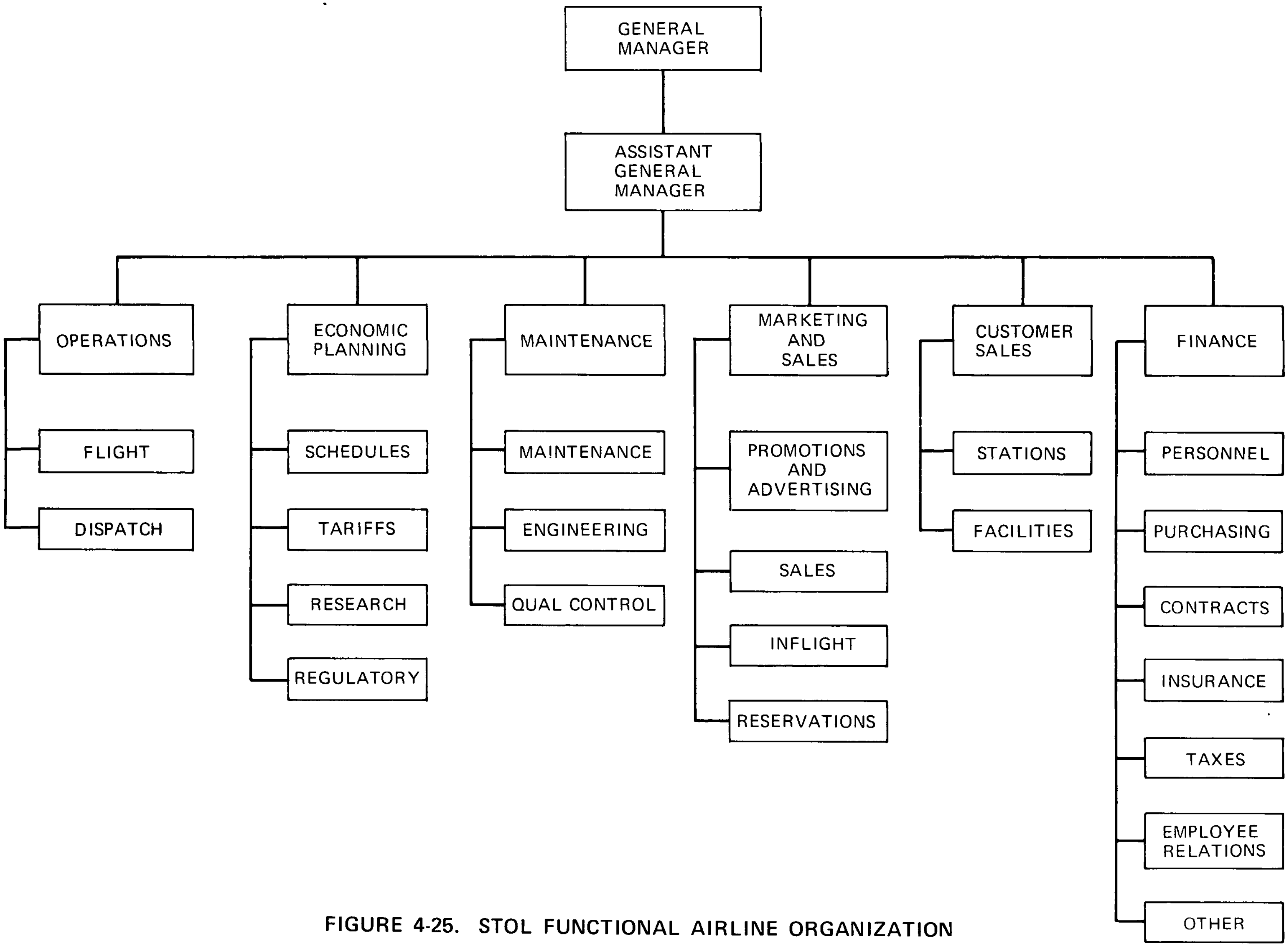


FIGURE 4-25. STOL FUNCTIONAL AIRLINE ORGANIZATION

employees that comprise such an organization is developed from the assumption that the operation is typical of airlines exhibiting a productivity index of 1600 to 2500 passengers per employee. This assumption is based on the 1971 data given in Table IV-26 for enplaned passengers and numbers of employees for the category of airlines grouped as "other". Using this as a basis, it is expected that the head count for the baseline airplane in the Chicago Region would be about 4,200 employees.

TABLE IV-26

COMPARISON OF PASSENGERS AND EMPLOYEES FOR DOMESTIC TRUNK AND REGIONAL CARRIERS FOR 1971

AIR CARRIERS	ENPLANED PASSENGERS (THOUSANDS)	EMPLOYEES (THOUSANDS)	PRODUCTIVITY (PASSENGERS PER EMPLOYEE
TRUNKS			
American	19,730	35.407	557
Braniff	6,208	9.523	652
Continental	5,692	8.656	658
Delta	16,937	21.000	807
Eastern	23,022	30.900	745
National	5.502	7.714	713
Northeast	2,784	3.700	752
Northwest	6,284	10.113	621
Pan American	11,323	40.156	282
Trans World	14,424	35.306	403
United	26,048	48.364	539
Western	6,670	9.039	738
12 Trunks average	144,624	259.878	557
REGIONAL			
Allegheny	6,489	5.018	1293
Frontier	2.758	3,053	903
Hughes Airwest	2,965	3.200	927
Mohawk	1,766	2.205	801
North Central	3,794	3.000	1265
Ozark	2,778	2.405	1155
Piedmont	2,853	3.133	911
Southern	1,993	2.000	997
Texas International	2,393	2.110	1134
9 Regionals average	27,789	26.124	1064
OTHER AIRLINES			
Air California	896	.577	1553
Aloha	1,121	.763	1469
Hawaiian	1,880	1.145	1642
Pacific Southwest	5,600	2.177	2572

4.3 Total System Costs

The immediately preceding sections have developed the economics of the STOL and short-haul airplanes considered in this study with primary emphasis upon the airplanes themselves and the Chicago region. Development of a comprehensive overview requires treatment of the other five individual regions as operating entities and where pertinent the influence of foreign markets. The six regional operations have been structured to provide STOL service along the medium and high density 1985 short haul routes. The joint influence of the market, technology, economics and collateral environmental criteria lead to an operational concept of a distributed peripheral STOL system rather than a more diffuse point to point system. The STOL systems utilize relatively large, and efficient, STOL airplanes operating at moderate frequencies along major paths connecting the general peripheral sectors of two cities. This concept minimizes the need for new facilities by utilizing upgraded existing facilities. Therefore, the investment of the various governmental entities, both federal and local, has been minimized.

The national data required to translate the investments, operating costs and revenues into an integrated appraisal of national impact requires separate forecasts for each of the regions. These forecasts focus first upon the public sector, then upon the airlines themselves and finally upon the major durable goods industries, construction and aerospace. The governmental requirements were developed by the system analysis task, the individual regions by the market analysis, and the aerospace industry from the designs produced by the aircraft task.

These all contribute to the complex flow of resources required to implement STOL technology based on the E150.3000 airplane. These flows of resources can be viewed as transactions among the various sectors expressed in 1972 economics. The aggregate results are termed gross transaction rather than total system cost to emphasize the many sided nature of the economic impact of STOL transportation.

4.3.1 Public sector

4.3.1.1 Investments. - Public investments provide additional airport facilities and air traffic control capability. Construction of runways, taxiways and gates and aprons are cost shared between the various local communities and the federal government on a 50/50 basis. Terminal buildings and parking are sole responsibility of local authority while the federal government funds the expansion of the air traffic control system.

Since the facilities at each individual airport within the six regional STOL systems varies, the requirements are unique to each individual airport. Hence, a convenient cost index such as facilities per airplane for each region varies widely. For example, the total public investment required for STOL implementation in the Chicago region is $61.8 million, Table IV-27, or about 14 percent of the cost of the 38 airplanes; the comparable figures for the California region are $86.5 million or almost 15 percent of the total cost of its 52 airplanes, Table IV-28. The lowest relative local investment requirement occurs in the Northeast 6.5 percent, Table IV-29, while the highest is associated with the California region. The highest relative Federal investments per airplane are required for the Northwest region, Table IV-30, and the Southern region, Table IV-31. Each of the regions is sensitive to the availability and present condition of the individual airports within the region. The Southeast region, Table IV-32, is almost a median case. The

TABLE IV-27

SUMMARY OF AIRPORT FACILITIES INVESTMENTS FOR CHICAGO REGION
PUBLIC RELATED INVESTMENTS
(1972 DOLLARS)

FACILITY TYPE	LOCAL OR COMMUNITY	FEDERAL		TOTAL
		ADAP	FAA	
RUNWAYS	$ 559,000	$ 559,000	$ -	$ 1,118,000
TAXIWAYS	160,000	160,000	-	320,000
TERMINAL BUILDINGS	24,450,000	-	-	24,450,000
PARKING	1,281,000	-	-	1,281,000
GATES AND APRONS	6,868,000	6,868,000	-	13,736,000
AIR TRAFFIC CONTROL	-	-	20,868,000	20,868,000
TOTAL	$33,318,000	$7,587,000	$20,868,000	$61,773,000

TABLE IV-28

SUMMARY OF AIRPORT FACILITIES INVESTMENTS FOR CALIFORNIA REGION
PUBLIC RELATED INVESTMENTS
(1972 DOLLARS)

FACILITY TYPE	LOCAL OR COMMUNITY	FEDERAL		TOTAL
		ADAP	FAA	
RUNWAYS	$ 507,000	$ 507,000	$ -	$ 1,014,000
TAXIWAYS	170,000	170,000	-	340,000
TERMINAL BUILDINGS	37,425,000	-	-	37,425,000
PARKING	2,855,000	-	-	2,855,000
GATES AND APRONS	11,892,500	11,892,500	-	23,785,000
AIR TRAFFIC CONTROL	-	-	21,028,000	21,028,000
TOTAL	$52,849,500	$12,569,500	$21,028,000	$86,447,000

TABLE IV-29

SUMMARY OF AIRPORT FACILITIES INVESTMENT FOR NORTHEAST REGION

PUBLIC RELATED INVESTMENTS

(1972 DOLLARS)

FACILITY TYPE	LOCAL OR COMMUNITY	FEDERAL		TOTAL
		ADAP	FAA	
RUNWAYS	$1,001,000	$1,001,000	—	$2,002,000
TAXIWAYS	$ 463,500	$ 463,500	—	$ 927,000
TERMINAL BUILDINGS	$28,830,000	—	—	$28,830,000
PARKING	$ 2,670,000	—	—	$ 2,670,000
GATES AND APRONS	$ 9,045,000	$9,045,000	—	$18,090,000
AIR TRAFFIC CONTROL	—	—	$10,255,000	$10,255,000
TOTAL	$42,009,500	$10,509,500	$10,255,000	$62,774,000

TABLE IV-30

SUMMARY OF AIRPORT FACILITIES INVESTMENTS FOR NORTHWEST REGION

PUBLIC RELATED INVESTMENTS

(1972 DOLLARS)

FACILITY TYPE	LOCAL OR COMMUNITY	FEDERAL		TOTAL
		ADAP	FAA	
RUNWAYS	$ —	—	—	—
TAXIWAYS	—	—	—	—
TERMINAL BUILDINGS	$3,600,000	—	—	$ 3,600,000
PARKING	$ 181,000	—	—	$ 181,000
GATES AND APRONS	$1,340,000	$1,340,000	—	$ 2,680,000
AIR TRAFFIC CONTROL	—	$ —	$5,128,000	$ 5,128,000
TOTAL	$5,121,000	$1,340,000	$5,128,000	$11,589,000

TABLE IV-31

SUMMARY OF AIRPORT FACILITIES INVESTMENTS FOR SOUTHERN REGION

PUBLIC RELATED INVESTMENTS

(1972 DOLLARS)

FACILITY TYPE	LOCAL OR COMMUNITY	FEDERAL		TOTAL
		ADAP	FAA	
RUNWAYS	$221,000	$221,000	—	$442,000
TAXIWAYS	$134,000	$134,000	—	$268,000
TERMINAL BUILDINGS	$16,965,000	—	—	$16,965,000
PARKING	$ 1,340,000	—	—	$ 1,340,000
GATES AND APRONS	$ 5,695,000	$5,695,000	—	$11,390,000
AIR TRAFFIC CONTROL	—	—	$18,326,000	$18,326,000
	$24,355,000	$6,050,000	$18,326,000	$48,731,000

TABLE IV-32

SUMMARY OF AIRPORT FACILITIES INVESTMENTS FOR SOUTHEAST REGION

PUBLIC RELATED INVESTMENTS

(1972)

FACILITY TYPE	LOCAL OR COMMUNITY	FEDERAL		TOTAL
		ADAP	FAA	
RUNWAYS	$ 666,000	$ 666,000	—	$ 1,332,000
TAXIWAYS	$ 166,500	$ 166,500	—	$ 333,000
TERMINAL BUILDINGS	$30,240,000	—	—	$30,240,000
PARKING	$ 2,313,000	—	—	$ 2,313,000
GATES AND APRONS	$10,887,500	$10,887,500	—	$21,775,000
AIR TRAFFIC CONTROL	—	—	$25,333,000	$25,333,000
TOTAL	$44,273,000	$11,720,000	$25,333,000	$81,326,000

representative government/airplane asset ratio for this area is 12.4 percent, with a 55/45 division between the local and federal governments. Almost two-thirds of the latter represents additional air traffic control requirements.

Implementation of the six region STOL system requires government outlays of $357 million, based upon 1972 economics. The bulk, 57 percent, is local airport facilities while only about 28 percent is required to purchase and install air traffic control equipment and centers, Table IV-33.

4.3.1.2 Operating costs. - The facilities must be operated over the term of the planning horizon, 10 years. The local governments are responsible for the operation and maintenance of airport facilities and buildings including joint federal/local projects. The federal government through the FAA is responsible for the operation and maintenance of the air traffic control system.

Annual airport maintenance costs include the operation and maintenance of both the locally financed and federally assisted projects. The annual costs were assumed at 25 percent per annum. The operating costs for the incremental portions of the air traffic control system were projected at 16 percent per annum based on Department of Transportation, Office of the Assistant Secretary for Policy and International Affairs data.

4.3.1.3 Revenues. - Four major revenue streams are apparent from the inter-sector resource flows: (1) Corporate federal income taxes on airline profits, (2) The eight-percent ticket tax collected from the general public, (3) Local governments share of parking fees and concessions, and (4) local governments share of landing fees and building leases. The first item is calculated at 48 percent of estimated ten-year net profits, the second at the eight-percent

TABLE IV-33

PUBLIC SECTOR FIXED ASSETS
(1972 DOLLARS)

REGION	LOCAL OR COMMUNITY	FEDERAL		TOTAL
		ADAP	FAA	
CHICAGO	33,318,000	7,587,000	20,868,000	61,773,000
CALIFORNIA	52,849,500	12,569,500	21,028,000	86,447,000
NORTHEAST	42,009,500	10,509,500	10,255,000	62,774,000
NORTHWEST	5,121,000	1,340,000	5,128,000	11,589,000
SOUTHEAST	44,273,000	11,720,000	25,333,000	81,326,000
SOUTHERN	24,355,000	6,050,000	18,326,000	48,731,000
TOTAL	201,926,000	49,776,000	105,938,000	352,640,000

rate, the third at an assumed $1.25 per passenger per year and the fourth at 13 percent of indirect operating cost in Section 4.2.1.2.6. The parking fee and concession receipts estimates considered the nature of the short-haul travel market including both passenger per car characteristics and trip duration.

4.3.2 The airline industry

4.3.2.1 Operating assets. - Each of the six regional operators requires airplanes, ground support equipment, spares, maintenance hangars, shops and shop equipment collectively called operating assets. Regional airplane investments were computed as the product of the airplane unit price $11.323 and the regional airplane fleet. The equipment and facilities costs for each regional airline are presented in Tables IV-34 to IV-39. Careful inspection of these data show the influence of the simulation in determining maintenance requirements. For example the Chicago region requires 3 maintenance bases, one full and two limited capability locations, the California region four, the Northeast three, the Northwest one, the Southeast three, and the Southern region four maintenance bases. Ground support equipment requirements also are directly related to the city pair network of each region.

Spares requirements were based upon the ratio of initial spares to airplane costs as a function of the fleet size. Commercial provisioning experience and modern inventory models definitely establish that the ratio decreases at a decreasing rate as a function of fleet size, Table IV-10. The requirements for maintenance facilities and equipment was developed from maintenance analyses simulating the system maintenance infrastructure required to support full scale operations. The results of these simulations are separately reported in Volume VI.

The total operating asset requirements are summarized by region and asset category in Table IV-40. Out of total airline assets of $2.991 billion only $55.8 million are provided by the construction industry. The remainder are provided by the aerospace industry. One of the primary influences upon

TABLE IV-34

AIRLINE EQUIPMENT AND FACILITIES COST

CHICAGO REGION E150.3000.68

(1972 DOLLARS)

Description	Cost, Dollars
Ground Support Equipment (GSE) for 19 airports, one (1) full maintenance base and two (2) limited maintenance bases	1,268,000
Ground Handling Equipment (GHE) for 48 gates for the 19 airports	2,704,000
Hangar costs for one (1) full maintenance base and two (2) limited maintenances bases	7,600,000
Maintenance and overhaul shops at the full maintenance base	2,000,000
Engine test cell cost at the full maintenance base	750,000
Shop equipment	734,000
Engine test cell tools and equipment	255,000
Total	15,311,000

TABLE IV-35

AIRLINE EQUIPMENT AND FACILITIES COST

CALIFORNIA REGION E150.3000.68

(1972 DOLLARS)

Description	Cost, Dollars
Ground Support Equipment (GSE) costs for 22 airports, and one (1) full maintenance base and three (3) limited maintenance bases.	1,531,000
Ground Handling Equipment (GHE) costs for 73 gates for the 22 airports.	3,767,000
Hangar costs for one (1) full maintenance base and three (3) limited maintenance bases.	9,600,000
Maintenance and overhaul shop costs at full maintenance base.	2,000,000
Shop equipment costs	734,000
Engine test cell costs at the full maintenance base	750,000
Engine test cells and equipment	255,000
Total	18,637,000

TABLE IV-36

AIRLINE EQUIPMENT AND FACILITIES COST

NORTHEAST REGION E150,3000.68

(1972 DOLLARS)

Description	Cost, Dollars
Ground Support Equipment (GSE) costs for 18 airports, one (1) full maintenance base and three (3) limited maintenance bases.	1,550,369
Ground Handling Equipment (GHE) costs for 66 gates for the 18 airports.	3,616,000
Hangar costs for one (1) full maintenance base and two (2) limited maintenance bases. The cost for a third limited base, Detroit City has been accounted for in the Chicago Region.	7,600,000
Maintenance and overhaul shops at full maintenance base	2,000,000
Shop equipment costs	734,000
Engine test cell cost at the full maintenance base	750,000
Engine test cells and equipment	255,000
Total	16,505,369

TABLE IV-37

AIRLINE EQUIPMENT AND FACILITIES COST

NORTHWEST REGION E150.3000.68

(1972 DOLLARS)

Description	Cost, Dollars
Ground Support Equipment (GSE) for one (1) full maintenance base and one (1) limited maintenance base	929,000
Ground Handling Equipment (GHE) for 12 gates for the 7 airports	765,000
Hangar costs for one (1) full maintenance base. Limited maintenance base is accounted for in the California Region.	1,800,000
Maintenance and overhaul shop costs at full maintenance base.	2,000,000
Shop equipment costs	734,000
Engine test cell costs at the full maintenance base.	750,000
Engine test cell tools and equipment	255,000
Total	7,233,000

TABLE IV-38

AIRLINE EQUIPMENT AND FACILITIES COST

SOUTHEAST REGION E150.3000.68

(1972 DOLLARS)

Description	Cost, Dollars
Ground Support Equipment (GSE) for 37 airports, one (1) full maintenance base and four (4) limited maintenance bases.	1,928,000
Ground Handling Equipment (GHE) for 85 gates for the 37 airports.	4,850,000
Hangar costs for one (1) full maintenance base and two (2) limited maintenance bases. The costs for two additional limited maintenance bases are accounted for in the Chicago and Northeast Regions.	7,600,000
Maintenance and overhaul shop costs at full maintenance base	2,000,000
Shop equipment costs	734,000
Engine test cell costs at the full maintenance base	750,000
Engine test cell tools and equipment	255,000
Total	18,117,000

TABLE IV-39

AIRLINE EQUIPMENT AND FACILITIES COST

SOUTHERN REGION E150.3000.68

(1972 DOLLARS)

Description	Cost, Dollars
Ground Support Equipment (GSE) for 20 airports, one (1) full maintenance base and three (3) limited maintenance bases	1,282,000
Ground Handling Equipment (GHE) for 45 gates for the 20 airports.	2,142,000
Hangar costs for one (1) full maintenance base and three (3) limited maintenance bases.	9,600,000
Maintenance and overhaul shop costs at full maintenace base.	2,000,000
Shop equipment costs	734,000
Engine test cell costs at the full maintenance base	750,000
Engine test cell tools and equipment	255,000
Total	16,763,000

TABLE IV-40

PRIVATE SECTOR (AIRLINE) OPERATING ASSETS

(1972 DOLLARS)

REGION	AIRPLANE QUANTITY	DOLLARS IN MILLIONS				
		AIRPLANES	SPARES	EQUIPMENTS	FACILITIES	TOTAL
Chicago	38	430.274	37.311	5.711	9.600	482.896
California	52	588.796	47.819	7.037	11.600	655.252
Northeast	57	645.411	51.293	6.905	9.600	713.209
Northwest	7	79.261	11.412	3.433	3.800	97.906
Southeast	58	656,734	51.785	8.517	9.600	726.636
Southern	24	271.512	26.649	5.163	11.600	315.164
Total	--	2,672.228	226.269	36.766	55.800	2,991.063

the asset source distribution is the autonomous operating division concept. This necessarily implies that other assets must and would be provided by the parent airlines to support the STOL subsidiaries. Among the assets are office space and equipment, common training, passenger handling, and other equipments required in the customary performance of passenger service.

4.3.2.2 Capital requirements. - The initial capitalization requirements were scaled from the initial capital requirements rationale for the Chicago region, Section 4.2.4.1.2. This rationale utilizes the 1.14 initial capitalization to operating asset ratio to provide working capital and reserves for acquisition of the second and third lot deliveries, approximately 25 percent each of total fleet requirements. (Subsequently the Chicago financial simulation showed the 1.14 ratio was too high, and that for the Chicago region a .625 ratio would be adequate based on cash requirements and generation.) The allocation between debt and equity was calculated by the 1.5:1.0 initial debt to equity ratio, Table IV-41.

Profits were scaled from a year by year analysis of the Chicago region financial simulation results as reported in Sections 4.3.2.3 and 4.3.2.4. Interest was calculated at 8.5 percent per annum on the debt amount. The debt refinancing concept was applied to hold the debt structure constant over the first ten years of operations in anticipation of expansion and second generation airplane procurement.

4.3.2.3 Operating revenues. - The operating revenues for all regions were scaled from the Chicago region growth pattern described in Section 4.2.4.2.1. This results in a ten-year operating revenue production equal to 7.74 years at tenth year revenue level. Direct fare yields were held constant over the ten-year period. Incidental revenues were estimated at $0.375 per passenger as

TABLE IV-41

CAPITAL CONTRIBUTIONS AND RETURNS

REGION	INITIAL EQUITY	TEN YEAR PROFITS	DEBT.	TEN YEAR INTEREST
CALIFORNIA	298.5	415.5	449.8	380.6
CHICAGO	220.0	322.0	330.0	280.5
NORTHEAST	324.9	562.3	487.4	414.3
SOUTHERN	143.7	256.0	215.5	183.2
SOUTHEAST	331.1	443.6	496.7	422.2
NORTHWEST	44.6	36.6	66.9	56.9
TOTAL	1362.8	2036.0	2044.3	1737.7

described in Section 4.2.2.2. The CAB Phase 7 fare structure provides a different yield level for each regional system based upon the average stage length as shown by Table IV-20. The division between federal ticket tax receipts, eight percent, and airline ticket revenues produces $2.25 billion revenue per annum by the tenth year. Incidentals add another $26 million, Table IV-42.

4.3.2.4 Operating costs. - The annual operating costs were calculated from the cost per available seat-mile (seat-kilometer) direct and indirect oper ating cost data presented in Section 4.2.1.2.3. The regional direct and indirect costs per assm (askm) are a function of the average stage lengths. Total direct and indirect costs for the tenth year were then determined. Tenth-year depreciation was calculated from the Chicago region results for 38 airplanes assuming industry wide uniform depreciation procedures. The interest was calculated from the debt structure at 8.5 percent. The tenth year cost accounts by region are presented in Table IV-43.

Straight line depreciation was used to determine accounting profits and losses, but the accelerated double declining balance method was used to compute corporate income taxes. The indirect operating costs per available seat mile decline over the ten year operating period as described in the Chicago Region Financial Analysis, Section 4.2.4.2.2. On the other hand direct operating costs per available seat-mile (seat-kilometer) were held constant. This may introduce a small favorable bias during the first few years but the bias would not be significant over the ten-year period.

4.3.2.5 Operating results. - The forecasted tenth-year operating results were scaled from the tenth-year Chicago region results as adjusted for stage

TABLE IV-42

ESTIMATED ANNUAL REGIONAL REVENUES AT
ULTIMATE OPERATING LEVELS (10TH YEAR)
(1972 DOLLARS)

REGION	AVERAGE STAGE LENGTH STATUTE MILES	TOTAL TICKET RECEIPTS DOLLARS (MILLIONS)	FEDERAL TICKET TAX DOLLARS (MILLIONS)	TICKET REVENUES DOLLARS (MILLIONS)	BEVERAGE SALES DOLLARS (MILLIONS)	GROSS PASSENGER REVENUE DOLLARS (MILLIONS)
CHICAGO	319	396.762	29.390	367.372	4.376	371.748
CALIFORNIA	309	516.572	38.265	478.307	5.698	484.005
NORTHEAST	296	589.399	43.659	545.740	6.697	552.437
NORTHWEST	333	59.155	4.382	54.773	0.634	55.407
SOUTHEAST	406	572.658	42.419	530.239	5.507	535.746
SOUTHERN	342	296.034	21.928	274.106	3.084	277.190
TOTAL		2,430.580	180.043	2,250.537	25.996	2,276.533

TABLE IV-43

ULTIMATE ANNUAL DOCs, IOCs, DEPRECIATION AND INTEREST

MILLIONS OF DOLLARS PER YEAR-10TH YEAR

(1972 DOLLARS)

REGION	DOC LESS DEPRECIATION	IOC	DEPRECIATION	INTEREST	TOTAL
CALIFORNIA	116.5	150.6	45.5	38.1	350.7
CHICAGO	92.9	114.4	33.2	28.0	268.5
NORTHEAST	125.9	154.9	49.8	41.4	372.0
SOUTHERN	72.6	83.2	21.0	18.3	195.1
SOUTHEAST	141.3	159.1	50.7	42.2	393.3
NORTHWEST	13.4	18.5	6.1	5.7	43.7

length variation. Federal taxes were computed at 48 percent of net income before taxes and dividends were calculated at seven percent of initial equity. The comparative operating results for each of the six regions and the domestic industry are displayed in Table IV-44. These were extended to cover the ten-year period using the Chicago region total to tenth-year ratios based upon the data of Section 4.2.4.2.3 and Table IV-23.

4.3.3 Construction industry. - The total construction industry contribution by region includes private sector and local and federal facilities expenditures. The aggregate impact is $307 million for the United States as a whole, Table IV-45. The derivation of the individual components previously was described. Aerospace manufacturing facilities and machine tool sales were deliberately omitted. There is now (1973) and in the foreseeable future adequate aerospace plant capacity to handle the likely programs through the 1980 to 1985 time period. Although machine tool sales will undoubtedly be significant during the early development and production period, the size and technology requirements of the STOL and short haul airplane designs of Phase I and II do not dictate appreciable single purpose machine tool requirements. Therefore machine tool requirements coincident with the commercial STOL program would be a function of normal obsolescence and technological evolution rather than an incremental impact of the commercial STOL program.

4.3.4 The aerospace industry

4.3.4.1 Aircraft sales. - The total acquisition price for 400 airplanes at a ten percent profit is shown in Table IV-46. The R and D costs amount to between 12 and 14 percent of the total airplane program. Propulsion costs, excluding nacelles, amount to between 20 and 33 percent of the total program

TABLE IV-44

COMPARATIVE REGIONAL OPERATING RESULTS

	CALIFORNIA	CHICAGO	NORTHEAST	SOUTHERN	SOUTHEAST	NORTHWEST	TOTAL
REVENUES	484.0	371.7	552.4	277.2	535.7	55.4	2,276.4
LESS COSTS							
DIRECT OPERATING	116.5	92.9	125.9	72.6	141.3	13.4	562.6
INDIRECT OPERATING	150.6	114.4	154.9	83.2	159.1	18.5	680.7
DEPRECIATION	45.5	33.2	49.8	21.0	50.7	6.1	206.3
SUBTOTAL	312.6	240.5	330.6	176.8	351.1	38.0	1449.6
OPERATING PROFIT	171.4	131.2	221.8	100.4	184.6	12.4	826.8
INTEREST	38.1	28.0	41.4	18.3	42.2	5.7	173.7
PROFIT BEFORE TAXES	133.3	103.2	180.4	82.1	142.4	11.7	653.1
PROVISION FOR FED. TAXES	64.0	49.5	86.6	39.4	68.4	5.6	313.5
NET PROFIT	69.3	53.7	93.8	42.7	74.0	6.1	339.6
DIVIDENDS	20.9	15.4	22.7	10.1	23.2	3.1	95.4
RETAINED EARNINGS	48.4	38.3	71.7	32.6	50.8	3.0	244.2

TABLE IV-45

CONSTRUCTION INDUSTRY SALES
(1972 DOLLARS-MILLIONS)

REGION	PRIVATE SECTOR	PUBLIC SECTOR		TOTAL
		LOCAL	FEDERAL	
CHICAGO	9.6	33.3	7.6	50.5
CALIFORNIA	11.6	52.8	12.6	77.0
NORTHEAST	9.6	42.0	10.6	62.2
NORTHWEST	3.8	5.1	1.3	10.2
SOUTHEAST	9.6	44.3	11.7	65.6
SOUTHERN	11.6	24.4	6.0	42.0
	55.8	201.9	49.8	307.5

TABLE IV-46

PHASE II SYSTEMS ANALYSIS AIRPLANES - TOTAL ACQUISITION PRICE BREAKDOWN
FOR 400 AIRPLANES - 1972 DOLLARS

Airplane Configuration	E150 2000 .68	A150 2000 .79	U150 2000 .79	E100 3000 .67	E150 3000 .68 (a)	M150 3000 .71	E200 3000 .70	H150 4000 .76	C150 7500 .80
Production Qty.	400	400	400	400	400	400	400	400	400
Development Price - $ M									
Airframe	498.4	481.1	573.4	284.2	386.8	432.6	503.5	369.4	335.4
Nacelle	5.8	7.3	9.4	4.5	5.3	10.0	5.9	9.9	9.6
Engine	182.0	153.0	158.0	159.0	172.0	174.0	184.0	172.0	165.0
Avionics	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUB-TOTAL	686.2	641.9	740.8	447.7	564.1	616.6	693.4	542.3	510.0
Production Price - $ M									
Airframe	3108.4	3226.1	3425.0	1715.8	2385.6	2650.6	3132.5	2166.4	2003.8
Nacelles	165.4	206.6	376.2	96.3	135.5	212.4	174.9	208.5	182.4
Engines	1323.6	1061.4	1162.0	1029.8	1192.8	732.4	1364.8	725.6	671.0
Avionics	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2
SUB-TOTAL	4848.6	4745.3	5214.4	3093.1	3965.1	3846.6	4923.4	3351.7	3108.4
Total Airplane Price - $ M									
Airframe	3606.8	3707.2	3998.4	2000.0	2772.4	3083.2	3636.0	2526.8	2339.2
Nacelles	171.2	214.4	385.6	100.8	140.8	222.4	180.8	218.4	192.0
Engines	1505.6	1214.4	1320.0	1188.8	1364.8	906.4	1548.8	897.6	836.0
Avionics	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2	251.2
TOTAL	5534.8	5387.2	5955.2	3540.8	4529.2	4463.2	5616.8	3894.0	3618.4

[a]Baseline

value with the advanced CTOL and the two mechanical flap designs lying at the lower end of the range.

These figures for 400 airplanes include both domestic and foreign sales. However the total value of the E150.3000 STOL program is almost 50 percent greater by the end of the first ten years of operation. The other $2.1 billion is composed of initial and follow-on spares, ground support equipment and the domestic air traffic control system.

4.3.4.2 Total program projection. - The total program value is presented in Table IV-47. This shows the breakdown among the various aerospace industry components - airframe, propulsion, and avionics, and the distribution between initial investment and recurring supporting purchases. While the airframe industry contributes about 60 percent of the early sales value, its share of the follow-on expenditures drops to 23 percent. In part, this is the result of major foreign purchases of airframe spares from their own sources. During the early years, U. S. purchases probably would be the rule, but as time progresses local procurement of the less expensive replacement parts would become more important. Almost 60 percent of the follow-on business would benefit the propulsion industry. In fact spares amount to 40 percent of the program's value to the propulsion industry vis-a-vis 10 percent for the airframe industry.

4.3.5 Gross transactions. - The earlier paragraphs of this duscussion have developed the contributors to the major intra system transactions flow. The interactions now can be illustrated showing the interactions. The top of Figure 4-26 presents the transactions affecting the public sector, including both federal and local components, while the lower portion shows the transactions among private sector components.

TABLE IV-47

DOMESTIC AEROSPACE INDUSTRY SALES

E150.3000 SYSTEMS ANALYSIS CONFIGURATION

1972 DOLLARS-MILLIONS

INVESTMENT	AIRFRAME	PROPULSION	AVIONICS	TOTAL
AIRPLANES	2913.2[a]	1364.8	251.2	4529.2
SPARES	117.7	217.0	39.3	374.0
GROUND EQUIPMENT	36.8	15.7	10.4	62.9
FAA	--	--	105.9[c]	105.9
SUBTOTAL	3067.7	1597.5	406.8	5072.0
OPERATIONS - 10 YEARS				
AIRPLANES	354.9[b]	1091.9	78.1[b]	1524.9
FAA	--	--	26.4	26.4
SUBTOTAL	354.9	1091.9	104.5	1551.3
GRAND TOTAL	3422.6	2689.4	511.3	6623.3

[a]Includes Nacelles

[b]Foreign Follow-on Spares 50% Non-U.S. Source

[c]Foreign Countries Procure ATC Locally

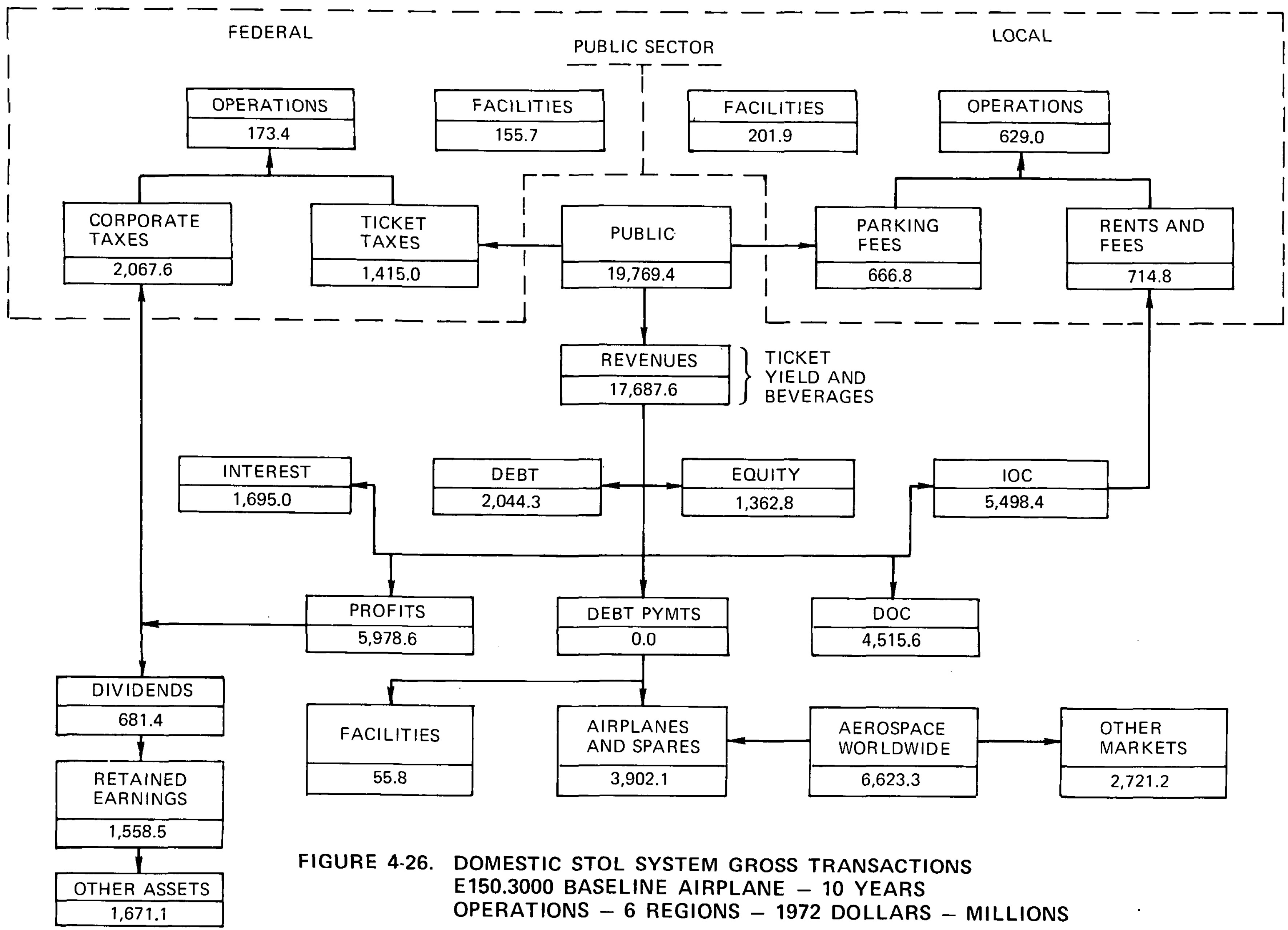


FIGURE 4-26. DOMESTIC STOL SYSTEM GROSS TRANSACTIONS
E150.3000 BASELINE AIRPLANE – 10 YEARS
OPERATIONS – 6 REGIONS – 1972 DOLLARS – MILLIONS

Federal outlays would be recovered about once a year while local outlays would be recovered about once in five years in terms of the incremental cost and revenues estimated here excluding terminal concessions. The figure shows airline industry outlays on the order of $3.4 billion. The retained earnings, dividends, and other assets generated by the operation provide recovery about once every nine years.

The transactions shown here were converted into annual dollar flows for subsequent processing by the econometric model. Since the econometric model provides interaction estimates the primary input data required was:

- Annual Government Investments
- Annual Airline Operations Data
    - Revenue Passenger Miles
    - Revenue
    - Domestic Purchases of Airplanes
    - Domestic Purchases of Spares
- Annual Aerospace Data
    - Domestic Airplanes and Other Equipment Sales
    - Foreign Airplanes and Other Equipment Sales
    - Domestic Spares Sales
    - Foreign Spares Sales
    - Wage Bill
    - Raw Material Bill
    - Semi Finished Products Bill
    - Durable Investments

The external effects of the E150.3000 program are presented in the next section.

4.4 External Effects

4.4.1 Annual economic data. - The Douglas econometric model, a specialized version of the Wharton econometric model, is used to examine the economy-wide effects of various national policies. The effects are measured by comparing the results of a baseline economic scenario against the results of a perturbed scenario reflecting changes in various direct economic activities. The perturbed values are determined by revising the baseline annual economic data to reflect the direct activity generated by a new policy, in this case the implementation of the STOL regional system.

The data increments required to perform this analysis are illustrated in Table IV-48. The data perturbations begin approximately three and one-half years prior to the completion of the first airline fiscal year to account for the dynamic effects of the R and D program. Therefore only the first seven and one-half years operation of the domestic STOL system could be examined within the 10 year limit of the econometric model.

The model itself provides a simultaneous solution of a non-linear set of econometric equations involving 451 variables. The outputs cover final demand by sector, input output, and labor, wages and prices. The fundamental assumption for this analysis was that the aerospace industry would be operating below capacity and therefore the STOL program would not disturb supply/demand equilibrium of aerospace resources. The results were interpreted as gross changes to the gross national product in real terms, total employment, and government revenues in current dollars, i.e. including the baseline scenario price changes. The important limitation on the interpretation is the gross change hypothesis. This hypothesis assumed the implementation of the domestic

TABLE IV-48

SELECTED OUTLAYS, REQUIREMENTS AND REVENUES FOR
STOL PROGRAM FOR MANUFACTURER AND AIRLINES
(MILLIONS OF 1972 DOLLARS)

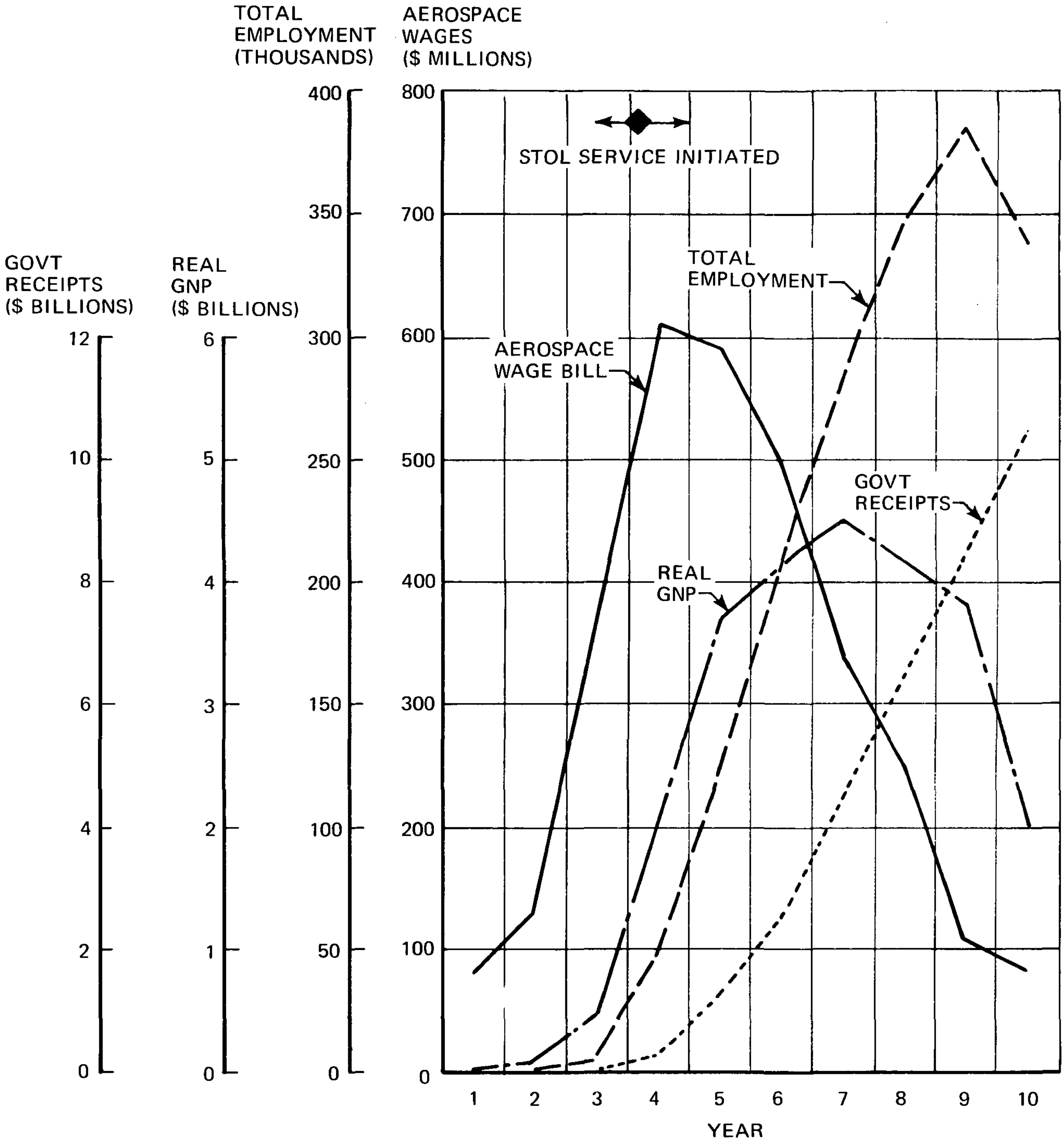
YEAR	1	2	3	4	5	6	7	8	9	10
Airplane Deliveries										
Domestic			2	39	76		58		36	23
Exports						84	21	48		13
Total			2	39	76	84	79	48	36	36
Domestic Airline Operation										
Revenue Passenger Mile (Thousands)			202	4,043	10,718	13,063	17,074	18,662	22,442	22,824
Revenues			20	403	1,069	1,303	1,703	1,861	2,243	2,276
Equipment Investment			132	508	988	3	689	3	430	275
Facilities Investment			10	35	10					
Spares				12	36	60	85	109	120	120
Direct Aerospace Employment (Wages)	80	129	377	620	588	500	338	250	110	85

Source: Section 4.3

STOL program and the resulting system would be in addition to the baseline scenario. In particular, the assumption was STOL airplane sales would not displace other sales and further that the domestic operation would not divert any revenue from other existing transportation systems.

4.4.2 Projected impact. - During the early years of the STOL program the government receipts forecasts showed a small negative impact. This resulted from the channeling of industrial activity into investment reducing the industrial value added and therefore profits. The additional personal income tax yield would be offset by reduced corporate taxes reflecting the early manufacturing losses. The primary driving econometric influence is the aerospace wage bill. The external effects follow, in time, the aerospace wage bill increments due to the STOL program. Figure 4-27 displays the temporal distribution of the wage bill increments, government receipts (in current or then year dollars), gross national product in constant dollars and employment in thousands of jobs. The gross national product lags aerospace employment by two or three years, total employment lags by four to five and government receipts lag by four to five years. Large increases in total employment and government receipts are more closely linked to STOL service initiation than to aerospace manufacturing. Gross national product on the other hand reflects the greater contribution of the manufacturing sector as opposed to the service sector.

The STOL program value of $5.8 billion over the ten-year period (out of a total of $6.6 billion over the first 10 years of airline operations) and the subsequent airline operations increase real gross national product by almost $25 billion, total employment by 1.75 billion man years, and government revenues by $34 billion (current dollars). The dynamic multipliers which



SOURCE: DOUGLAS' ECONOMETRIC MODEL

FIGURE 4-27. STOL PROGRAM EFFECTS UPON AEROSPACE WAGES, TOTAL EMPLOYMENT, REAL GNP AND GOVERNMENT RECEIPTS

normalize the distribution effects of a distributed investment per million dollars invested in the STOL program are:

Real Gross National Product	2.8
Total Employment	197 Man Years
Government Receipts	3.34

The multipliers would have to be examined in the context of competitive national investments in order to determine the worth of the STOL program vis-a-vis other national transportation policy alternatives. The effect on government receipts showed the federal government receiving almost two-thirds of the generated receipts in the early years. As the STOL operating system expands the state and local governments receive a larger and larger share until in the tenth year they receive 48 percent of the additional revenue generated.

4.5 California Region

4.5.1 CAB phase 7 versus intrastate fares. - The previous results are based on CAB phase 7 fare levels. The question then arises, "How might STOL operations be affected when forced to compete against carriers operating under intrastate fare structures?" The California region provides an instructive example. The intrastate fare structure is nominally about 51% of the CAB phase 7 fares at the same segment lengths. Unless the regional operator is permitted to meet intrastate fares on intrastate routes, load factors surely would suffer. The resulting "malallocation" of resources may not inevitably imply an operating loss but it would surely imply extensive inefficiencies.

An investigation was undertaken to determine the amount of subsidy required to hold projected return on equity levels or alternatively the reduction in indirect operating costs which must be made to meet those profit goals. Before considering the income statement itself it is necessary to examine the incremental fare dilution which would result by meeting California intrastate fares on intrastate routes.

4.5.2 Estimated incremental dilution. - The CAB Phase 7 fare for a 309-st. mi. (497-km) stage length is $31.48 before federal user's tax. The corresponding California intrastate fare is approximately $16.02 or 51 percent of the Phase 7 fare. Regional carriers presently are experiencing an estimated 13 percent fare dilution to 8.87 cents per st. mi. (5.51 cents per km). The corresponding dilution estimate under the California intrastate fare structure is estimated at three percent. This reduces the yield per statute mile from 5.18¢/rpsm (3.22¢/rpkm) to 5.02 ¢/rpsm (3.12¢/rpkm).

Table IV-49 illustrates the average fare structure calculation for the California region STOL system. Interstate routes, i.e. city pairs where one or both cities are outside California, accounted for 67.9 percent of the available seat-miles (seat-km). The resulting system wide yield of 7.63¢/rpsm (4.74¢/rpkm) for the California region at the average 309-statute-mile (497-km) stage length results in a yield of 14 percent less than the yield obtained by current regional operators.

4.5.3 Projected operating results. - The yields must then be translated into financial results in order to compare the impact. Four illustrative cases are presented. The first case depicts the tenth-year operating results for the 1.14 capital to operating asset ratio zero dilution case. The first column of Table IV-50 is a recap of the California region column of Table IV-44, Section 4.3.2.5. The second column provides a revised base case reflecting the CAB Phase 7 fare levels with 13 percent dilution and the .624 capital to operating asset ratio perturbation previously presented. The third column shows the effect of further average fare dilution as calculated in Table IV-49. In this case return on equity parity is attained by a $31.4 million subsidy on a net-profit basis. This is equivalent to a $60.5 million subsidy on a pretax basis. The fourth case achieves the same return on equity parity by slashing system wide indirect operating cost by 40 percent or the same $60 million pretax amount per year. The 40 percent cut would reduce IOC's from about $10 per passenger system-wide to a little over $6.00 per passenger, a very ambitious operating goal.

However, the alternative to hyper efficient indirect cost control is clear. Operation in the California region would not only sharply raise the five-year subsidy requirements, $355 million as previously estimated, to

TABLE IV-49

CALIFORNIA REGION YIELDS
[ASL = 309 st. mi. (497 km)]

Cost or yield element,	California, CAB Phase 7, 13% Dilution	California Projected
CAB Phase 7 fare at ASL, $	31.48[a]	31.48[a]
Fare rate, ¢/rpsm (¢/rpkm)	10.19 (6.33)	10.19 (6.33)
California intrastate fare, $	—	16.02[a]
Fare rate, ¢/rpsm (¢/rpkm)	—	5.18 (3.22)
CAB fare rate, with 13% dilution, ¢/rpsm (¢/rpkm)	8.87 (5.51)	8.87 (5.51)
Interstate ASM's (% region total)	—	67.894
Interstate yield component ¢/rpsm (¢/rpkm)	—	6.02 (3.74)
Calif. intrastate fare rate, with 3% dilution, ¢/rpsm (¢/rpkm)	—	5.02 (3.12)
Intrastate ASM's (% region total)	—	32.106
Intrastate yield component, ¢/rpsm (¢/rpkm)	—	1.61 (1.00)
Average yield, ¢/rpsm (¢/rpkm)	8.87 (5.51)	7.63 (4.74)[b]
Relative yields	1.00	0.86

[a]Base ticket price without the 8% federal tax.
[b]Sum of interstate and intrastate components.

TABLE IV-50

COMPARATIVE CALIFORNIA REGION
10TH YEAR RESULTS
(DOLLARS IN MILLIONS)

	CAB PHASE 7 FARES NO DILUTION	CAB PHASE 7 FARES 13% DILUTION	CAB/INTRA STATE FARES DILUTION	CAB/INTRA STATE FARES REDUCED IOCS
CAPITAL BASE ~ MILLIONS	748.3	408.1	408.1	408.1
REVENUES	484.0	421.8	361.5	361.5
LOSS COSTS				
DIRECT	116.5	116.5	116.5	116.5
INDIRECT	150.6	150.6	150.6	90.2
DEPRECIATION	45.5	45.5	45.5	45.5
SUBTOTAL	312.6	312.6	312.6	252.2
OPERATING PROFIT	171.4	109.2	48.9	109.3
INTEREST	38.1	20.8	20.8	20.8
PROFIT BEFORE TAXES	133.3	88.4	28.1	88.5
CORPORATE TAXES	64.0	42.4	13.5	42.5
NET PROFIT (OPERATIONS)	69.3	46.0	14.6	46.0
SUBSIDY (NET)		—	31.4	—
TOTAL PROFIT	69.3	46.0	46.0	46.0
RETURN ON INITIAL EQUITY	23.2	28.2	28.2	28.2

probably unacceptable levels but also would raise the potential of an indefinite subsidy requirement if the California regional system is to be made an attractive investment alternative.

4.6 Military/Commercial Commonality

A study was conducted of the effects of commonality on a commercial derivative of the military STOL airplane. A typical military transport designed to meet a military STOL transport mission is shown in Figure 4-28. From this design, a commercial transport was derived, as shown in Figure 4-29. The characteristics of these airplanes are compared in Table IV-51. The field lengths for the two airplanes were calculated to different ground rules, i.e., the military airplane was designed to the military takeoff and landing requirements, while the Model 24C commercial derivative meets the criteria used for commercial STOL airplanes in Phase II. The military STOL transport is an externally blown flap configuration powered by four advanced technology engines with a bypass ratio of six, and no acoustical treatment.

The commercial derivative airplane (Model 24C) has an engine which used the same engine core as the military transport. The military engine which has a fan pressure ratio of about 1.6, is replaced with a commercial engine using a variable pitch fan with a 1.32 fan pressure ratio. With acoustical treatment lining the internal nacelle walls, and without treated rings, the airplane has an estimated noise level of 102 EPNdB at 500 foot (153 m) sideline, assuming 1980 technology.

The military STOL transport fuselage has a diameter of 216 inches (5.5m) which allows a double aisle, eight-abreast seating in the commercial version. The military aircraft was typical of cargo configurations featuring low cargo floors to facilitate loading through a rear clam-shell door. Although the same shell size is used in the commercial airplane, the floor is located higher which permits space for baggage, cargo and landing gear retraction into the belly compartment.

MILITARY STOL TRANSPORT

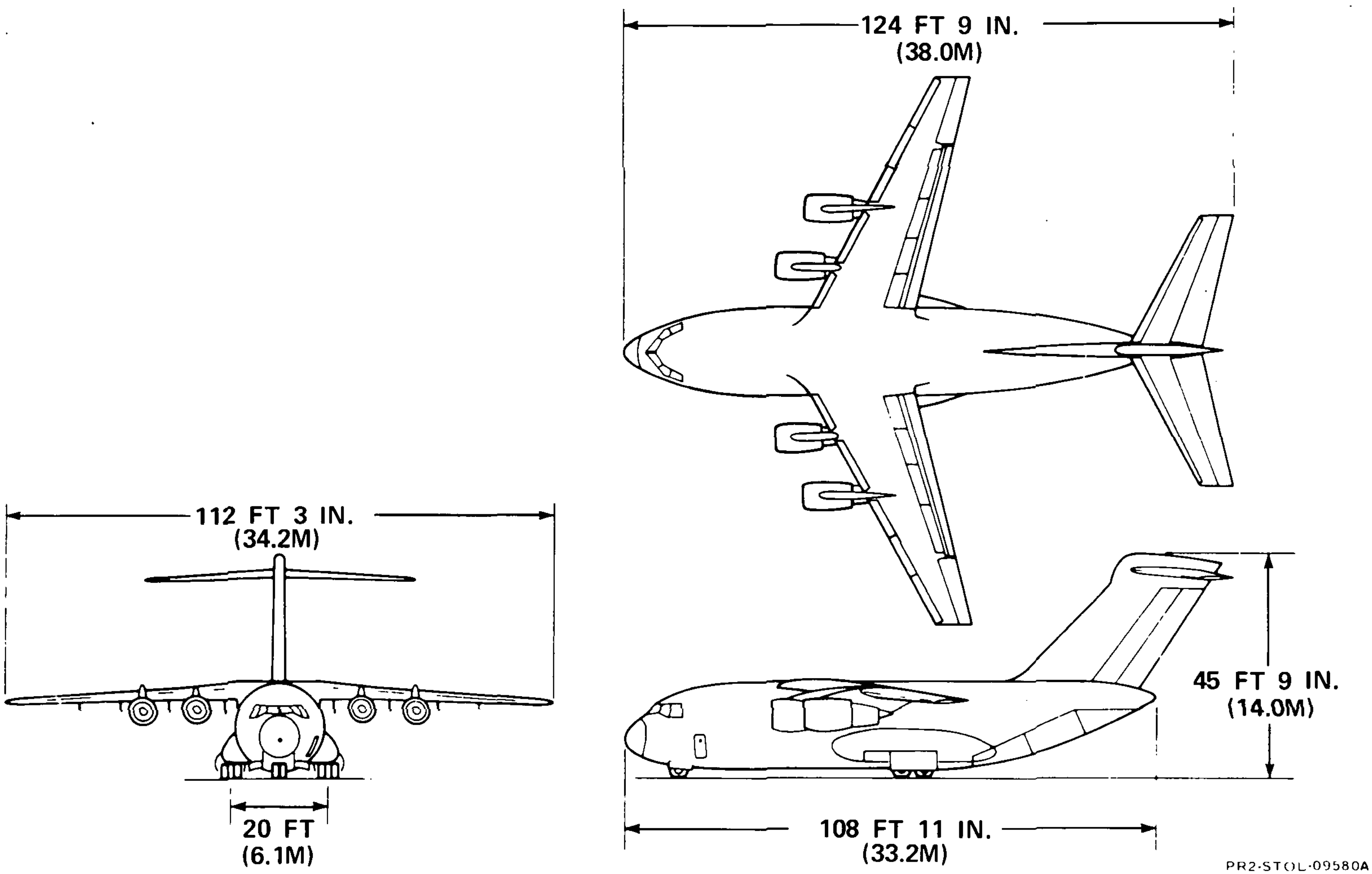


FIGURE 4-28.

MODEL 24C

GENERAL ARRANGEMENT

COMMERCIAL DERIVATIVE OF MILITARY TRANSPORT

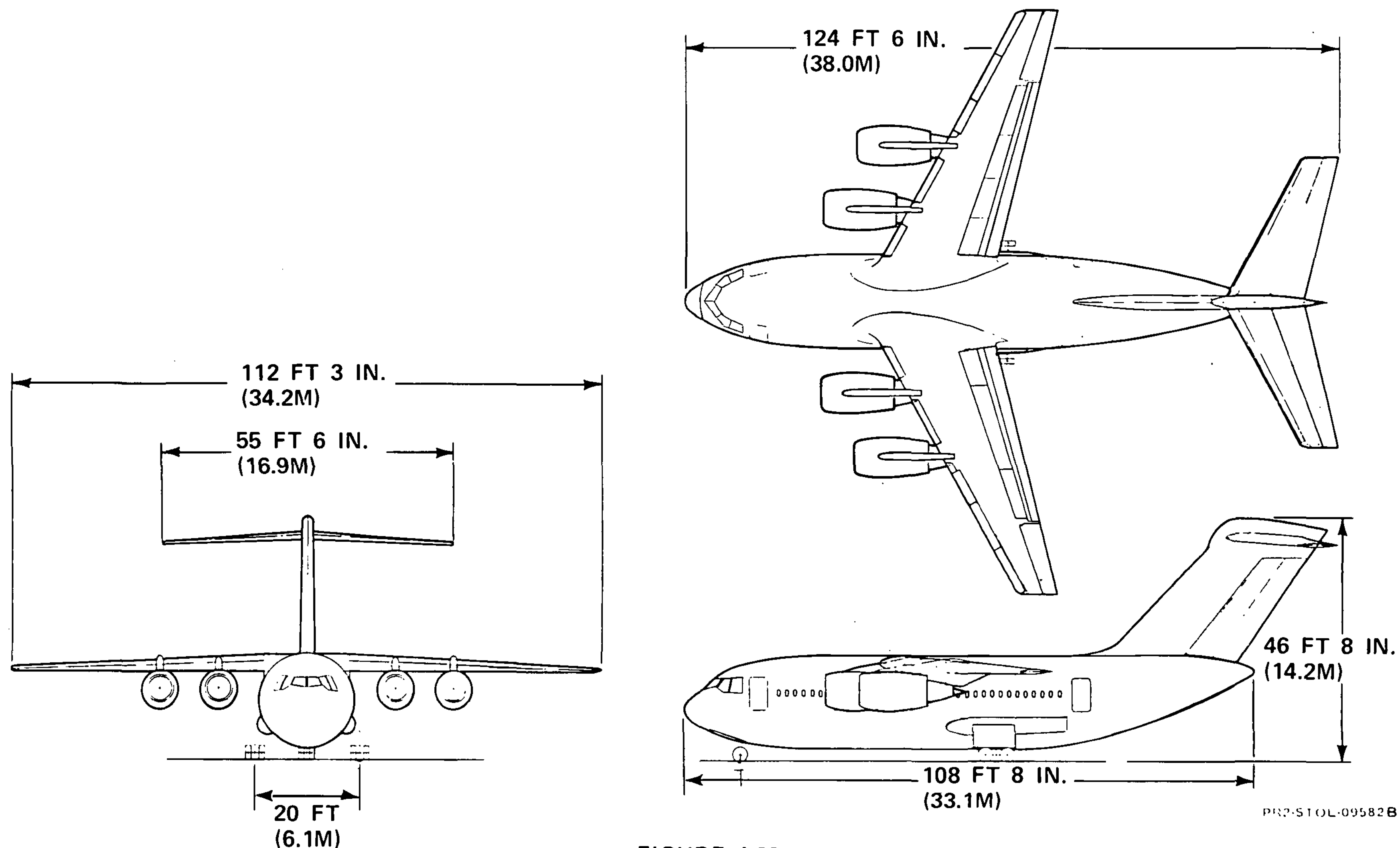


FIGURE 4-29.

TABLE IV-51

AIRCRAFT CHARACTERISTICS
[Military STOL vs model 24C]

		Military STOL		Model 24C	
Takeoff gross weight	lb (kg)	146,000	(66,220)	164,350	(74,550)
Operational empty weight	lb (kg)	101,530	(46,050)	113,560	(51,510)
Payload	lb (kg) - psgr	28,000	(12,700)	151	
Wing area	ft^2 (m^2)	1,800	(167)	1,800	(167)
Wing loading	lb/ft^2 (kg/m^2)	81.1	(396)	91.3	(446)
Aspect ratio		7		7	
Engine thrust	lb (n)	18,900	(84,070)	24,000	(106,760)
T/W		0.493		0.584	
Field length	ft (m)	2,000	(610)	2,700	(823)
Design range	st mi (km)	575	(926)	575	(926)
Cruise mach no.		0.75		0.78	
Cruise altitude	ft (m)	30,000	(9,144)	28,000	(8,534)
DOC	¢/assm (¢/askm)	---		2.15	(1.34)

The wing, vertical and horizontal tail are 100 percent common. Some of the other components, such as, wing and tail attach structure in the fuselage, the pilot's compartment, flight controls, and the various systems have commonality in varying degrees. A detailed weight breakdown of the two airplanes showed that 44.5 percent of the commercial cost weight and 48.6 percent of the military cost weight are common parts of the two airplanes. The common engine core weight is not reflected in the weight breakdown since dry engine weight is not considered in cost weight totals.

It should be noted that the Model 24C is quite different from the 150 passenger, 3000 ft. (915 m) field length study baseline. There are differences in fuselage cross section, wing area, aspect ratio, thrust to weight ratio and wing loading to name a few. The study baseline airplane is more optimum for the short-haul mission, while the Model 24C with its extra thrust, larger wing, and wider fuselage has a far greater potential for stretching both range and passenger payload.

Cost analysis shows that an airplane such as the Model 24 would cost approximately 5 percent less in a combined Military/Commercial program and that airframe development costs could be reduced as much as 50 percent. The costs are based on a 400 unit production for the commercial airplane program and assumed engine commonality only in the engine core. These costs do not include engine development. The commercial program, for noise reasons, has to bear the costs of development of a high bypass ratio variable pitch fan thereby reducing the potential cost savings. The attractiveness of commonality could obviously be designed to use the same power plant.

5.0 CONCLUSIONS

5.1 Background

Air transportation in the early 1970s has suffered from a pause in traffic growth and vocal opposition to the current frequencies at major airports. The first problem has reduced traffic and increased fare dilution leading to unsatisfactory financial results. There is some doubt that even the present schedules and frequencies can long continue in the presence of concerted public action to abate noise and congestion. The obvious solution is to divert significant traffic from major hubs to existing satellite (peripheral) airports or to new aerial ports. This is not politically feasible now. The noise generated by current operations has irritated the suburban public so much that there are movements demanding that existing frequencies be curtailed or moved into someone else's backyard. There is the impasse.

Major hub noise and congestion cannot be alleviated without diverting traffic. Traffic cannot be diverted using current airplanes. The economic fact that efficient transportation is essential to the U. S. economy has been obscured by the public outcry against the noise generated by the airplane. One of the potential solutions could be an efficient quiet STOL system operating from non-hub airports. The emphasis on these aspects is evident from the work statement outlining a system study of quiet, nominally 95 PNdB, STOL, 1500 to 3000-ft (457-914 m) field length airplanes. The results of such a study should point toward airplane designs, operational concepts, and concrete airline routes which would provide a large enough passenger demand and therefore an airplane market to produce viable quiet STOL operations.

The preceding sections of this report have addressed, in detail, the various economic aspects of viable STOL operations. This section returns to a discussion of the main findings as they relate to identifying preferred design options and tracing the economic implications.

5.2 System Economics

5.2.1 Payload evaluation. - System economics are tied to the market analysis. The results of the modal split analyses showed the public would not patronize a STOL system if the fare levels were much higher than the CAB Phase 7 fares. Since DOC's and therefore fares are coupled, this finding in Phase I ruled out the 50-passenger airplane designs. The DOC's per seat mile (seat km) for the Phase II systems analysis 100-passenger EBF airplane were 22 percent higher than the 150-passenger EBF airplane. After these two 3000-ft (914 m) field length airplanes were refined using revised acoustic and other design criteria, the cost differential widened slightly to about 24 percent. Clearly these higher costs would imply an unacceptable fare differential. On the other hand, analysis of the various 1985 route systems showed that for most markets the 200-passenger EBF airplane to be too large (from a frequency standpoint) to take advantage of its 10-13 percent lower DOC when compared to the E150.3000 for the 1985 market. Therefore, the 150-passenger airplane is preferred.

5.2.2 Field length evaluation. - The direct operating cost criteria eliminated the 1500-ft (457 m) field length by the end of Phase I. The Phase II final design 2000-ft (610 m) airplane designs produced DOC's about 20 percent greater than the 3000-ft (914 m) designs. The differential is large enough to seriously compromise the future of 2000-ft (610 m) STOL systems. Field lengths greater than 3000 ft (914 m) could be considered. The revised Phase II final design 150-passenger 3000-ft (914 m) EBF airplane has slightly higher, 7 percent, DOC's than the 4000-ft (1219 m) mechanical flap airplane. However, the difference in operating regimes and technology requirements between 3000 ft (914 m) and 4000 ft (1219 m) is large enough to militate against direct result-for-result DOC comparisons. This regime subsequently has been made the subject of a separate study.

The transition during Phase II from systems analysis airplanes to final design airplanes resulted in a revised ranking of preferred lift concepts. For example, the M150.3000 systems analysis airplane had a 3.4 percent lower DOC than the E150.3000 under design range conditions. The revised design data used for the final design airplanes reversed this advantage. The M150.3000 airplane now has an 11-percent higher DOC than the E150.3000 and the redesigned EBF is preferred over the mechanical flap. Furthermore, the 63.5 lb/ft^2 (310 kg/m^2) wing loading of the M150.3000 final design would not provide a "comfortable" passenger ride by current jet standards.

5.2.3 Economic evaluation

5.2.3.1 Operational concept. - The selection of a relatively large STOL airplane naturally leads to route structures and airport selections which will make it economical. This dictates the adoption of moderate sized traffic collection hubs and moderate frequencies. This kind of operation, not very dissimilar from today's short haul operations, leads to a satellite or peripheral route system rather than the point to point system dictated by smaller airplanes.

The 96 EPNdB E150.3000 final design airplane would be an acceptable neighbor. The noise generated by 35 takeoffs and landings of current JT8D powered airplanes as measured by the 30-NEF contour area contains 1613 acres (653 hectares). The 96 EPNdB E150.3000 generates an area of only 77 acres (31 ha.), a 95 percent reduction. Even sharply higher daily frequencies would be acceptable to the general public and therefore to local authorities.

The complexities of large STOL regional systems necessarily imply the need for experienced management and operating personnel. These prerequisites can be best attained by operating the regional STOL systems as autonomous subsidiaries of existing major airlines. Existing operating practices would be tailored to support the STOL subsystem. Among the revised practices are flight planning and Air Traffic Control procedures to reduce total maneuver time to 8 minutes vis-a-vis the current 21 minute allowance. Offsetting the small unavoidable DOC increases requires organizational realignment and tighter control to reduce IOC's by commensurate amounts.

5.2.3.2 Direct operating costs. - The DOC for the final design E150.3000 is about 14 percent higher than the advanced CTOL final design, when both are compared at the STOL design range of 575 st. mi. (926 km). This differential is primarily influenced by the weights, performance and price differences of the two designs, especially the significant differences in field length and noise design criteria. The higher final costs cannot be offset by reduced crew requirements and maintenance performance both of which must meet interstate standards.

5.2.3.3 Indirect operating costs. - Attaining a commensurate reduction in IOC's requires more careful organization and control of the large IOC items, primarily passenger handling and food and beverage expense. Simplification of these services when properly controlled can reduce total IOC's per passenger by about $1.00 or about eight percent.

5.2.3.4 Profitability. - Once the regional STOL systems have passed through the growth stage, results as profitable as regional CTOL operations are anticipated subject to the discussion in 5.2.3.5 and 5.2.3.6. Return on investment calculated using the discounted cash flow method shows about 24 percent for the final design 150-passenger STOL and 24 percent for the advanced CTOL at a representative average stage length of 319 st. mi. (513 km). The projected tenth year operating results for the Chicago region show a post tax return on stockholder's equity of about 12.5 percent after 13 percent fare dilution. By any standards the long term prognosis is acceptable.

5.2.3.5 Subsidy. - Despite the promise of long term viability the initial operating years might require subsidy. The cumulative profits over the first five years probably may not be large enough to induce the required investment in view of the good but not great long term profits. The five regional systems studied (excluding California) could probably require aggregate subsidies up to $60 million per year for the first few years. The sharply improved operating results during the sixth year due to system maturation should sharply reduce subsidies to each of the individual region entities.

The financial outlook is not as sanguine wherever a regional STOL system must compete against intrastate operations constrained to the sharply reduced fare structures imposed by state Regulatory Commissions. For example, the California Region system would require an annual $60.5 million pre tax subsidy to offset lower yields from California intrastate flights. The choice under these circumstances is either permanent subsidy, either direct or in the form of premium route awards, or alternatively deep cuts in indirect operating costs. Direct costs cannot be substantially trimmed while maintaining flight safety. Of course the STOL airplanes examined in this study offer more comfort than the typically high density intrastate configurations. However, it is not clear how well this greater comfort can be translated into either higher intrastate load factors or fare premiums above intrastate fares or a mixture of both. See Section 5.2.3.6.4.

5.2.3.6 Critical control parameters. - The results discussed above are contingent upon achieving consistent performance of several critical parameters. These parameters affect both direct and indirect operating costs.

5.2.3.6.1 Block speed. - The block speeds attained by the STOL aircraft include both aircraft and system performance aspects. The 350 mph (568 km/hr) block speed over a 319-st. mi. (513-km) stage length depends upon the eight-minute maneuver time, only achievable with an efficient air traffic control system. Near maximum speeds occasionally might be used to offset traffic delays but extensive use would dilute the fuel economies of design cruise speeds.

5.2.3.6.2 Utilization. - The nominal utilizations calculated as a result of the schedule and maintenance analyses were 7 to 8 hours per day. While there seems to be no utilization limit due to maintenance constraints, there always are prime time limits. Although these were analyzed extensively during the study careful time management of thru stop and daytime turnaround ground times would be required.

5.2.3.6.3 Insurance. - The two percent annual insurance rate used throughout the study provides a small hedge against overly optimistic parameter estimates. Over an extended period insurance rates should drop provided accident rates are consistent with the long haul industry.

5.2.3.6.4 Load factors. - The CAB Phase 7 fare structure, the system load factor estimate, 60.7 percent, and the dilution factor, 13 percent, contribute to healthy revenue projections. The 60.7-percent load factor may at first seem optimistic when the major trunks are experiencing average load factors near 50 percent. California intrastate experience suggests that high load factors can be maintained even in high density configurations, and with sufficient fare differentials compared to equivalent interstate rates. These high-density, lower-load-factor results actually occupy a greater percentage of the available cabin floor space (on an equivalent seat basis) than do the lower density, higher-load-factor results typical of the STOL configurations examined in this study. The reaction of the travelling public to the comfort-vs-fare trade off has not been completely analyzed; but, in any case, the load factors provided as a result of the market analysis are a critical contributor to financial success.[a]

5.2.3.6.5 Service and image. - The success of any service company is directly related to the service it apparently provides. The challenge of STOL operations is to provide the image of service at near minimum indirect costs. Unless this challenge is met and the other critical variables simultaneously are controlled there is little chance of successful

[a]The extensions are outlined in Appendix 7.6, A Look to the Future.

STOL operations. The short haul carriers certainly are aware of the challenge and all are trying to meet it. The difficulty is evidenced by the fact that only a few short haul operators have been able both to prosper and grow over an extended period.

5.2.3.6.6 Economic summary. - The basic results show STOL regional systems can be viable provided almost all of the various design and operating objectives can be attained, Figure 5-1. The early subsidy issue cannot be definitively resolved at this time.

FIGURE 5-1

PREREQUISITES FOR SUCCESSFUL STOL OPERATIONS
AT EXISTING FARE LEVELS

AIRPLANE PREREQUISITES	
Payload	Approximately 150 passengers
Field Length	Approximately 3000 ft (914 m)
Airframe Price	No cost per seat penalty
Engine Price	Minimum noise abatement penalty consistent with environmental objectives
MANAGEMENT PREREQUISITES	
System Concept	Satellite arrangement of airports
Operating Entity Productivity	At least 2000 passengers per employee
OPERATING PREREQUISITES	
Block Speed	Low total maneuver times
Utilization	7 to 8 hours per day at 300 st. mi. (483 km) stage length
Insurance	Demonstrate safe operations
Load Factors	About 60 percent
Indirect Costs	Minimized
Image	Frequency and service at minimum cost
GOVERNMENT PREREQUISITE	
Subsidy	
Initial	May be required
Sustained	May be necessary to compete in California

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7.0 APPENDICES

7.1 Ground Rules and Assumptions

This section contains the basic ground rules and assumptions that were used to derive the air transportation system costs and revenues for the Douglas configurations generated for both Phase I and Phase II.

7.1.1 Costs for equipment and effort were expressed in 1972 economics. (Reference 2)

7.1.2 Only those costs attributable and in support of the air transportation system were considered. In Phase I this excluded ground facilities (e.g., maintenance base); but included the ground support equipment for the airplane. During Phase II all identifiable cost elements were included (e.g., maintenance base, shop equipment, etc.) in the regional network analyses only. (Reference 5)

7.1.3 Airplane deliveries to the airlines are assumed to follow a schedule of 50 percent the first year, 25 percent the third year and the remaining 25 percent the fifth year. (Reference 5)

7.1.4 Direct operating costs were computed using a modified version of the 1967 ATA "Standard Method of Estimating Comparative Direct Operating Costs of Turbine Powered Transport Airplanes". Two main modifications were made - (1) all dollars values were adjusted to reflect more realistically CTOL maintenance and spares requirements as well as operational concepts, and (2) all values were escalated to 1972 economics (References 6, 7, and 8).

7.1.5 Indirect operating costs were derived using the combined industry effort of Boeing, Douglas and Lockheed. (Reference 10)

7.1.6 Propulsion costs (development and production) for both the engines and nacelles were developed and supplied by the STOL Propulsion System Study Contractors - Allison and General Electric. General Electric did not itemize (breakdown of price into development and production for both the engines and the nacelles) its prices. Therefore, G.E. engine/nacelle data were displayed in terms of a single selling price (Reference 11).

7.1.7 Airplane prices and operating costs in Phase I were based on a production run of 300 airplanes. This airplane quantity was changed from an original specification of 400 in the RFP. (References 6, 8 and 12)

7.1.8 Return on investment was derived on an individual airplane basis. (Reference 6)

7.1.9 With the exception of evaluating the financial aspects of the airline as an entity in Phase II, operating revenues were limited to passenger yield. In Phase II beverage sales were included and identified as incidentals. (Reference 5)

7.1.10 No provisions were made for mail and freight cargo as well as baggage as a means of generating additional revenue. (Reference 5)

7.1.11 Financing cost and terms were used only in Phase II in structuring the financial analysis of the airline.

7.1.12 Each region was organized geographically into representative airline networks with the STOL airline assumed to be an autonomous operating division of a profitable, tax paying major airline.

7.1.13 While STOL operations are planned at all airports considered, no comingling of CTOL and STOL air traffic was planned. Separate or dedicated runways are assumed. Operations were planned for a single STOL runway unless the analysis results in a level of operations which require a second STOL runway. *The number of STOLports in the same city is consistent with air* passenger demand and economic factors.

7.1.14 A STOL network may include the following types of airports.

- Major air carrier airports with separate STOL facilties
- Secondary airports with separate STOL and general aviation facilities.
- New STOLports at market-oriented sites exclusively dedicated for STOL operations.
- Existing civil or military airports converted exclusively to short-haul operations, or joint use of facilities by STOL and CTOL where feasible.

7.1.15 The STOL systems assume transition from existing CTOL operations into mixed CTOL/STOL operations with the STOL system operating as a separate subsidiary entity. The impacts upon the complementary CTOL are not addressed.

7.1.16 All costs developed for this study through the application of the DAC advanced design cost model and other estimating techniques are rough order of magnitude estimates. Such estimates are used for Budgetary and Planning purposes only, and do not represent a commitment on the part of DAC, its subcontractors and other referenced agencies to furnish services and equipments in the amounts stipulated.

7.2 Market Data

7.2.1 Demand for civil STOL airplanes. - In the preceding sections, reference was made to the use of a market size on the order of 800 commercial STOL airplanes and assuming two manufacturers, this left a basic commercial market of 400 airplanes per producer. The purpose of this section is to show the build-up of the market forecast.

7.2.1.1 National demand for civil STOL airplanes. - Determining the domestic market for STOL airplanes required preparing a traffic forecast, selecting city pairs and deriving a modal split procedure. Stage lengths from zero to 600 st. mi. (966 km) were selected for purposes of calculating the baseline demand for STOL airplanes. This was necessary because the data output from existing computer programs are in terms of 100-st. mi. (160-km) increments. This was as close as it was possible to come to the 575 st. mi. (926 km) range used in the balance of the study.

During the course of the study, a target load factor of 60 percent was used. It is also the load factor by which forecasted passenger miles was converted into seat miles. The 1985 STOL market demand was calculated using the modal split procedure described in Volume IV, Markets, of this report. The STOL passenger-mile demand at the 0-600 st. mi. (966 km) range is 16.193 billion (26.060 billion passenger-kilometers). At the 60-percent load factor this converts to 26.988 billion seat-miles (43.433 billion seat-km).

The seat-mile (-kilometer) productivity of the selected STOL airplanes follows:

PASSENGER DESIGN CAPACITY	150
ANNUAL UTILIZATION, HOURS	2500
BLOCK SPEED, MPH	300
KPH	483
ANNUAL PRODUCTIVITY (MILLIONS)	
SEAT MILES	112.5
SEAT KILOMETERS	181.1

These productivity values provide the basis for estimating the STOL domestic market. When the 1985 seat-mile (-kilometer) demand is divided by the annual productivity an estimate of the U. S. domestic market for STOL results. This computation indicates that there is a potential base market for 240 airplanes in 1985.

The STOL passenger-mile (-kilometer) demand is composed of city pairs with an annual origin-destination passenger density of 300,000 or above. This volume of passenger travel was assumed as the minimum necessary to consider a dual STOL/CTOL air transportation system. City pairs with an annual traffic volume of less than 300,000 origin-destination passengers are potential candidates for dual STOL/CTOL service when traffic growth brings them to this point.

An estimate of the U. S. domestic market for the baseline STOL airplane (E150.3000.68) was also made for the year 1990. The traffic growth rates used are consistent with those in the official annual publication "Passenger Air Transport Market". Accordingly, in 1990 there is a demand for 320 STOL airplanes.

It was a requirement of this study to investigate the effects of designing the airplane to fly extended ranges. The impact of this provision upon the market for the baseline STOL airplane was determined for ranges up to 1200 st. mi. (1931 km) and the results are shown below. In each extended range market study the basic modal split procedure described in Volume IV was used.

		Stage Length		
Year	St. Mi. km	0-600 0-966	0-900 0-1449	0-1200 0-1931
1985		240	375	535
1990		320	500	715

7.2.1.2 Foreign demand for civil STOL airplanes. - In order to determine the potential STOL airplane production level, it was also necessary to estimate the potential foreign markets. The procedure for estimating the non-U. S. market for STOL airplanes followed closely the procedure used for the United States. In general, differences arise due to the greater availability of data for the United States. For example, the U. S. Civil Aeronautics Board publishes detailed origin-destination passenger statistics that are not available on a worldwide basis. However, where possible, as in the case of the modal or traffic split analysis, a similar analytical approach was adopted. The details of the approach are contained in Volume IV, but the results are as follows:

		Stage Length		
Year	St. Mi. km	0-600 0-966	0-900 0-1449	0-1200 0-1931
1985		320	415	475
1990		545	710	810

For the STOL systems study the 1990 combined worldwide estimate (320 U. S. + 545 NON-U. S.) of 865 airplanes was divided between two assumed producers (865 ÷ 2 = 432 EA.) and then rounded down to a conservative estimate of 400 STOL airplanes per producer.

APPENDIX 7.3

COMPUTATIONAL PROCEDURE FOR INDIRECT OPERATING COSTS

SYSTEM EXPENSE

= Direct Maintenance Labor x Baseline System Expense Factor (K_1) x STOL Adjustment Factor (K_A)

LOCAL EXPENSE

= (Takeoff Gross Weight ÷ 1000) x Number of Departures x Baseline Local Expense Factor (K_2) x STOL Adjustment Factor (K_B)

AIRPLANE CONTROL EXPENSE

= Number of Departures x Baseline Airplane Control Expense Factor (K_3) x STOL Adjustment Factor (K_C)

CABIN ATTENDANT EXPENSE

= Cabin Attendant Block Hours x Baseline Cabin Attendant Expense Factor (K_4) x STOL Adjustment Factor (K_D)

FOOD AND BEVERAGE EXPENSE

= Passenger Block Hours x Baseline Food and Beverage Expense Factor (K_5) x STOL Adjustment Factor (K_E)

PASSENGER HANDLING EXPENSE

= Passengers Enplaned x Baseline Passenger Handling Expense Factor (K_6) x STOL Adjustment Factor (K_F)

CARGO HANDLING EXPENSE

= Total Tons Carried x Baseline Cargo Handling Expense Factor (K_7) x STOL Adjustment Factor (K_G)

OTHER PASSENGER SERVICES EXPENSE

= Revenue Passenger Miles x Baseline Other Passenger Service Expense Factor (K_8) x STOL Adjustment Factor (K_H)

FREIGHT COMMISSIONS/ADVERTISING EXPENSE

= Revenue Freight Ton-Miles x Baseline Freight Comm/Adver Expense Factor (K_9) x STOL Adjustment Factor (K_I)

GENERAL AND ADMINISTRATIVE EXPENSE

- [IOC x (DOC - Depreciation Apl., GPE and Insurance) x STOL Adjustment Factor (K_J)] x Baseline General and Administrative Expense Factor (K_{10})

7.4 FACTORS AND CONSTANTS

7.4.1	Baseline System Expense Factor (K_1), Dollars	0.54
7.4.2	Baseline Local Expense Factor (K_2), Dollars	1.43
7.4.3	Baseline Airplane Control Expense Factor (K_3), Dollars	20.66
7.4.4	Baseline Cabin Attendant Expense Factor (K_4), Dollars Per Hour	20.00
7.4.5	Baseline Food and Beverage Expense Factor (K_5) Dollars Passenger Block Hour	0.20
7.4.6	Baseline Passenger Handling Expense Factor (K_6), Dollars	3.65
7.4.7	Baseline Cargo Handling Expense Factor (K_7), Dollars	70.43
7.4.8	Baseline Other Passenger Services Expense Factor (K_8), Dollars	0.0044
7.4.9	Baseline Freight Freight Commissions and Advertising Expense Factor (K_9), Dollars	0.0086
7.4.10	General and Administrative Expense Factor (K_{10}), Dollars	0.06
7.4.11	STOL System Expense Adjust Factor (K_A)	0.76
7.4.12	STOL Local Expense Adjustment Factor (K_B)	1.00
7.4.13	STOL Airplane Control Expense Adjustment Factor (K_C)	0.80
7.4.14	STOL Cabin Attendant Expense Adjustment Factor (K_D)	1.00
7.4.15	STOL Food and Beverage Expense Adjustment Factor (K_E)	1.00
7.4.16	STOL Passenger Handling Expense Adjustment Factor (K_F)	1.00
7.4.17	STOL Cargo Handling Expense Adjustment Factor (K_G)	1.00
7.4.18	STOL Other Passenger Service Expense Adjustment Factor (K_H)	1.00
7.4.19	STOL Freight Comm/Adver. Expense Adjustment Factor (K_I)	1.00

7.4.20	STOL General and Administrative Expense Adjustment Factor (K_J)	1.00
7.4.21	Number of Flight Crew Personnel Per Airplane	3
7.4.22	Labor Rate for DOC Computations, Dollars Per man-hour (Modified from ATA Value at $4.00 Per Man-Hour)	6.00
7.4.23	Annual Utilization, Hours Per Airplane Per Year Design Mission	2500
7.4.24	Block Time Minus Flight Time, Minutes - Phase I (Modified from ATA Value at 21 Minutes)	10
7.4.25	Crew Cost Increase from 1967 ATA DOC Method, Percent	40
7.4.26	Fuel Cost, Dollars Per U.S. Gallon (Modified from 1967 ATA Method at $.096 Per U.S. Gallon)	0.115
7.4.27	Ground Time for Deriving Block Fuel, Minutes Phase I	6
7.4.28	Air Maneuver Time for Deriving Block Fuel, Minutes - Phase I	4
7.4.29	1972 Maintenance Flight Hour Costs as a Function of 1967 ATA DOC Method, Percent	75
7.4.30	1972 Maintenance Flight Cycle Costs as a Function of 1967 ATA DOC Method, Percent	75
7.4.31	Depreciation Schedule to Zero Residual Values, Years	12
7.4.32	Engine Spares Factor as a Function of Engine Price, Percent (Modified from 1967 ATA DOC Method at 40 Percent) - Design Mission	25
7.4.33	Passenger Load Factor for Sizing Mission Profile at 575 st.mi. (926 km), Percent	60
7.4.34	Start-Up Cost Factor, Dollars Per Seat	500
7.4.35	Ground Support Equipment as a Function of Airplane Price, Percent - Design Mission	5
7.4.36	Predelivery Payment Schedule, Percent	
	24 Months Prior to Delivery	10
	18 Months Prior to Delivery	5
	12 Months Prior to Delivery	5
	6 Months Prior to Delivery	5
	3 Months Prior to Delivery	5

7.4.37	Airframe Spares as a Function of Airframe Price, Percent - Design Mission	10
7.4.38	Nacelle Spares as a Function of Nacelle Price, Percent - Design Mission	10
7.4.39	Ground Support Equipment Spares as a Function of GSE Price, Percent	10
7.4.40	Depreciable Life for ROI Computation, Years	7
7.4.41	Depreciable Residual Value, Percent	5
7.4.42	Depreciation Method for all Equipment, Acceleration Rate	2
7.4.43	Capitalized Interest Rate, Percent	6
7.4.44	Income Tax Rate, Percent	48
7.4.45	Airplane Resale Value as a Function of Initial Purchase Price, Percent	10
7.4.46	Federal Ticket Tax, Percent	8
7.4.47	Profit Level for Cost Generated Fares as a Function of Total Operating Cost, Percent	10
7.4.48	CAB Fixed Station Cost, Dollars - Phase I Fare	9
7.4.49	CAB Rate Per Mile up to 500,st.mi., Dollars (in Effect During Phase I)	.06
7.4.50	CAB Rate Per Mile 501 to 1000 st.mi., Dollars (in Effect During Phase I)	.056
7.4.51	Estimated California Intra-state Fare Fixed Cost, Dollars	4.80
7.4.52	Estimated California Intra-state Fare Rate Per Statute Mile, Dollars	.04047
7.4.53	Variable Design Passenger Capacity for Phase I, Quantity	50 100 200
7.4.54	Variable Design Field Lengths for Phase I, ft(m)	1500(457) 2000(610) 3000(914)

7.4.55	Variable Design Cruise Mach Number for Phase I	.70 .75 .80
7.4.56	CAB Jet Coach Fare for 575 st.mi. (926 km), Dollars (with Fed. Tax)	
	Phase I	48
	Phase II	51
7.4.57	Variable Fare Multiples of Jet Coach Fare for Phase I	1.00 1.25 1.50
7.4.58	Fixed Sizing Mission Range, st.mi. (km)	575 (926)
7.4.59	Cabin Attendant-to-Available Passenger Seat Ratio	1:50

7.5 Airline Financial Simulation Program

7.5.1 Introduction. - One of the most important divisions of any modern enterprise is financial management. Among its principal functions are to describe an operating plan in terms of financial language and to measure the impact of the operating plan on the financial health of the organization.

For an airline, an operating plan usually originates from such areas as *traffic forecasting*, *equipment requirements*, *scheduling*, *engineering operating regulations*, etc., which are generally non-financial in nature. These non-financial aspects of management coupled with certain financial policies are translated into such terms as revenues, costs, taxes, profits, cash flow, assets, liabilities, etc. and then summarized in the form of financial statements such as income statements, balance sheets and statements of sources and applications of funds. The financial statements are in turn used as the basis to evaluate the operating plan.

The Airline Financial Simulation Program is designed to provide such a translating tool. It duplicates generally accepted accounting procedures, operating regulations, tax laws, etc., to process the input values from non-financial as well as financial divisions and to produce detailed tabulation of future operating and financial data along with forecast financial statements.

7.5.1.1 A financial planning tool. - The use of the Financial Simulation Program as a financial planning tool stems from its ability to show:

- The airline's projected net profit position
- The airline's projected cash flow position
- The airline's projected balance sheet position
- Projected capital requirements and restraints due to debt repayments, aircraft purchases and daily operating needs.

A comparison of inflows and outflows will disclose situations in which heavy outflows will require some type of financing. With the knowledge of approximately how much capital is required and some idea of the debt/equity position of the airline at that particular time, it is possible for management to estimate the consequences of future debt and/or equity financing on the fiscal structure of the airline. The financing alternatives can also be interpreted as to their effects on the net profit position and on various financial ratios.

7.5.1.2 A corporate planning tool. - By rapidly testing different alternatives, it is obvious that the Financial Simulation Program can serve as a decision-making tool for corporate strategy planning. The program is designed to generate various essential items which are derived from and dependent upon the particular fleet mix being used. These items can be used to monitor the airline's short-range plans while also helping to develop its long-range plans. By using different mixes which meet passenger demand, as well as routing and scheduling requirements, the airline can compare the costs generated by such a fleet composition and their effects on capital requirements.

7.5.2 General remarks on the model. - Three annual financial statements are generated by the program:

1. Income Statement (Exhibit 1)
2. Source and Application of Funds (Exhibit 3)
3. Balance Sheet (Exhibits 5A, 5B)

In addition, three separate supplementary schedules are generated. These are:

1. Computation of Tax (Exhibit 2)
2. Operating Ratios (Exhibit 4)
3. Balance Sheet Ratios (Exhibit 6)

With appropriate input, the model is capable of generating most of the accounts in these statements.

The maximum time span of analysis is fifteen years, which can be a combination of historic and projected periods. Historic data is input while most projected values are internally computed. Although no historic data is absolutely required (exceptions are indicated in the following section), it is recommended that at least one year of historic data be provided for reference and comparison.

The model has been designed to be as flexible as possible while not sacrificing accuracy or adherence to accounting principles. Several general features of the model should be mentioned. First, each phase of the computation is independent. Therefore, an analyst can utilize one or more features of the program without using the others. An example of this is that the depreciation or debt calculation can be accomplished, requiring only the significant data. Inputs for all other phases of the model would not be needed. Secondly, the program has the ability to generate financial statements by any fiscal year. No significant change in input data is required to convert from a calendar to fiscal year format. In the instance that the analyst has information that cannot be calculated by the model, two features are provided to increase flexibility. The first is an "override" function. This allows the analyst the capability to override any internally computed account with his own calculations. A variation of this feature is the "additive" capability. This provides the user to add or subtract any amount from any internally computed account. This feature is helpful in cases such as depreciation of ground equipment, where the analyst does not have the cost and depreciation terms of each asset in the program input. In this case, he would estimate the yearly depreciation for these ground equipment items and add the total to the amount of ground depreciation generated by the model.

The program is coded in FORTRAN IV language. It is designed in a manner such that no knowledge of any computer language is required of the user.

7.5.3 Input data. - There are four input data divisions: financial statement data, loan data, aircraft characteristics data and fleet data. A general description of each category follows:

7.5.3.1 Financial statement data. - This set of data contains historic financial statements, projected values of revenue accounts, and general information required to execute the program - such as time period under study, output print options, etc.

Historic values are supplied to provide a frame of reference for the projected data. The use of historic data is not a necessity. One exception should be noted, however. At least one year of historic data is required as a starting point if a balance sheet projection is desired.

7.5.3.2 Loan data. - For each loan outstanding or to be outstanding, the input should include essential information such as the amount of the loan, annual interest rate, issuing data, maturing date, number of months between interest payments, number of months between principal payments, compensating balance, commitment fee and the type of repayment. Options for repayment include computed level principal, annuity in advance, annuity in arrears and input principal schedule. If desired, the loan data can be classified as senior or subordinated debt and summarized accordingly. (See Exhibits 7A-12).

7.5.3.3 Aircraft characteristics data. - This data set is primarily needed to compute various operating results. Information included in Exhibit 13A is necessary if correct depreciation and amortization are to be obtained. Items included are residual percentage (both for book and for tax), depreciable life (for book and for tax), accelerated rate, and preservice cost. If new equipment is to be procured within the analysis period, payment schedules (Exhibit 13G) should be provided. To correctly estimate operating cost other than depreciation and amortization, available seat miles (Exhibit 24) and available ton miles (Exhibit 25), additional information such as that displayed in Exhibits 13B, 13C, 13D is essential. Exhibit 13E shows the hull insurance rate applied to the cost of the aircraft to determine yearly insurance premiums.

7.5.3.4 Fleet data (Exhibit 14). - The data contained in Division (3) is for each type of equipment. Special information pertinent to each piece of equipment - aircraft, ground facilities and other assets, possessed or to be possessed during the analysis period - is provided in the fleet data. Items included are equipment name, fuselage number (if it is an aircraft), order date, delivery data, purchase price, phase-out date (optional), and selling price (optional). If equipment is leased, the annual leasing expenses are input. If equipment is leased to another airline, the period of the lease and the corresponding yearly revenue is input. The model has the ability to distinguish between passenger, cargo, rapid change and convertible aircraft. Engines and spares, ground equipment and intangible items may also be analyzed in the fleet data.

7.5.4 Output and methodology. - In order that users can fully grasp the mechanics of the model, presented in this section is a description of financial statement accounts, methods by which values of these accounts are projected, and the various outputs which are generated. Users are reminded that all historic values of the accounts are input.

7.5.4.1 Income statement (Exhibit 1). - The result of operation is summarized here in terms of four principal groups of accounts. They are: (1) operating revenues, (2) operating expenses, (3) non-operating income and expenses, and (4) tax consideration. Their descriptions follow:

7.5.4.1.1 Operating revenue. - Accounts established in this section include revenues derived from the performance of air transportation and net revenues from services performed incidental to the performance of air transportation. Five accounts are established in the model.

1. Passenger revenue - Revenue from the transportation of scheduled passengers by air, both first class and coach. Projected values are computed as a multiplication of projected revenue passenger miles (kilometers) and projected yields.

2. Cargo revenue - Revenue from scheduled as well as nonscheduled air transportation of mails, express, excess passenger baggage, and other properties. Projected values are also computed from projected traffic and yields.

3. Leasing income - Gross revenues from property and equipment owned or leased which has been leased or subleased to others exclusive of associate companies. Depreciation and other expenses related to leasing should not be recorded here. Projected leasing income from each piece of equipment (or property) is obtained from a schedule of revenues input with each applicable piece of equipment. Total leasing income is the sum of all leasing income from individual property and equipment. In Exhibit 17, negative numbers represent leasing income.

4. Incidental revenues. - Net revenues resulting from services performed in connection with air transportation such as hotel, restaurant and food service, limousine service, interchange sales, general service sales, air cargo services, airline mutual aid receipts and payments, federal subsidies, etc. Projected values are necessary inputs.

5. Other operating revenues. - All revenues associated with air transportation but not provided for in previous accounts. Some examples are charter revenue, reservation cancellation fees, failure to cancel or late cancellation fees, etc. Projected values are necessary inputs.

6. Total operating revenues. - Sum of the above five accounts.

7.5.4.1.2 Operating expenses. - Expenses incurred in the performance of air transportation fall into this group. Projected values can either be input or be computed by the model.

7. Direct operating expense. - Costs incurred in direct association with flying operation such as personnel wages and expenses, fuel costs, aircraft maintenance, etc. Using the input data in the aircraft characteristics (Exhibit 13A and 13B) and fleet deck (Exhibit 14), the model computes annual direct operating cost for each aircraft (Exhibit 15). The total for the entire fleet is then entered into the income statement. Annual direct operating cost for each aircraft is obtained by multiplying the block hour cost by the daily utilization and the number of days of annual utilization. The total shown on the income statement reflects the total cirect costs as shown in Exhibit 15 added to the insurance costs shown in Exhibit 16.

8. Fleet depreciation. - Fleet refers to both airframes and aircraft engines. Two methods of depreciation are built into the model -- one for book purposes, the other for tax purposes. For book purposes, capitalized interest may be imputed on predelivery payments and added to the cash cost and the total will be depreciated by the straight line method. (Exhibit 18).

   If an aircraft is delivered or retired in the middle of the year, the depreciation is apportioned accordingly. (NOTE: Residual value and depreciable life need not be identical for the two methods).

9. Fleet amortization. - Amortization applies to deferred charges attaching to air transportation services which are not payments of recurrent expenses ordinarily requiring expenditures of working capital within one year, such as preoperating expenses,

research and development cost, lease improvement. For tax purposes, these expenses are written off at the time they are incurred. For book purposes, the straight line method is applied. (Exhibit 20).

10. Total direct operating cost. - Sum of accounts 7, 8, and 9.

11. Indirect operating expense. - Indirect operating expense is the combined cost of maintenance and burden on ground equipment, passenger service, aircraft and traffic servicing, promotion and sales, advertising expenses, general and administrative expenses, etc. Since the forecasting of indirect operating costs is treated in various ways by different airlines, no attempt is made to project these costs within the model. Total annual indirect costs must be provided by the analyst.

12. Ground and other depreciation. - Any property and equipment not included in the fleet belong to the account "Ground and others". The methods used to depreciate cash cost and capitalized interest are identical to those used to depreciate flight equipment cost and capitalized interest. (Exhibit 18).

13. Ground and other amortization. - Preoperating expenses, research and development cost, lease improvement, intangibles, etc., which are related to ground and other property. The methods used are identical to those in fleet amortization. (Exhibit 20).

14. Total indirect operating costs. - Sum of accounts 11, 12, and 13.

15. Leasing expenses. - Aircraft, equipment or other property leased from outside of the company are not subjected to depreciation. Their rental is, however, a part of operating costs. Projected leasing expenses are obtained by totaling the yearly costs as provided by the analyst. The program requires a yearly lease cost per piece of equipment. This cost is pro-rated by month for an asset which operated a portion of any year. (Exhibit 17).

16. Total operating expenses. - The sum of total direct operating costs, total indirect operating costs, and leasing expense.

17. Operating income. - This is the surplus from regular operation. It is obtained by subtracting total operating expense from total operating revenue.

Non-operating income and expense. - This classification includes income and expense incident to commercial ventures not inherently related to the performance of the common air transport services, other revenues and expenses attributable to financing or other activities which are extraneous to and not an integral part of air transportation or its incidental services, and special recurrent items of a nonperiodic nature.

18. Interest expense. - Historic values are input. Future interest expenses are calculated from outstanding and planned notes, bonds and revolving credit. Generally speaking, the inputs required -- for each loan outstanding or to be outstanding -- are amount of loan, annual interest rate, term of the loan (beginning and maturing dates), number of months between

interest payments, number of months between principal payments, compensating balance, commitment fee, and the type of repayment. With these inputs, the model generates payment schedules for each individual loan, detailing monthly principal payments, interest payments, remaining balance, useable balance, accrued interest, etc., and then passes the related totals to the financial statements. Options for repayment include level principal, annuity in arrear, annuity in advance, and input principal schedule. (Exhibits 7 - 12).

19. Capitalized interest. - Interest imputed on predelivery payments each year is compounded monthly and debited under the balance sheet account "property and equipment". Concurrently, the same amount is credited to the income statement account "interest expense". The interest rate used to compute capitalized interest is the average interest rate on outstanding debt and is computed from the loan data supplied by the analyst. A schedule of capitalized interest, detailed by equipment and by year, is available from the model (Exhibit 23). The total amount of capitalized interest attributed to each equipment is added to its cash cost and depreciated over its economic life (c.f. account 8 above). This is an optional computation as capitalized interest is usually limited to use by U.S. domestic airlines.

20. Net interest expense. - Obtained by subtracting capitalized interest from interest expense.

21. Book gain on disposal. - Gain on disposal of equipment based on book depreciation. It is obtained by subtracting undepreciated book value (straight line) and unamortized pre-service cost from total proceeds of the sale, with negative results indicating losses. Information related to the sale of equipment is summarized in Exhibit 26.

22. Other non-operating income (net). - All credits and debits of a non-operating character not otherwise provided for belong to this account. Examples of non-operating credits are royalties from patents, gain from the reacquisition and retirement or resale of debt securities, etc. Examples of non-operating debits are fines or penalties imposed by governmental authorities, donations for charitable, social or community welfare purposes, losses on uncollectible, non-operating receivables, etc. Analysts are expected to supply the projected values of this account.

23. Total non-operating income. - Obtained by summing accounts 20, 21, and 22.

24. Net income before tax. - This figure is the sum of operating income and non-operating income.

25. Income tax. - This is a result of net income before tax (account 24) being multiplied by the tax rate as supplied by

26. Net income. - The net income is obtained by subtracting income tax (account 25) from net income before tax.

7.5.4.1.2 Tax consideration. - While the straight line method of depreciation and amortization is most often used for book purposes, it is not uncommon, especially in the case of U.S. domestic airlines, that the declining balance method of depreciation and immediate write-off of prepaid expenses are used for tax purposes. Such differences should be reconciled before accurate taxable income can be computed. Also to be adjusted is capitalized interest, which is neither taxable nor tax deductible. The following items (1 through 4) are set up for such purposes, but are not required in the case where no difference exists between tax and book accounting methods:

1. Net accounting income before tax. - This account is identical to account 24, net income before tax.

2. Excess of tax over book depreciation. - Tax depreciation refers to accelerated depreciation with switchover to straight line of fleet, ground and other equipment. Book depreciation refers to the sum of accounts 8 and 12. Since tax depreciation is used to calculate income tax accrual, the excess of the former over the latter should be deducted from accounting income.

3. Excess of tax over book amortization. - For tax purposes, pre-operating cost, research and development cost and other intangible costs are written-off as they occur. For book purposes, however, they are amortized over an input period of time. Figures in this account are obtained by subtracting yearly book amortization (sum of accounts 9 and 13) from total current outlay of these expenditures.

4. Excess of book over tax gain on disposal. - Gain on disposal is the excess of proceeds over undepreciated book value. If different methods are used for depreciation, tax gain is different from book gain. Book gain on disposal has been recorded in account 21; only the excess of tax over book gain, therefore, should be added to accounting income to obtain taxable income. Equivalently, the excess of book over tax gain should be subtracted from accounting income.

5. Capitalized interest. - Since capitalized interest included in accounts 8, 9, 12, 13 and 21 had been offset by items 2, 3, and 4 under "tax consideration", this figure is identical to that of account 19. Since capitalized interest is usually not allowable for tax purposes, the amount credited to interest expense is added back here.

6. Adjustment for tax computation. - Sum of accounts 2, 3, 4, and 5 under "tax consideration."

7. Taxable income. - Obtained by subtracting account 6 from account 1, under "tax consideration".

8. Federal income tax. - The amount of federal tax due on the taxable income. It is obtained by multiplying taxable income with an input tax rate, the tax rate being variable by year.

9. Investment tax credits applied. - This credit is calculated by the analyst and supplied as input.

10. Federal tax accrual. - This is the amount of tax payable in the current accounting period. It is calculated by subtracting investment tax credit applied from federal income tax.

11. Deferred federal tax. - This is the income tax debit or credit deferred due to imputation of capitalized interest and the different treatments of depreciation and amortization in tax and book accounting. The figure is obtained by multiplying account 6 with the income tax rate.

12. Provision for federal tax. - The sum of federal tax accrual, and deferred federal tax.

In the model, it is assumed that investment tax credit is applied at the earliest date possible for tax purposes, but is amortized over a specified period of time for book purposes. To account for this practice, the following computation (accounts 13 and 15) is required:

13. Investment tax credits applied. - This is the repetition of account 9 (tax consideration).

14. Amortization of investment tax credits. - Investment tax credit earned from capital investment is amortized over a number of years. This account records the amount amortized for the current period. Data must be supplied by the user.

15. Investment tax credit deferred. - This account records investment tax credits of the current period which are transferred to the balance sheet account "deferred investment tax credit". The figure is obtained by subtracting account 14 from account 13.

16. Accounting income tax. - This figure is the sum of accounts 12 and 15. It shows the amount of tax that should have been paid if no measures had ever been taken to postpone tax payments. This account is transferred to account 25 of the income statement.

7.5.4.2 Statement of sources and applications of funds (Exhibit 3). - A statement of sources and applications of funds is a combined summary of income statement and balance sheet with special emphasis on cash flow. In ordinary language, the term funds refers to cash and its equivalents. The model, however, has the capability to define funds also as working capital, which is the excess of current assets over current liabilities. The source and application of funds statement can therefore determine either the cash and equivalent or the working capital available to the airline.

The purpose of the funds statement is to summarize the inflows and outflows of funds. The result is an explanation of the changes in the amount of cash or working capital during the fiscal period. Any transaction that increases cash or working capital is a source of funds. Any transaction that decreases cash or working capital is an application of funds.

The starting point of a statement of sources and applications of funds is net income, (item 1). Non-cash outlays are added to net income and non-cash receipts are subtracted from net income.

The most important non-cash outlay is depreciation and amortization (Item 2), which is the sum of accounts 7, 8, 11 and 12 in the corresponding income statement.

Capitalized interest, if computed, is a non-cash income. But instead of showing this account in the funds statement, the model expresses it as the difference of interest payment (Item 14, an application of funds) and interest expense net (Item 3, a source of funds). Both values are obtained from the income statement.

Two other non-cash outlays from the income statement are deferred income tax (Item 4) and investment tax credit deferred (Item 5).

In order to show the result of property liquidation, proceeds from sale of property (Item 6) is listed as a source of funds. To avoid double-accounting of gain on sale of property in Items 1 and 6, Gain on sale of property (Item 19) is listed as an application of funds.

Four sources of funds are not included in the income statement. First, Proceeds from issuance of long-term debt. This is computed from the debt subroutine by adding total proceeds from issuance of bonds, notes and revolving credit. Second, Proceeds from issuance of common stock (Item 8). Analysts are asked to input the proceeds and the number of shares issued. In the case where the analyst is forecasting cash rather than working capital, an estimate of the increase in current liabilities (Item 9) is required as a source of funds. This represents the change in the costs charged in the income statement but not paid by year end. Item 10 is a general account for all Other sources not accounted for elsewhere.

7.5.4.2.1 New Debt. - Item 11 is entitled New debt. The model has the ability to estimate the amount of outside financing required for operation of the airline.

The analyst supplies details of the type of debt to be assumed (payback period, interest rate, etc.) along with the month of the year in which the loan is to be issued and the multiple in which funds are to be secured. The analyst determines the minimum cash or working capital balance which is required for each year of the forecast period. The model calculates the cash or working capital under the assumption that no financing is secured, and then generates enough new funds to maintain the minimum balances supplied. A new set of financial statements is produced showing the results of all assumed financing. (See Exhibit 12).

Item 12, Total sources of funds, is the total of Items 1 through 11.

7.5.4.2.2 Loan payments, (Item 13), is a major application of funds. It is obtained from the debt subroutine by summing principal payments of notes, bonds, and revolving credit.

7.5.4.2.3 Interest Payments, (Item 14), reflects the actual payments made under debt agreement. Since this value may differ from the interest expense charged to the income statement, the actual cash outflow is determined by adding the interest expense as a source of funds and deducting the interest payment as an application of funds.

7.5.4.2.4 Dividend Payments, (Item 15), may be provided by the analyst or can be specified as a percentage of the net income.

7.5.4.2.5 Predelivery payments, (Item 16), and Delivery payments (Item 17) on purchased aircraft are computed in accordance with purchase agreements made between the airline and the aircraft manufacturer. Back-up schedules listing predelivery and delivery payments by individual aircraft can be obtained from the model. (Exhibits 21,22).

7.5.4.2.6 Ground property and facilities, (Item 18), includes progress payments and final payment on equipment other than aircraft. These payments constitute part of the back-up schedules mentioned above. They are applications of funds.

7.5.4.2.7 Increase in deferred charges, (Item 20), is simply the sum of pre-service cost, research and development cost and other intangible cost incurred each year. Amortization of these accounts is included in Item 2.

In the instance of computing cash balances, the analyst must account for differences in revenues credited to the income statement but not yet received. Item 21, Increase in non-cash current assets, provides for this reconciliation as does Item 9 in the sources of funds.

Although Change in maturing long term debt is neither a non-cash outlay nor a non-cash income, it affects the amount of working capital while negative changes increase working capital. When the model is designated to estimate working capital, values are computed from the debt subroutine by subtracting debts in a given year from those due in the following year.

7.5.4.2.8 Other Applications. - All Other applications of working capital not provided above are included in Item 22.

7.5.4.2.9 Total application of funds. - This is identified as Item 23.

7.5.4.2.10 Changes in cash (or working capital) (Item 24). - Is the excess total sources of funds over total application of funds.

7.5.4.2.11 Balance available at end of year (Item 25), - is obtained by adding changes in cash or working capital of the current year to the balance available at the end of the previous year.

7.5.4.3 Operating ratios. - In order to aid the user in the analysis of the results of the financial simulation program, a set of operating ratios (Exhibit 4) is generated. This statement provides the analyst with key relationships which may be used to interpret the results of the model.

Item 1 is the Revenue passenger miles (kilometers) used internally in the model to compute passenger revenue. Available seat miles (kilometers) (Item 2) are computed from the fleet characteristics and operating fleet. The load factor (Item 3) is the ratio of revenue passenger miles to available seat miles.

The Passenger yield (Item 4) is the average revenue yield per revenue passenger mile used to compute passenger revenue. Because of the fact that yields may vary within a passenger system, the model has several alternatives in the area of yields and revenue computation. If desired, the analyst may provide the program with any two of the following items and the third will be computed:

a) Passenger revenue

b) Revenue passenger miles

c) Passenger yield

The Breakeven load factor (Item 5) is the percentage of the available seat miles which must be sold to produce zero net income before tax. The computation is:

$$\frac{\dfrac{\text{Total Expenses (Operating + Non-operating) - Non-passenger Revenue}}{\text{Passenger Yield}}}{\text{Available Seat Miles}}$$

The total direct operating costs by aircraft type are related to the available seat miles (kilometers) generated by that aircraft type. The Direct operating cost per ASM (ASK) (Item 6) includes crew, fuel, oil, maintenance, burden, hull insurance, depreciation and lease costs for each aircraft type.

Items 7, 8, 9, 10 are percentage relationships of major income statement accounts.

Items 11 through 18 relate the major divisions of the income statement to capacity offered to produce an income statement on a revenue and cost per available ton mile (kilometer) basis.

It should be noted that "direct operating costs" as referred to above is defined as "total direct operating cost" plus "leasing expense", Line 10 plus Line 15 of the income statement.

7.5.4.4 Balance Sheet (Exhibit 5A, 5B). - The balance sheet summarizes the financial position of the airline at the end of each year of the forecast period.

All values required for the following balance sheet accounts are computed by the model except those noted as requiring input by the analyst.

7.5.4.4.1 Current assets.

1. Cash and equivalent include cash, marketable securities and liquid deposits.

2. Notes and accounts receivable include any accounts which are due to be received within one year.

3. Other current assets include inventories, short-term prepayments, and any other current assets and must be supplied by the analyst.

4. Total current assets is the sum of Items 1, 2, and 3.

Investments and Special Funds

5. Subsidiaries refers to investment in associated companies, advances to non-transport divisions, etc. All projected values must be supplied by the analyst.

6. Other investments and receivables includes any long-term deposits or investments with non-associated companies. (Analyst supplied).

7. Pre-delivery payments is the total of funds on deposit with manufacturers for the purchase of new equipment.

8. Other special funds include funds for self insurance and any other unspecified funds. (Analyst supplied).

9. Total investment and special funds is the total of Items 5, 6, 7 and 8.

7.5.4.4.2 Property and equipment

10. Flight equipment refers to the original cost of aircraft, engines and spare parts.

11. Accumulated depreciation is the cumulative charges to depreciation for flight equipment.

12. Flight equipment net is cost less depreciation (Item 10 minus Item 11).

13-15. The description of these accounts is identical to Items 10-12, but for ground equipment and other assets, including land.

16. Construction in progress is the amount of funds invested in new construction until the asset is operational. When the construction is completed, the account is transferred to "Other property and equipment".

17. Total property and equipment is the sum of Items 12, 15, and 16.

7.5.4.4.3 Deferred charges

18. The Deferred charges account should include unamortized development and pre-operating costs, long term prepayments and any other deferred charges.

19. Total assets is the sum of Items 4, 9, 17 and 18.

7.5.4.4.4 Current liabilities

20. Notes and accounts payable include all debts to trade and notes due within one year.

21. The Current maturity of long-term debt is that portion of outstanding debt which is due within one year.

22. Accrued interest is the amount of interest on debt accrued but not paid.

23. Other current liabilities includes any accounts not covered in Items 20-22. The analyst is expected to supply the projected values for this account.

24. Total current liabilities is the sum of Items 20-23.

7.5.4.4.5 Non-current liabilities

25. Senior debt is the long term portion of debt designated as senior,

26. Subordinated debt is the long term portion of debt designated as subordinate to senior debt.

27. New debt is the designation for the amount of indebtedness determined by the model to fulfil minimum cash or working capital requirements as defined by the analyst.

28. Other non-current liabilities refers to all other non-current accounts not covered in 25-27 above. These values are supplied by the analyst.

29. Total non-current liabilities is the sum of items 25 through 28.

7.5.4.4.6 Deferred credits

30. Deferred income tax is the cumulative balance of the differences in tax accruals arising from differences in accounting procedures for book and tax purposes.

31. Investment tax credit includes tax credits utilized as reduction of tax liabilities when the airline exercises the option to defer such credits for amortization over the life of the related equipment.

32. Other deferred credits should include deferred credits not included in 30 and 31. These values must be provided by the analyst.

33. Total deferred credits is the sum of Items 30, 31, and 32.

34. Total liabilities is the sum of Items 24, 29, and 33.

7.5.4.4.7 Stockholders' equity

35. Capital stock and capital surplus refers to the total proceeds (par value plus paid in capital) of common and preferred stock.

36. Cost of treasury stock is the cost to the airline for purchase of treasury stock. These values are supplied by the analyst.

37. Paid in capital is capital stock and capital surplus less the cost of treasury stock.

38. Retained earnings is the cumulative profit or loss of the airline less dividends paid.

39. Total stockholders' equity is the total of items 35, 36, 37, and 38.

40. Total liability and equity is the total of Items 34 and 39.

7.5.4.4.8 Balance sheet ratios (Exhibit 6). - The analysis of a balance sheet is a complex undertaking. In order to facilitate this procedure, several ratios have been included in the output of the financial simulation program. Intended to aid the analyst in the evaluation of the forecast. The ratios are divided into two caregories: Financial position ratios and Productivity ratios. A brief description of each ratio follows:

7.5.4.4.8.1 Financial position

1. Current ratio = Current assets/current liabilities. This ratio indicates the company's ability to meet current obligations.

2. Total capital to total liabilities - Stockholders' equity/ liabilities. The relationship of ownership between stockholders' and creditors is measured by this ratio.

3. Total plant and equipment to total long term debt is a relationship designed to indicate the protection available to creditors in terms of the value of assets pledged as collateral.

4. Total capital to total plant and equipment indicates the stockholders' contribution to the cost of assets.

5. Debt to equity. This is total outstanding debt as related to stockholders' equity in the classical interpretation.

6. Senior debt to total effective tangible net worth. The ratio indicated here is a modification of the usual debt to equity ratio. Senior debt is defined as:

    Total debt less subordinated debt plus capitalized leases.

   Total effective tangible net worth is defined as:

    Stockholders' equity plus subordinated debt less deferred charges.

7.5.4.4.8.2 Productivity ratios

7. Rate of return on investment. This is an estimate of rate of return as defined by the Civil Aeronautics Board. Since the information contained in the program is not as detailed as that available to the CAB, this can only be regarded as an estimation.

8. Sales to assets measures the productivity of assets in terms of revenue generation.

9. The fixed asset turnover measures sales as a percentage of plant and equipment

10. The Asset productivity rate is the relationship of net income to total assets.

11. Return on stockholders' equity. This ratio is the net income as a percentage of total stockholders' equity.

12. Times interest earned is an indication of the firm's ability to meet its interest payments on borrowed capital.

13. Times debt service covered measures the company's ability to pay principal and interest out of the cash throw-off.

14. The Day's expenses in working capital is designed to estimate the number of days an airline might operate on funds available from working capital.

15. Working capital is the excess (deficiency) of current assets over current liabilities.

16. The Adjusted working capital value does not include the current portion of long term debt as a current liability.

17. Earnings per share is the net income divided by the number of shares of common stock outstanding.

MCDCNNELL DOUGLAS CORPORATICN

AIRLINE FINANCIAL SIMULATICN PRCGRAM

** ABC AIRLINES **

INCOME STATEMENT ** AEC AIRLINES ** EXHIBIT 1

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74
1 PASSENGER REVENUE	63.350	69.680	76.648	85.789	93.062	101.227
2 CARGO REVENUE	5.060	5.570	6.130	6.960	7.450	8.120
3 LEASING INCOME	0.0	0.0	0.0	0.0	0.475	0.920
4 INCIDENTALS	0.750	1.000	1.520	1.810	1.920	2.050
5 OTHER OPERATING REVENUE	1.000	1.550	2.000	3.000	3.500	3.750
6 TOTAL OPERATING REVENUE	70.160	77.800	86.298	97.459	106.427	116.047
7 DIRECT OPERATING EXPENSE	24.590	27.020	33.450	34.981	40.151	39.547
8 FLEET DEPRECIATION	5.919	6.757	6.396	6.896	7.562	7.558
9 AMORTIZATION - FLEET	0.215	0.238	0.227	0.135	0.183	0.205
10 TOTAL DIRECT OPERATING COSTS	30.724	34.015	40.573	42.012	47.896	47.310
11 INDIRECT OPERATING EXPENSES	27.692	30.430	33.440	37.440	40.620	44.200
12 GROUND AND OTHER DEPRECIATION	0.710	0.810	0.0	0.0	0.060	0.100
13 AMORTIZATION - GROUND AND OTHER	0.0	0.0	2.000	2.000	0.0	0.0
14 TOTAL INDIRECT OPERATING COSTS	28.402	31.240	35.440	39.440	40.680	44.300
15 LEASING EXPENSE	0.0	0.0	0.780	0.780	2.833	3.250
16 TOTAL OPERATING EXPENSES	59.126	65.255	76.793	82.232	91.409	94.860
17 OPERATING INCOME	10.034	12.545	9.505	15.227	15.018	21.187
18 INTEREST EXPENSE	1.615	2.941	2.880	2.820	2.574	2.570
19 LESS CAPITALIZED INTEREST	0.180	0.200	0.551	1.148	0.944	0.861
20 INTEREST EXPENSE NET	1.435	2.741	2.329	1.672	1.630	1.709
21 BOOK GAIN ON DISPOSAL	0.100	0.0	0.0	0.0	-1.197	-0.963
22 OTHER NON-OPERATING INCOME (NET)	0.0	0.0	0.0	0.0	0.0	0.0
23 TOTAL NON-OPERATING INCOME	-1.535	-2.741	-2.329	-1.672	-2.828	-2.673
24 NET INCOME BEFORE TAX	8.499	9.804	7.176	13.555	12.190	18.515
25 INCOME TAX (PER COMPUTATION OF TAX)	0.0	0.0	3.444	6.506	5.851	8.887
26 NET INCOME	4.419	5.099	3.731	7.049	6.339	9.628

INCOME STATEMENT (COMPUTATION OF TAX) ** ABC AIRLINES ** EXHIBIT 2

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74
1 NET ACCOUNTING INCOME BEFORE TAX	8.499	9.804	7.176	13.555	12.190	18.515
2 EXCESS OF TAX OVER BOOK DEPRECIATION	0.0	0.0	4.689	2.117	3.694	6.217
3 EXCESS OF TAX OVER BOOK AMORTIZATION	0.0	0.0	-2.227	-2.135	0.417	0.095
4 EXCESS OF BOOK OVER TAX GAIN ON DISPOSAL	0.0	0.0	0.0	0.0	-7.181	-3.242
5 CAPITALIZED INTEREST	0.0	0.0	0.551	1.148	0.944	0.861
6 ADJUSTMENT FOR TAX COMPUTATION	0.0	0.0	3.013	1.130	-2.126	3.931
7 TAXABLE INCOME	0.0	0.0	4.162	12.425	14.315	14.584
8 FEDERAL INCOME TAX	0.0	0.0	1.998	5.964	6.871	7.000
9 INVESTMENT TAX CREDIT APPLIED	0.0	0.0	0.0	0.0	0.0	0.0
10 FEDERAL TAX ACCRUAL	0.0	0.0	1.998	5.964	6.871	7.000
11 DEFERRED FEDERAL TAX	0.0	0.0	1.446	0.542	-1.020	1.887
12 PROVISION FOR FEDERAL TAX	4.080	4.705	3.444	6.506	5.851	8.887
13 INVESTMENT TAX CREDIT APPLIED	0.0	0.0	0.0	0.0	0.0	0.0
14 AMORTIZATION OF INVESTMENT TAX CREDIT	0.0	0.0	0.0	0.0	0.0	0.0
15 INVESTMENT TAX CREDIT DEFERRED	0.0	0.0	0.0	0.0	0.0	0.0
16 ACCOUNTING INCOME TAX	0.0	0.0	3.444	6.506	5.851	8.887

SOURCES AND APPLICATIONS OF FUNDS ** ABC AIRLINES ** EXHIBIT 3

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74
SOURCES OF FUNDS						
1 NET INCOME	4.419	5.099	3.731	7.049	6.339	9.628
2 DEPRECIATION AND AMORTIZATION	6.844	7.805	9.123	9.031	7.805	7.863
3 INTEREST EXPENSE NET	1.435	2.741	2.329	1.672	1.630	1.709
4 DEFERRED FEDERAL INCOME TAX	0.0	0.0	1.446	0.542	-1.020	1.887
5 INVESTMENT TAX CREDITS DEFERRED	0.0	0.0	0.0	0.0	0.0	0.0
6 PROCEEDS FROM SALE OF PROPERTY	0.0	0.0	0.0	0.0	28.749	3.000
7 PROCEEDS FROM ISSUANCE OF LONG-TERM DEBT	7.000	7.100	0.0	0.0	0.0	0.0
8 PROCEEDS FROM ISSUANCE OF COMMON STOCKS	0.0	0.0	0.0	0.0	0.0	0.0
9 INCREASE IN CURRENT LIABILITIES	0.520	0.831	0.930	0.491	0.937	0.483
10 OTHER SOURCES	0.0	0.0	0.0	0.0	0.0	0.0
11 NEW DEBT	0.0	0.0	8.000	6.000	3.000	9.000
12 TOTAL SOURCES OF FUNDS	20.218	23.576	25.560	24.785	47.439	33.570
APPLICATIONS OF FUNDS						
13 LOAN REPAYMENTS	7.436	11.409	8.793	9.474	7.752	6.159
14 INTEREST PAYMENTS	2.978	2.892	2.960	2.899	2.635	2.611
15 DIVIDEND PAYMENTS	1.100	1.100	1.100	1.800	1.800	1.800
16 PREDELIVERY PAYMENTS	0.0	0.0	11.275	9.450	5.160	6.185
17 DELIVERY PAYMENTS	0.0	13.800	0.0	0.0	29.475	16.740
18 GROUND PROPERTY AND FACILITIES	0.0	0.0	0.0	0.0	0.600	0.400
19 GAIN ON SALE OF PROPERTY	0.100	0.0	0.0	0.0	-1.197	-0.963
20 INCREASE IN DEFERRED CHARGES	0.0	0.225	0.0	0.0	0.600	0.300
21 INCREASE IN NON-CASH CURRENT ASSETS	0.200	0.179	0.538	0.465	0.974	0.601
22 OTHER APPLICATIONS	0.0	0.0	0.0	0.0	0.0	0.075
23 TOTAL APPLICATION OF FUNDS	13.814	29.605	24.667	24.088	47.798	33.907
24 CHANGE IN CASH	6.404	-6.029	0.893	0.697	-0.359	-0.338
25 BALANCE AVAILABLE AT END OF YEAR	10.350	4.321	5.214	5.911	5.553	5.215

OPERATING RATIOS

** ABC AIRLINES **

EXHIBIT 4

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74
1 REVENUE PASSENGER MILES (MIL)	1173.0	1290.0	1393.6	1559.8	1692.4	1840.5
2 AVAILABLE SEAT MILES (MIL)	2444.0	2850.0	2902.9	2943.1	3463.9	3324.3
3 LOAD FACTOR (PCT)	47.995	45.263	48.007	52.998	48.858	55.365
4 PASSENGER YIELD (CENTS/RPM)	5.401	5.402	5.500	5.500	5.500	5.500
5 BREAK-EVEN LOAD FACTOR (PCT) -TOTAL EXP.	41.556	38.895	43.513	44.624	42.459	45.239
6 DOC / ASM BY AIRCRAFT TYPE (CENTS/ASM)						
B707-100	0.0	0.0	1.488	1.533	1.546	1.585
DC-9-10	0.0	0.0	2.151	2.216	2.227	2.296
B727-200	0.0	0.0	1.325	1.338	1.318	1.321
DC-8-61	0.0	0.0	1.095	1.118	1.144	1.188
DC-10-30	0.0	0.0	0.0	0.0	1.321	1.250
TOTAL DOC / TOTAL ASM	0.242	0.222	1.364	1.395	1.385	1.338
7 NET INCOME / TOTAL REVENUE (PCT)	6.298	6.554	4.324	7.232	5.956	8.296
8 DOC / TOTAL REVENUE (PCT)	43.791	43.721	47.919	43.908	47.666	43.569
9 IOC / TOTAL REVENUE (PCT)	40.482	40.154	41.067	40.468	38.223	38.174
10 IOC / DOC (PCT)	92.442	91.842	85.701	92.167	80.190	87.618
11 REVENUE / ATM (CENTS/ATM)	0.0	0.0	0.181	0.202	0.190	0.184
12 CASH COSTS / ATM	0.0	0.0	0.142	0.152	0.141	0.138
13 DEPRECIATION AND AMORTIZATION / ATM	0.0	0.0	0.019	0.019	0.013	0.012
14 TOTAL OPERATING EXPENSE / ATM	0.0	0.0	0.161	0.170	0.154	0.150
15 OPERATING INCOME / ATM	0.0	0.0	0.020	0.032	0.025	0.034
16 NON-OPERATING EXPENSE / ATM	0.0	0.0	0.005	0.003	0.005	0.004
17 TAX / ATM	0.0	0.0	0.007	0.013	0.010	0.014
18 NET INCOME / ATM	0.0	0.0	0.008	0.015	0.011	0.015

BALANCE SHEET ** ABC AIRLINES ** EXHIBIT 5A

	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74
CURRENT ASSETS						
1 CASH AND EQUIVALENTS	10.350	4.321	5.214	5.911	5.553	5.215
2 NOTES AND ACCOUNTS RECEIVABLE	2.920	3.249	3.596	4.061	4.434	4.835
3 OTHER CURRENT ASSETS	7.400	4.018	4.200	4.200	4.800	5.000
4 TOTAL CURRENT ASSETS	20.670	11.579	13.010	14.172	14.787	15.050
INVESTMENT AND SPECIAL FUNDS						
5 SUBSIDIARIES	0.0	0.0	0.0	0.0	0.0	0.0
6 OTHER INVESTMENT AND RECEIVABLES	0.551	0.651	0.600	0.500	0.500	0.500
7 PREDELIVERY PAYMENTS	0.0	0.0	11.826	22.424	12.957	11.816
8 OTHER SPECIAL FUNDS	0.0	0.0	0.0	0.0	0.0	0.0
9 TOTAL INVESTMENT AND SPECIAL FUNDS	0.551	0.651	12.426	22.924	13.457	12.316
PROPERTY AND EQUIPMENT						
10 FLIGHT EQUIPMENT	88.200	102.000	102.000	102.000	108.847	125.499
11 LESS ACCUMULATED DEPRECIATION	13.187	19.944	26.840	33.736	33.046	36.218
12 NET	75.013	82.056	75.160	68.264	75.801	39.281
13 OTHER PROPERTY AND EQUIPMENT	5.400	5.400	5.400	5.400	6.000	6.400
14 LESS ACCUMULATED DEPRECIATION	4.590	5.400	5.400	5.400	5.460	5.560
15 NET	0.810	0.0	0.0	0.0	0.540	0.840
16 CONSTRUCTION WORK IN PROGRESS	0.0	0.0	0.0	0.0	0.0	0.0
17 TOTAL PROPERTY AND EQUIPMENT	75.823	82.056	75.160	68.264	76.341	90.121
DEFERRED CHARGES						
18 DEFERRED CHARGES	4.757	4.519	2.292	0.157	0.574	0.669
19 TOTAL ASSETS	101.801	93.805	102.888	105.517	105.160	118.157
	********	********	********	********	********	********

BALANCE SHEET (CONTINUED) ** ABC AIRLINES ** EXHIBIT 5B

	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74
CURRENT LIABILITIES						
20 NOTES AND ACCOUNTS PAYABLE	4.356	4.787	5.639	6.100	6.967	7.250
21 CURRENT MATURITY OF LONG-TERM DEBT	11.409	8.393	9.174	7.602	5.709	6.585
22 ACCRUED INTEREST	0.444	0.363	0.283	0.203	0.143	0.102
23 OTHER CURRENT LIABILITIES	1.022	1.422	1.500	1.530	1.600	1.800
	--------	--------	--------	--------	--------	--------
24 TOTAL CURRENT LIABILITIES	17.231	14.965	16.596	15.435	14.419	15.737
NON-CURRENT LIABILITIES						
25 SENIOR DEBT	24.084	20.699	14.333	10.140	8.140	6.165
26 SUBORDINATED DEBT	16.055	14.144	12.135	10.127	8.117	6.107
27 NEW DEBT	0.0	0.0	6.800	11.100	12.250	18.200
28 OTHER NON-CURRENT LIABILITIES	1.422	1.930	1.791	1.691	1.690	1.590
	--------	--------	--------	--------	--------	--------
29 TOTAL NON-CURRENT LIABILITIES	41.561	36.773	35.059	33.057	30.198	32.063
DEFERRED CREDITS						
30 DEFERRED INCOME TAX	5.660	5.660	7.106	7.649	6.628	8.515
31 INVESTMENT TAX CREDIT	0.0	0.0	0.0	0.0	0.0	0.0
32 OTHER DEFERRED CREDITS	0.552	0.611	0.700	0.700	0.700	0.800
	--------	--------	--------	--------	--------	--------
33 TOTAL DEFERRED CREDITS	6.212	6.271	7.806	8.349	7.328	9.315
34 TOTAL LIABILITIES	69.398	58.009	59.461	56.841	51.945	57.115
	********	********	********	********	********	********
STOCKHOLDERS EQUITY						
35 CAPITAL STOCK AND CAPITAL SURPLUS	19.112	19.112	19.112	19.112	19.112	19.112
36 LESS COST OF TREASURY STOCK	0.0	0.0	0.0	0.0	0.0	0.0
37 PAID-IN CAPITAL	19.112	19.112	19.112	19.112	19.112	19.112
38 RETAINED EARNINGS	17.685	21.684	24.315	29.564	34.103	41.930
	--------	--------	--------	--------	--------	--------
39 TOTAL STOCKHOLDERS EQUITY	36.797	40.796	43.427	48.676	53.215	61.042
	********	********	********	********	********	********
40 TOTAL LIABILITY AND EQUITY	101.801	98.805	102.388	105.517	105.160	119.157
	********	********	********	********	********	********

EXHIBIT 6

BALANCE SHEET RATIOS

** ABC AIRLINES **

	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74
FINANCIAL POSITION						
1 CURRENT RATIO	1.200	0.774	0.784	0.918	1.025	0.956
2 TOTAL CAPITAL / TOTAL LIABILITIES	0.530	0.703	0.730	0.956	1.024	1.069
3 TOTAL PLANT AND EQUIPMENT (NET) / TOTAL LONG TERM DEBT	1.839	2.355	2.259	2.176	2.678	2.957
4 TOTAL CAPITAL / TOTAL PLANT AND EQUIPMENT (NET)	0.485	0.497	0.578	0.713	0.697	0.677
5 DEBT / EQUITY	1.401	1.060	0.977	0.801	0.643	0.607
6 SENIOR DEBT / TOTAL EFFECTIVE TANGIBLE NET WORTH	0.669	0.517	0.512	0.442	0.384	0.423
PRODUCTIVITY						
7 RATE OF RETURN ON INVESTMENT (PCT)	18.657	9.835	8.246	13.669	12.111	15.090
8 SALES / ASSETS (ASSET TURNOVER) (PCT)	137.837	77.565	85.573	93.528	101.033	103.931
9 FIXED ASSET TURNOVER (PCT)	185.063	98.556	109.783	135.904	147.197	139.428
10 ASSET PRODUCTIVITY RATE (PCT)	8.682	5.084	3.700	6.764	6.017	9.622
11 RETURN ON STOCKHOLDERS EQUITY (PCT)	24.018	13.143	8.860	15.306	12.442	16.852
12 TIMES INTEREST EARNED	6.263	4.334	3.491	5.807	5.735	8.205
13 TIMES DEBT SERVICE COVERED	1.237	1.108	1.632	2.053	2.173	3.301
14 DAYS EXPENSES IN WORKING CAPITAL	24.009	-21.512	-19.341	-6.299	1.605	-2.881
15 WORKING CAPITAL	3.439	-3.386	-3.586	-1.263	0.368	-0.687
16 ADJUSTED WORKING CAPITAL	14.848	5.007	5.588	6.338	6.077	5.898
17 EARNINGS PER SHARE	0.812	0.937	0.691	1.305	1.174	1.783

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** ABC AIRLINES ** EXHIBIT 7A

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        INSURANCE CO.              (SUBORDINATED)

BEGINNING BALANCE        20555000.
           20555000.  IS CONSTRUED AS A PROCEED IN SOURCES AND APPLICATIONS OF FUNDS STATEMENT
REPAYMENT METHOD
        LEVEL PRINCIPAL -- INPUT AS      50000.
PAYMENTS MADE
        IN ARREARS (AT END OF MONTH)
BEGINNING DATE
        10/68
TOTAL TERM
        120 MONTHS
PRINCIPAL PERIOD
          3 MONTHS
INTEREST PERIOD
          3 MONTHS
INTEREST RATE
        DERIVED FROM INPUT TABLE --
    5.0000  BEGINNING  10/68          5.5000  BEGINNING  10/69          6.0000  BEGINNING  10/70
COMPENSATING BALANCE
         0.0    PCT
```

DATE	PRINCIPAL PAYMENT	INTEREST PAYMENT	TOTAL PAYMENT	OUTSTANDING DEBT	USEABLE AMOUNT	COMPENSATING BALANCE	ACCRUED INTEREST	INTEREST RATE
10/31/68	0.	0.	0.	20555000.	20555000.	0.	95646.	0.0041667
11/30/68	0.	0.	0.	20555000.	20555000.	0.	171292.	0.0041667
12/31/68	500000.	256938.	756937.	20055000.	20055000.	0.	0.	0.0041667
1/31/69	0.	0.	0.	20055000.	20055000.	0.	83562.	0.0041667
2/28/69	0.	0.	0.	20055000.	20055000.	0.	167125.	0.0041667
3/31/69	500000.	250698.	750687.	19555000.	19555000.	0.	0.	0.0041667
4/30/69	0.	0.	0.	19555000.	19555000.	0.	81479.	0.0041667
5/31/69	0.	0.	0.	19555000.	19555000.	0.	162958.	0.0041667
6/30/69	500000.	244438.	744437.	19055000.	19055000.	0.	0.	0.0041667
7/31/69	0.	0.	0.	19055000.	19055000.	0.	79396.	0.0041667
8/31/69	0.	0.	0.	19055000.	19055000.	0.	158792.	0.0041667
9/30/69	500000.	238188.	738187.	18555000.	18555000.	0.	0.	0.0041667
10/31/69	0.	0.	0.	18555000.	18555000.	0.	85044.	0.0045833
11/30/69	0.	0.	0.	18555000.	18555000.	0.	170087.	0.0045833
12/31/69	500000.	255131.	755131.	18055000.	18055000.	0.	0.	0.0045833
1/31/70	0.	0.	0.	18055000.	18055000.	0.	82752.	0.0045833
2/28/70	0.	0.	0.	18055000.	18055000.	0.	165504.	0.0045833
3/31/70	500000.	248256.	748256.	17555000.	17555000.	0.	0.	0.0045833
4/30/70	0.	0.	0.	17555000.	17555000.	0.	80460.	0.0045833
5/31/70	0.	0.	0.	17555000.	17555000.	0.	160921.	0.0045833
6/30/70	500000.	241381.	741381.	17055000.	17055000.	0.	0.	0.0045833
7/31/70	0.	0.	0.	17055000.	17055000.	0.	78169.	0.0045833
8/31/70	0.	0.	0.	17055000.	17055000.	0.	156338.	0.0045833
9/30/70	500000.	234506.	734506.	16555000.	16555000.	0.	0.	0.0045833
10/31/70	0.	0.	0.	16555000.	16555000.	0.	82775.	0.0050000
11/30/70	0.	0.	0.	16555000.	16555000.	0.	165550.	0.0050000
12/31/70	500000.	248325.	748325.	16055000.	16055000.	0.	0.	0.0050000
1/31/71	0.	0.	0.	16055000.	16055000.	0.	80275.	0.0050000
2/28/71	0.	0.	0.	16055000.	16055000.	0.	160550.	0.0050000
3/31/71	500000.	240825.	740825.	15555000.	15555000.	0.	0.	0.0050000
4/30/71	0.	0.	0.	15555000.	15555000.	0.	77775.	0.0050000
5/31/71	0.	0.	0.	15555000.	15555000.	0.	155550.	0.0050000
6/30/71	500000.	233325.	733325.	15055000.	15055000.	0.	0.	0.0050000
7/31/71	0.	0.	0.	15055000.	15055000.	0.	75275.	0.0050000
8/31/71	0.	0.	0.	15055000.	15055000.	0.	150550.	0.0050000
9/30/71	500000.	225825.	725825.	14555000.	14555000.	0.	0.	0.0050000
10/31/71	0.	0.	0.	14555000.	14555000.	0.	72775.	0.0050000
11/30/71	0.	0.	0.	14555000.	14555000.	0.	145550.	0.0050000
12/31/71	500000.	218325.	718325.	14055000.	14055000.	0.	0.	0.0050000
1/31/72	0.	0.	0.	14055000.	14055000.	0.	70275.	0.0050000
2/28/72	0.	0.	0.	14055000.	14055000.	0.	140550.	0.0050000
3/31/72	500000.	210825.	710825.	13555000.	13555000.	0.	0.	0.0050000
4/30/72	0.	0.	0.	13555000.	13555000.	0.	67775.	0.0050000
5/31/72	0.	0.	0.	13555000.	13555000.	0.	135550.	0.0050000
6/30/72	500000.	203325.	703325.	13055000.	13055000.	0.	0.	0.0050000

EXHIBIT 8A

** ABC AIRLINES **

REV. CREDIT (SENIOR)

BEGINNING BALANCE 10000000.

NOT CONSTRUED AS A PROCEED IN SOURCES AND APPLICATIONS OF FUNDS STATEMENT

REPAYMENT METHOD

REVOLVING CREDIT

PAYMENTS MADE

IN ARREARS (AT END OF MONTH)

BEGINNING DATE

1/69

TOTAL TERM

24 MONTHS

INTEREST PERIOD

6 MONTHS

INTEREST RATE

0.2500 PCT OVER PRIME

7.0000 BEGINNING 1/69	7.5000 BEGINNING 4/69	8.5000 BEGINNING 8/69
8.0000 BEGINNING 3/70	7.5000 BEGINNING 9/70	7.2500 BEGINNING 11/70
6.7500 BEGINNING 12/70	6.0000 BEGINNING 1/71	5.7500 BEGINNING 2/71
5.2500 BEGINNING 3/71	5.5000 BEGINNING 4/71	6.0000 BEGINNING 7/71
6.2500 BEGINNING 1/72		

COMPENSATING BALANCE

0.0 PCT

COMMITMENT FEE

0.2500 PCT

DATE	PRINCIPAL PAYMENT	INTEREST PAYMENT	TOTAL PAYMENT	AVAILABLE BALANCE	AMOUNT BORROWED	COMPENSATING BALANCE	ACCRUED INTEREST	INTEREST RATE
1/31/69	0.	0.	0.	10000000.	0.	0.	2083.	0.0060417
2/28/69	-5000000.	0.	-5000000.	5000000.	5000000.	0.	4167.	0.0060417
3/31/69	0.	0.	0.	5000000.	5000000.	0.	35417.	0.0060417
4/30/69	0.	0.	0.	5000000.	5000000.	0.	68750.	0.0064583
5/31/69	0.	0.	0.	5000000.	5000000.	0.	102083.	0.0064583
6/30/69	0.	135417.	135417.	5000000.	5000000.	0.	0.	0.0064583
7/31/69	0.	0.	0.	5000000.	5000000.	0.	33333.	0.0064583
8/31/69	0.	0.	0.	5000000.	5000000.	0.	70833.	0.0072917
9/30/69	-2000000.	0.	-2000000.	3000000.	7000000.	0.	108333.	0.0072917
10/31/69	0.	0.	0.	3000000.	7000000.	0.	160000.	0.0072917
11/30/69	0.	0.	0.	3000000.	7000000.	0.	211667.	0.0072917
12/31/69	0.	263333.	263333.	3000000.	7000000.	0.	0.	0.0072917
1/31/70	0.	0.	0.	3000000.	7000000.	0.	51667.	0.0072917
2/28/70	0.	0.	0.	3000000.	7000000.	0.	103333.	0.0072917
3/31/70	0.	0.	0.	3000000.	7000000.	0.	152083.	0.0068750
4/30/70	4000000.	0.	4000000.	7000000.	3000000.	0.	200833.	0.0068750
5/31/70	0.	0.	0.	7000000.	3000000.	0.	222917.	0.0068750
6/30/70	-7000000.	245000.	-6755000.	0.	10000000.	0.	0.	0.0068750
7/31/70	0.	0.	0.	0.	10000000.	0.	68750.	0.0068750
8/31/70	0.	0.	0.	0.	10000000.	0.	137500.	0.0068750
9/30/70	0.	0.	0.	0.	10000000.	0.	202083.	0.0064583
10/31/70	0.	0.	0.	0.	10000000.	0.	266667.	0.0064583
11/30/70	0.	0.	0.	0.	10000000.	0.	329167.	0.0062500
12/31/70	0.	387500.	387500.	0.	10000000.	0.	0.	0.0058333

** ABC AIRLINES ** EXHIBIT 9A

REV. CR. PAYBACK (SENIOR)

BEGINNING BALANCE 1C000C00.

NCT CCNSTRUEC AS A PROCEED IN SOURCES AND APPLICATICNS OF FUNDS STATEMENT

REPAYMENT METHCD

LEVEL PRINCIPAL -- CCMPUTED

PAYMENTS MACE

IN ARREARS (AT END OF MONTH)

BEGINNING DATE

1/71

TCTAL TERM

120 MCNTHS

PRINCIPAL PERICC

6 MCNTHS

INTEREST PERIOD

6 MCNTHS

INTEREST RATE

8.0CCO PCT

CCMPENSATING BALANCE

C.0 PCT

DATE	PRINCIPAL PAYMENT	INTEREST PAYMENT	TOTAL PAYMENT	OUTSTANDING DEBT	USEABLE AMOUNT	COMPENSATING BALANCE	ACCRUED INTEREST	INTEREST RATE
1/31/71	0.	0.	0.	10000000.	10000000.	0.	66667.	0.0066667
2/28/71	0.	0.	0.	10000000.	10000000.	0.	133333.	0.0066667
3/31/71	0.	0.	0.	10000000.	10000000.	0.	200000.	0.0066667
4/30/71	0.	0.	0.	10000000.	10000000.	0.	266667.	0.0066667
5/31/71	0.	0.	0.	10000000.	10000000.	0.	333333.	0.0066667
6/30/71	500000.	400000.	900000.	9500000.	9500000.	0.	0.	0.0066667
7/31/71	0.	0.	0.	9500000.	9500000.	0.	63333.	0.0066667
8/31/71	0.	0.	0.	9500000.	9500000.	0.	126667.	0.0066667
9/30/71	0.	0.	0.	9500000.	9500000.	0.	190000.	0.0066667
10/31/71	0.	0.	0.	9500000.	9500000.	0.	253333.	0.0066667
11/30/71	0.	0.	0.	9500000.	9500000.	0.	316667.	0.0066667
12/31/71	500000.	380000.	880000.	9000000.	9000000.	0.	0.	0.0066667
1/31/72	0.	0.	0.	9000000.	9000000.	0.	60000.	0.0066667
2/28/72	0.	0.	0.	9000000.	9000000.	0.	120000.	0.0066667
3/31/72	0.	0.	0.	9000000.	9000000.	0.	180000.	0.0066667
4/30/72	0.	0.	0.	9000000.	9000000.	0.	240000.	0.0066667
5/31/72	0.	0.	0.	9000000.	9000000.	0.	300000.	0.0066667
6/30/72	500000.	360000.	860000.	8500000.	8500000.	0.	0.	0.0066667
7/31/72	0.	0.	0.	8500000.	8500000.	0.	56667.	0.0066667
8/31/72	0.	0.	0.	8500000.	8500000.	0.	113333.	0.0066667
9/30/72	0.	0.	0.	8500000.	8500000.	0.	170000.	0.0066667
10/31/72	0.	0.	0.	8500000.	8500000.	0.	226667.	0.0066667
11/30/72	0.	0.	0.	8500000.	8500000.	0.	283333.	0.0066667
12/31/72	500000.	340000.	840000.	8000000.	8000000.	0.	0.	0.0066667
1/31/73	0.	0.	0.	8000000.	8000000.	0.	53333.	0.0066667
2/28/73	0.	0.	0.	8000000.	8000000.	0.	106667.	0.0066667
3/31/73	0.	0.	0.	8000000.	8000000.	0.	160000.	0.0066667
4/30/73	0.	0.	0.	8000000.	8000000.	0.	213333.	0.0066667
5/31/73	0.	0.	0.	8000000.	8000000.	0.	266667.	0.0066667
6/30/73	500000.	320000.	820000.	7500000.	7500000.	0.	0.	0.0066667
7/31/73	0.	0.	0.	7500000.	7500000.	0.	50000.	0.0066667
8/31/73	0.	0.	0.	7500000.	7500000.	0.	100000.	0.0066667
9/30/73	0.	0.	0.	7500000.	7500000.	0.	150000.	0.0066667
10/31/73	0.	0.	0.	7500000.	7500000.	0.	200000.	0.0066667
11/30/73	0.	0.	0.	7500000.	7500000.	0.	250000.	0.0066667
12/31/73	500000.	300000.	800000.	7000000.	7000000.	0.	0.	0.0066667
1/31/74	0.	0.	0.	7000000.	7000000.	0.	46667.	0.0066667
2/28/74	0.	0.	0.	7000000.	7000000.	0.	93333.	0.0066667
3/31/74	0.	0.	0.	7000000.	7000000.	0.	140000.	0.0066667
4/30/74	0.	0.	0.	7000000.	7000000.	0.	186667.	0.0066667
5/31/74	0.	0.	0.	7000000.	7000000.	0.	233333.	0.0066667
6/30/74	500000.	280000.	780000.	6500000.	6500000.	0.	0.	0.0066667
7/31/74	0.	0.	0.	6500000.	6500000.	0.	43333.	0.0066667
8/31/74	0.	0.	0.	6500000.	6500000.	0.	86667.	0.0066667
9/30/74	0.	0.	0.	6500000.	6500000.	0.	130000.	0.0066667

DEBT SUMMARY

** ARC AIRLINES **

EXHIBIT 10

INSURANCE CO. (SUBORDINATED)

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	18055000.	16055000.	14055000.	12055000.	10055000.	8055000.	6055000.	4055000.	2055000.
MATURING	2000000.	2000000.	2000000.	2000000.	2000000.	2000000.	2000000.	2000000.	2055000.
NON-CURRENT	16055000.	14055000.	12055000.	10055000.	8055000.	6055000.	4055000.	2055000.	0.
PRINCIPAL PAYMENTS	2000000.	2000000.	2000000.	2000000.	2000000.	2000000.	2000000.	2000000.	2000000.
INTEREST PAYMENTS	988444.	972469.	918300.	798300.	678300.	558300.	438300.	318300.	198300.
INTEREST EXPENSE	988444.	972469.	918300.	798300.	678300.	558300.	438300.	318300.	198300.
ACCRUED INTEREST	0.	0.	0.	0.	0.	0.	0.	0.	0.

REV. CREDIT (SENIOR)

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	7000000.	10000000.	0.	0.	0.	0.	0.	0.	0.
MATURING	0.	0.	0.	0.	0.	0.	0.	0.	0.
NON-CURRENT	7000000.	0.	0.	0.	0.	0.	0.	0.	0.
PRINCIPAL PAYMENTS	0.	4000000.	0.	0.	0.	0.	0.	0.	0.
INTEREST PAYMENTS	398750.	632500.	0.	0.	0.	0.	0.	0.	0.
INTEREST EXPENSE	398750.	632500.	0.	0.	0.	0.	0.	0.	0.
ACCRUED INTEREST	0.	0.	0.	0.	0.	0.	0.	0.	0.

REV. CR. PAYBACK (SENIOR)

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	0.	0.	9000000.	8000000.	7000000.	6000000.	5000000.	4000000.	3000000.
MATURING	0.	1000000.	1000000.	1000000.	1000000.	1000000.	1000000.	1000000.	1000000.
NON-CURRENT	0.	9000000.	8000000.	7000000.	6000000.	5000000.	4000000.	3000000.	2000000.
PRINCIPAL PAYMENTS	0.	0.	1000000.	1000000.	1000000.	1000000.	1000000.	1000000.	1000000.
INTEREST PAYMENTS	0.	0.	780000.	700000.	620000.	540000.	460000.	380000.	300000.
INTEREST EXPENSE	0.	0.	780000.	700000.	620000.	540000.	460000.	380000.	300000.
ACCRUED INTEREST	0.	0.	0.	0.	0.	0.	0.	0.	0.

DEBT SUMMARY

** ABC AIRLINES **

EXHIBIT 11

TOTALS - EXISTING SENIOR DEBT

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	29490000.	27084286.	20698571.	14332857.	10140000.	8140000.	6165000.	4000000.	3000000.
MATURING	5405714.	6385714.	6365714.	4192857.	2000000.	1975000.	2165000.	1000000.	1000000.
NON-CURRENT	24084286.	20698571.	14332857.	10140000.	8140000.	6165000.	4000000.	3000000.	2000000.
PRINCIPAL PAYMENTS	5435714.	9405714.	6385714.	6365714.	4192857.	2000000.	1975000.	2165000.	1000000.
INTEREST PAYMENTS	1989379.	1916776.	1759957.	1377405.	1009879.	805367.	644533.	485667.	323000.
INTEREST EXPENSE	1907498.	1835762.	1679910.	1298157.	949521.	764533.	604700.	446433.	300000.
ACCRUED INTEREST	443767.	362752.	282705.	203457.	143100.	102267.	62433.	23000.	0.

TOTALS - EXISTING SUBORDINATED DEBT

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	18055000.	16151293.	14143537.	12135303.	10126560.	8117279.	6107425.	4096964.	2085857.
MATURING	2000000.	2007756.	2008234.	2008742.	2009281.	2009854.	2010462.	2011107.	2066792.
NON-CURRENT	16055000.	14143537.	12135303.	10126560.	8117279.	6107425.	4096964.	2085857.	19065.
PRINCIPAL PAYMENTS	2000000.	2003707.	2007756.	2008234.	2008742.	2009281.	2009854.	2010462.	2011107.
INTEREST PAYMENTS	988444.	975423.	923867.	803388.	682880.	562341.	441769.	321161.	200516.
INTEREST EXPENSE	988444.	975423.	923867.	803388.	682880.	562341.	441769.	321161.	200516.
ACCRUED INTEREST	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTALS - ALL EXISTING DEBT

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	47545000.	43235578.	34842108.	26468160.	20266560.	16257279.	12272425.	8096964.	5085857.
MATURING	7405714.	8393470.	8373949.	6201599.	4009281.	3984854.	4175462.	3011107.	3066792.
NON-CURRENT	40139286.	34842108.	26468160.	20266560.	16257279.	12272425.	8096964.	5085857.	2019065.
PRINCIPAL PAYMENTS	7435714.	11409422.	8393470.	8373949.	6201599.	4009281.	3984854.	4175462.	3011107.
INTEREST PAYMENTS	2977822.	2892199.	2683824.	2180793.	1692759.	1367708.	1086302.	807028.	523516.
INTEREST EXPENSE	2895941.	2811185.	2603776.	2101545.	1632402.	1326874.	1046459.	767594.	500516.
ACCRUED INTEREST	443767.	362752.	282705.	203457.	143100.	102267.	62433.	23000.	0.

DEBT SUMMARY   ** ABC AIRLINES **   EXHIBIT 12

NEW DEBT -- 7/71

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	0.	0.	7600000.	6800000.	6000000.	5200000.	4400000.	3600000.	2800000.
MATURING	0.	0.	800000.	800000.	800000.	800000.	800000.	800000.	800000.
NON-CURRENT	0.	0.	6800000.	6000000.	5200000.	4400000.	3600000.	2800000.	2000000.
PRINCIPAL PAYMENTS	0.	0.	400000.	800000.	800000.	800000.	800000.	800000.	800000.
INTEREST PAYMENTS	0.	0.	276500.	511000.	455000.	399000.	343000.	287000.	231000.
INTEREST EXPENSE	0.	0.	276500.	511000.	455000.	399000.	343000.	287000.	231000.
ACCRUED INTEREST	0.	0.	0.	0.	0.	0.	0.	0.	0.

NEW DEBT -- 7/72

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	0.	0.	0.	5700000.	5100000.	4500000.	3900000.	3300000.	2700000.
MATURING	0.	0.	0.	600000.	600000.	600000.	600000.	600000.	600000.
NON-CURRENT	0.	0.	0.	5100000.	4500000.	3900000.	3300000.	2700000.	2100000.
PRINCIPAL PAYMENTS	0.	0.	0.	300000.	600000.	600000.	600000.	600000.	600000.
INTEREST PAYMENTS	0.	0.	0.	207375.	383250.	341250.	299250.	257250.	215250.
INTEREST EXPENSE	0.	0.	0.	207375.	383250.	341250.	299250.	257250.	215250.
ACCRUED INTEREST	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTALS FOR NEW DEBT

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	0.	0.	7600000.	12500000.	13950000.	20800000.	22950000.	19850000.	16750000.
MATURING	0.	0.	800000.	1400000.	1700000.	2600000.	3100000.	3100000.	3100000.
NON-CURRENT	0.	0.	6800000.	11100000.	12250000.	18200000.	19850000.	16750000.	13650000.
PRINCIPAL PAYMENTS	0.	0.	400000.	1100000.	1550000.	2150000.	2850000.	3100000.	3100000.
INTEREST PAYMENTS	0.	0.	276500.	718375.	941937.	1242938.	1560562.	1525125.	1308125.
INTEREST EXPENSE	0.	0.	276500.	718375.	941937.	1242938.	1560562.	1525125.	1308125.
ACCRUED INTEREST	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTALS FOR ALL DEBT

12 MONTHS ENDING	12/31/69	12/31/70	12/31/71	12/31/72	12/31/73	12/31/74	12/31/75	12/31/76	12/31/77
ENDING BALANCES	47545000.	43235578.	42442108.	38968160.	34216560.	37057279.	35222425.	27946964.	21835857.
MATURING	7405714.	8393470.	9173949.	7601599.	5709281.	6584854.	7275462.	6111107.	6166792.
NON-CURRENT	40139286.	34842108.	33268160.	31366560.	28507279.	30472425.	27946964.	21835857.	15669065.
PRINCIPAL PAYMENTS	7435714.	11409422.	8793470.	9473949.	7751599.	6159281.	6834854.	7275462.	6111107.
INTEREST PAYMENTS	2377822.	2892199.	2960324.	2899168.	2634596.	2610645.	2646865.	2332153.	1831641.
INTEREST EXPENSE	2395941.	2811185.	2880276.	2819920.	2574339.	2569812.	2607031.	2292719.	1808641.
ACCRUED INTEREST	443767.	362752.	282705.	203457.	143100.	102267.	62433.	23000.	0.

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EXHIBIT 13A

INPUT AIRCRAFT CHARACTERISTICS

TYPE		AVERAGE UTILIZATION DAYS/YEAR	DEPRECIABLE LIFE ACC.	DEPRECIABLE LIFE S.L.	RESIDUAL PERCENTAGE ACC.	RESIDUAL PERCENTAGE S.L.	ACCELERATED RATE	PRE-SERVICE COST (000)	LAG (MONTHS)	REVENUE AVAILABLE TONS
B707-100	P	365.0	8	12	5.00	15.00	2.00	100.	0	23.40
B707-100	C	365.0	8	12	5.00	15.00	2.00	100.	0	35.00
DC-9-10	P	365.0	8	12	5.00	15.00	2.00	50.	0	11.10
DC-9-10	C	365.0	8	12	5.00	15.00	2.00	50.	0	15.00
B727-200	P	365.0	8	12	5.00	15.00	2.00	75.	0	18.00
DC-8-61	P	365.0	8	14	5.00	15.00	2.00	125.	0	30.00
DC-10-30	P	365.0	8	16	5.00	15.00	2.00	300.	0	55.00
SPARE ENG	E	0.0	8	12	5.00	15.00	2.00	0.	0	0.0
GROUND EQ	G	0.0	0	10	0.0	0.0	0.0	0.	0	0.0

EXHIBIT 13B

UTILIZATION (HOURS / DAY)

12 MONTHS ENDING 12/31

		1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	P	0.0	0.0	10.0	10.0	10.5	11.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	C	0.0	0.0	0.0	0.0	0.0	8.0	7.0	7.0	7.0	7.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	P	0.0	0.0	8.0	8.0	9.0	9.0	9.0	9.0	9.0	9.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	0.0	0.0	3.0	3.0	3.5	4.0	4.0	4.0	4.0	4.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	0.0	0.0	8.0	8.5	9.0	10.0	10.0	10.0	10.5	10.5	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	0.0	0.0	11.5	11.5	12.0	11.0	10.0	10.0	10.0	10.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	0.0	0.0	0.0	0.0	9.0	10.0	11.0	11.0	11.0	11.0	0.0	0.0	0.0	0.0	0.0

EXHIBIT 13C

BLOCK SPEED (STATUTE MILES / HOUR)

12 MONTHS ENDING 12/31

		1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	P	0.0	0.0	425.0	425.0	425.0	425.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	C	0.0	0.0	0.0	0.0	0.0	400.0	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	P	0.0	0.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	0.0	0.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	0.0	0.0	390.0	390.0	400.0	400.0	400.0	400.0	400.0	400.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	0.0	0.0	465.0	470.0	470.0	475.0	470.0	470.0	470.0	470.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	0.0	0.0	0.0	0.0	480.0	480.0	480.0	480.0	480.0	480.0	0.0	0.0	0.0	0.0	0.0

SEATS

EXHIBIT 13D

12 MONTHS ENDING 12/31

		1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	P	0.0	0.0	135.0	135.0	135.0	135.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	P	0.0	0.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	72.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	0.0	0.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	0.0	0.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	198.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	0.0	0.0	0.0	0.0	270.0	270.0	270.0	270.0	270.0	270.0	0.0	0.0	0.0	0.0	0.0

INSURANCE PAYMENTS (PERCENTAGES OF SALES PRICE)

EXHIBIT 13E

12 MONTHS ENDING 12/31

		1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	P	0.0	0.0	2.0	2.0	1.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	C	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	P	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0

DIRECT OPERATING COSTS (DOLLARS / HOUR)

EXHIBIT 13F

12 MONTHS ENDING 12/31

		1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	P	0.0	0.0	650.0	676.0	703.0	731.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	C	0.0	0.0	0.0	0.0	0.0	700.0	728.0	757.0	787.0	820.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	P	0.0	0.0	350.0	364.0	379.0	394.0	409.0	425.0	442.0	461.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	0.0	0.0	350.0	364.0	379.0	394.0	409.0	425.0	442.0	461.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	0.0	0.0	425.0	446.0	469.0	492.0	517.0	535.0	559.0	581.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	0.0	0.0	800.0	832.0	865.0	900.0	936.0	973.0	1012.0	1053.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	0.0	0.0	0.0	0.0	1000.0	1040.0	1082.0	1125.0	1170.0	1217.0	0.0	0.0	0.0	0.0	0.0

PRE-DELIVERY PAYMENTS (PERCENTAGES ARE OF SALES PRICE)

EXHIBIT 13G

DC-10-30	P	MONTHS BEFORE DELIVERY	36	30	24	18	12	9	6
		PAYMENT PERCENTAGE	2.50	5.00	5.00	5.00	5.00	5.00	3.00
		PAYMENT PERCENTAGE ON ORDER DATE	2.50						

EXHIBIT 14

EQUIPMENT AND PROPERTY DATA

NAME	TYPE	FUSELAGE NUMBER	ORDER DATE	DELIVERY DATE	PHASE OUT DATE	PURCHASE PRICE (000)	SELLING PRICE (000)	RESIDUAL VALUE (000) (ACCELERATED)	RESIDUAL VALUE (000) (ST. LINE)	
B707-100	V	N1421		5/66		8000.0	0.0	403.8	1211.3	
B707-100	P	N1422		8/66	7/75	8150.0	2350.0	407.5	3002.3	LEASED 7/73 - 7/75
B707-100	P	N1423		9/66	11/73	8150.0	3500.0	831.5	4012.6	
B707-100	P	N1424		11/66	11/73	8300.0	3500.0	933.2	4184.3	
B707-100	P	N1425		12/66	5/74	8350.0	3000.0	721.6	3963.3	
DC-9-10	C	N1451		1/67		3500.0	0.0	175.0	525.0	
DC-9-10	C	N1452		5/67		3550.0	0.0	177.5	532.5	
DC-9-10	C	N1453		6/67		3800.0	0.0	190.0	570.0	
DC-9-10	Q	N1454		10/67		3900.0	0.0	195.0	585.0	
B727-200	P	N1471		2/70		6500.0	0.0	0.0	0.0	LEASE
B727-200	P	N1472		6/70		6800.0	0.0	340.0	1020.0	
B727-200	P	N1473		10/70		7000.0	0.0	350.0	1050.0	
DC-8-61	P	N1401		6/68		10500.0	0.0	525.0	1575.0	
DC-8-61	P	N1402		10/68		11000.0	0.0	550.0	1650.0	
DC-8-61	P	N1403		10/68		11000.0	0.0	550.0	1650.0	
DC-10-30	P	N0001	1/71	3/73		21000.0	21748.0	0.0	0.0	LEASE
DC-10-30	P	N0002	1/71	5/73		21500.0	0.0	1075.0	3344.6	
DC-10-30	P	N0003	1/71	5/74		22000.0	0.0	1100.0	3439.0	
DC-10-30	P	N0004	1/71	5/75		23000.0	0.0	1150.0	3607.1	
DC-10-30	P	N0005	1/74	1/77		25300.0	0.0	1265.0	3963.2	
DC-10-30	P	N0006	1/74	1/78		26600.0	0.0	1330.0	4178.9	
SPARE ENG	E	DC10		1/73		1000.0	0.0	50.0	150.0	
SPARE ENG	E	DC10		1/74		2000.0	0.0	100.0	300.0	
GROUND EQ	G	DC10		1/73		600.0	0.0	0.0	0.0	
GROUND EQ	G	DC10		1/74		400.0	0.0	0.0	0.0	
SST AMORT	I			1/68	1/73	10000.0				

CONVERTED AIRCRAFT

NAME	FUSELAGE NUMBER	CONVERSION PERIOD	CONVERSION COST(000)	DEPRECIABLE LIFE OF CONVERSION COST ACCELERATED	ST. LINE
B707-100	N1421	7/73 TO 1/74	75.0	3	5

** ABC AIRLINES **

EXHIBIT 15

DIRECT OPERATING COSTS (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	2372.5	2467.4	1347.1	2044.0	1860.0	1934.1	2010.8	2095.1	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	2372.5	2467.4	1347.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	2372.5	2467.4	2245.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	2372.5	2467.4	2245.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	2372.5	2467.4	2694.2	978.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			11862.	12337.	9879.	3022.	1860.	1934.	2011.	2095.	0.	0.	0.	0.	0.
DC-9-10	Q	N1451	1405.2	1461.5	1729.2	1869.5	1940.7	2016.6	2097.3	2187.4	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1452	1405.2	1461.5	1729.2	1869.5	1940.7	2016.6	2097.3	2187.4	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1453	1405.2	1461.5	1729.2	1869.5	1940.7	2016.6	2097.3	2187.4	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1454	1405.2	1461.5	1729.2	1869.5	1940.7	2016.6	2097.3	2187.4	0.0	0.0	0.0	0.0	0.0
TOTALS			5621.	5846.	6917.	7478.	7763.	8066.	8389.	8750.	0.	0.	0.	0.	0.
B727-200	P	N1471	1241.0	1383.7	1540.7	1795.8	1887.0	1952.7	2142.4	2226.7	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	1241.0	1383.7	1540.7	1795.8	1887.0	1952.7	2142.4	2226.7	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	1241.0	1383.7	1540.7	1795.8	1887.0	1952.7	2142.4	2226.7	0.0	0.0	0.0	0.0	0.0
TOTALS			3723.	4151.	4622.	5387.	5661.	5858.	6427.	6680.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	3358.0	3492.3	3788.7	3613.5	3416.4	3551.4	3693.8	3843.4	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	3358.0	3492.3	3788.7	3613.5	3416.4	3551.4	3693.8	3843.4	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	3358.0	3492.3	3788.7	3613.5	3416.4	3551.4	3693.8	3843.4	0.0	0.0	0.0	0.0	0.0
TOTALS			10074.	10477.	11366.	10841.	10249.	10654.	11081.	11530.	0.	0.	0.	0.	0.
DC-10-30	P	N0001	0.0	0.0	2737.5	3796.0	4344.2	4516.9	4697.5	4886.2	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0002	0.0	0.0	2190.0	3796.0	4344.2	4516.9	4697.5	4886.2	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0003	0.0	0.0	0.0	2530.7	4344.2	4516.9	4697.5	4886.2	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0004	0.0	0.0	0.0	0.0	2896.2	4516.9	4697.5	4886.2	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0005	0.0	0.0	0.0	0.0	0.0	0.0	4697.5	4886.2	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4886.2	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	4928.	10123.	15929.	18067.	23488.	29317.	0.	0.	0.	0.	0.
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GR. TOTALS			31280.	32811.	37711.	36851.	41462.	44581.	51396.	58373.	0.	0.	0.	0.	0.

** ABC AIRLINES **

EXHIBIT 16

INSURANCE PAYMENTS (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	160.0	160.0	60.0	160.0	160.0	160.0	160.0	160.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	163.0	163.0	61.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	163.0	163.0	101.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	166.0	166.0	103.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	167.0	167.0	125.3	41.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			819.	819.	452.	202.	160.	160.	160.	160.	0.	0.	0.	0.	0.
DC-9-10	C	N1451	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1452	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1453	76.0	76.0	76.0	76.0	76.0	76.0	76.0	76.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1454	78.0	78.0	78.0	78.0	78.0	78.0	78.0	78.0	0.0	0.0	0.0	0.0	0.0
TOTALS			295.	295.	295.	295.	295.	295.	295.	295.	0.	0.	0.	0.	0.
B727-200	P	N1471	130.0	130.0	130.0	130.0	130.0	130.0	130.0	130.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	136.0	136.0	136.0	136.0	136.0	136.0	136.0	136.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	140.0	140.0	140.0	140.0	140.0	140.0	140.0	140.0	0.0	0.0	0.0	0.0	0.0
TOTALS			406.	406.	406.	406.	406.	406.	406.	406.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	210.0	210.0	210.0	210.0	210.0	210.0	210.0	210.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	220.0	220.0	220.0	220.0	220.0	220.0	220.0	220.0	0.0	0.0	0.0	0.0	0.0
TOTALS			650.	650.	650.	650.	650.	650.	650.	650.	0.	0.	0.	0.	0.
DC-10-30	P	N0001	0.0	0.0	350.0	420.0	420.0	420.0	420.0	420.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0002	0.0	0.0	286.7	430.0	430.0	430.0	430.0	430.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0003	0.0	0.0	0.0	293.3	440.0	440.0	440.0	440.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0004	0.0	0.0	0.0	0.0	306.7	460.0	460.0	460.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0005	0.0	0.0	0.0	0.0	0.0	0.0	506.0	506.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	532.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	637.	1143.	1597.	1750.	2256.	2788.	0.	0.	0.	0.	0.
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GR. TOTALS			2170.	2170.	2440.	2696.	3109.	3261.	3767.	4299.	0.	0.	0.	0.	0.

EXHIBIT 17

** ABC AIRLINES **

LEASE EXPENSE (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	0.0	0.0	-475.0	-900.0	-450.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	-475.	-900.	-450.	0.	0.	0.	0.	0.	0.	0.	0.
DC-9-10	Q	N1451	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1452	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1453	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
B727-200	P	N1471	780.0	780.0	750.0	750.0	750.0	750.0	750.0	750.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			780.	780.	750.	750.	750.	750.	750.	750.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-10-30	P	NC001	0.0	0.0	2083.3	2500.0	2500.0	2500.0	2500.0	2500.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC003	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC004	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	2083.	2500.	2500.	2500.	2500.	2500.	0.	0.	0.	0.	0.
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GR. TOTALS			780.	780.	2358.	2350.	2800.	3250.	3250.	3250.	0.	0.	0.	0.	0.

EXHIBIT 18

** ABC AIRLINES **

BOOK DEPRECIATION SCHEDULE (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	566.7	566.7	566.7	579.4	579.4	579.4	579.4	201.6	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	577.3	577.3	577.3	577.3	288.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	577.3	577.3	481.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	587.9	587.9	489.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	591.5	591.5	591.5	197.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			2901.	2901.	2706.	1354.	868.	579.	579.	202.	0.	0.	0.	0.	0.
DC-9-10	C	N1451	247.9	247.9	247.9	247.9	247.9	247.9	247.9	247.9	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1452	251.5	251.5	251.5	251.5	251.5	251.5	251.5	251.5	83.8	0.0	0.0	0.0	0.0
DC-9-10	C	N1453	269.2	269.2	269.2	269.2	269.2	269.2	269.2	269.2	112.2	0.0	0.0	0.0	0.0
DC-9-10	C	N1454	276.2	276.2	276.2	276.2	276.2	276.2	276.2	276.2	207.2	0.0	0.0	0.0	0.0
TOTALS			1045.	1045.	1045.	1045.	1045.	1045.	1045.	1045.	403.	0.	0.	0.	0.
B727-200	P	N1471	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	481.7	481.7	481.7	481.7	481.7	481.7	481.7	481.7	481.7	481.7	481.7	200.7	0.0
B727-200	P	N1473	495.8	495.8	495.8	495.8	495.8	495.8	495.8	495.8	495.8	495.8	495.8	371.9	0.0
TOTALS			977.	977.	977.	977.	977.	977.	977.	977.	977.	977.	977.	573.	0.
DC-8-61	P	N1401	637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5	637.5	265.6	0.0
DC-8-61	P	N1402	667.9	667.9	667.9	667.9	667.9	667.9	667.9	667.9	667.9	667.9	667.9	500.9	0.0
DC-8-61	P	N1403	667.9	667.9	667.9	667.9	667.9	667.9	667.9	667.9	667.9	667.9	667.9	500.9	0.0
TOTALS			1973.	1973.	1973.	1973.	1973.	1973.	1973.	1973.	1973.	1973.	1973.	1267.	0.
DC-10-30	P	N0001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0002	0.0	0.0	789.7	1184.5	1184.5	1184.5	1184.5	1184.5	1184.5	1184.5	1184.5	1184.5	1184.5
DC-10-30	P	N0003	0.0	0.0	0.0	812.0	1218.0	1218.0	1218.0	1218.0	1218.0	1218.0	1218.0	1218.0	1218.0
DC-10-30	P	N0004	0.0	0.0	0.0	0.0	851.7	1277.5	1277.5	1277.5	1277.5	1277.5	1277.5	1277.5	1277.5
DC-10-30	P	N0005	0.0	0.0	0.0	0.0	0.0	0.0	1403.6	1403.6	1403.6	1403.6	1403.6	1403.6	1403.6
DC-10-30	P	N0006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1480.0	1480.0	1480.0	1480.0	1480.0	1480.0
TOTALS			0.	0.	790.	1997.	3254.	3680.	5084.	6564.	6564.	6564.	6564.	6564.	6564.
SPARE ENG	E	DC10	0.0	0.0	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8	70.8
SPARE ENG	E	DC10	0.0	0.0	0.0	141.7	141.7	141.7	141.7	141.7	141.7	141.7	141.7	141.7	141.7
TOTALS			0.	0.	71.	212.	212.	212.	212.	212.	212.	212.	212.	212.	212.
GROUND EQ	G	DC10	0.0	0.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
TOTALS			0.	0.	60.	100.	100.	100.	100.	100.	100.	100.	100.	100.	40.
GR. TOTALS			6896.	6896.	7622.	7659.	8430.	8567.	9971.	11073.	10230.	9827.	9827.	8716.	6816.

** ABC AIRLINES **

TAX DEPRECIATION SCHEDULE (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	543.9	499.5	499.5	216.5	16.7	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	588.1	508.8	508.8	296.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	599.4	508.8	424.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	633.5	518.2	431.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	648.9	521.3	521.3	173.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			3014.	2557.	2386.	687.	17.	5.	0.	0.	0.	0.	0.	0.	0.
DC-9-10	C	N1451	276.9	218.5	218.5	218.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1452	312.0	241.4	221.6	221.6	73.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1453	342.3	263.6	237.3	237.3	98.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1454	385.6	292.2	243.5	243.5	182.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			1317.	1016.	921.	921.	355.	0.	0.	0.	0.	0.	0.	0.	0.
B727-200	P	N1471	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	1452.1	1089.1	816.8	612.6	471.8	424.6	424.6	176.9	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	1640.6	1230.5	922.9	692.1	524.5	437.0	437.0	327.8	0.0	0.0	0.0	0.0	0.0
TOTALS			3093.	2320.	1740.	1305.	996.	862.	862.	505.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	1261.2	945.9	728.5	655.6	655.6	273.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	1450.2	1087.6	824.3	686.8	686.8	515.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	1450.2	1087.6	824.3	686.8	686.8	515.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			4162.	3121.	2377.	2029.	2029.	1303.	0.	0.	0.	0.	0.	0.	0.
DC-10-30	P	N0001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0002	0.0	0.0	3583.3	4479.2	3359.4	2519.5	1889.6	1461.8	1342.3	1342.3	447.4	0.0	0.0
DC-10-30	P	N0003	0.0	0.0	0.0	3666.7	4583.3	3437.5	2578.1	1933.6	1495.8	1373.6	1373.6	457.9	0.0
DC-10-30	P	N0004	0.0	0.0	0.0	0.0	3833.3	4791.7	3593.8	2695.3	2021.5	1563.8	1436.0	1436.0	478.7
DC-10-30	P	N0005	0.0	0.0	0.0	0.0	0.0	0.0	6325.0	4743.8	3557.8	2668.4	2001.3	1579.6	1579.6
DC-10-30	P	N0006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6650.0	4987.5	3740.6	2805.5	2104.1	1660.8
TOTALS			0.	0.	3583.	8146.	11776.	10749.	14387.	17484.	13405.	10689.	8064.	5578.	3719.
SPARE ENG	E	DC10	0.0	0.0	250.0	187.5	140.6	105.5	79.1	62.4	62.4	62.4	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	500.0	375.0	281.3	210.9	158.2	124.9	124.9	124.9	0.0	0.0
TOTALS			0.	0.	250.	687.	516.	387.	290.	221.	187.	187.	125.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
TOTALS			0.	0.	60.	100.	100.	100.	100.	100.	100.	100.	100.	100.	40.
GR. TOTALS			11585.	9013.	11316.	13875.	15789.	13405.	15638.	18310.	13652.	10976.	8289.	5678.	3759.

EXHIBIT 20

** ABC AIRLINES **

AMORTIZED PRE-SERVICE COSTS (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			67.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-9-10	C	N1451	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1452	10.0	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1453	10.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1454	10.0	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			40.	15.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
B727-200	P	N1471	15.0	15.0	15.0	15.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	15.0	15.0	15.0	15.0	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	15.0	15.0	15.0	15.0	11.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			45.	45.	45.	45.	19.	0.	0.	0.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	25.0	25.0	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	25.0	25.0	18.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	25.0	25.0	18.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			75.	75.	48.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-10-30	P	NC001	0.0	0.0	50.0	60.0	60.0	60.0	60.0	10.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC002	0.0	0.0	40.0	60.0	60.0	60.0	60.0	20.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC003	0.0	0.0	0.0	40.0	60.0	60.0	60.0	60.0	20.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC004	0.0	0.0	0.0	0.0	40.0	60.0	60.0	60.0	60.0	20.0	0.0	0.0	0.0
DC-10-30	P	NC005	0.0	0.0	0.0	0.0	0.0	0.0	60.0	60.0	60.0	60.0	60.0	0.0	0.0
DC-10-30	P	NC006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	60.0	60.0	60.0	60.0	0.0
TOTALS			0.	0.	90.	160.	220.	240.	300.	270.	200.	140.	120.	60.	0.
SST AMORT	I		2000.0	2000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			2000.	2000.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GR. TOTALS			2227.	2135.	183.	205.	239.	240.	300.	270.	200.	140.	120.	60.	0.

** ABC AIRLINES **

PRE-DELIVERY PAYMENTS (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-9-10	Q	N1451	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1452	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1453	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
B727-200	P	N1471	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-10-30	P	N0001	4200.0	2730.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0002	4300.0	2795.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0003	2200.0	2200.0	2860.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0004	575.0	1725.0	2300.0	2990.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0005	0.0	0.0	0.0	2530.0	2530.0	3289.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0006	0.0	0.0	0.0	665.0	1995.0	2660.0	3458.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			11275.	9450.	5160.	6185.	4525.	5949.	3458.	0.	0.	0.	0.	0.	0.
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GR. TOTALS			11275.	9450.	5160.	6185.	4525.	5949.	3458.	0.	0.	0.	0.	0.	0.

EXHIBIT 22

** ABC AIRLINES **

DELIVERY PAYMENTS (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-9-10	C	N1451	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1452	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1453	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
B727-200	P	N1471	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-10-30	P	N0001	0.0	0.0	14070.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0002	0.0	0.0	14405.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0003	0.0	0.0	0.0	14740.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0004	0.0	0.0	0.0	0.0	15410.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0005	0.0	0.0	0.0	0.0	0.0	0.0	16951.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17822.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	28475.	14740.	15410.	0.	16951.	17822.	0.	0.	0.	0.	0.
SPARE ENG	E	DC10	0.0	0.0	1000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	2000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	1000.	2000.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	600.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	600.	400.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GR. TOTALS			0.	0.	30075.	17140.	15410.	0.	16951.	17822.	0.	0.	0.	0.	0.

** ABC AIRLINES **

EXHIBIT 23

CAPITALIZED INTEREST (000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-9-10	Q	N1451	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1452	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1453	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1454	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
B727-200	P	N1471	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-10-30	P	N0001	227.8	432.1	88.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0002	208.6	407.6	181.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0003	75.0	224.9	431.4	195.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0004	39.5	83.5	242.9	473.6	208.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0005	0.0	0.0	0.0	141.7	345.8	633.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0006	0.0	0.0	0.0	50.0	154.2	378.2	677.2	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			551.	1148.	944.	861.	708.	1012.	677.	0.	0.	0.	0.	0.	0.
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GR. TOTALS			551.	1148.	944.	861.	708.	1012.	677.	0.	0.	0.	0.	0.	0.

** ABC AIRLINES **

EXHIBIT 24

AVAILABLE SEAT MILES (000,000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	209.4	209.4	109.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	209.4	209.4	109.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	209.4	209.4	183.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	209.4	209.4	183.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	209.4	209.4	219.9	76.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			1047.	1047.	806.	77.	0.	0.	0.	0.	0.	0.	0.	0.	0.
DC-9-10	C	N1451	63.1	63.1	71.0	71.0	71.0	71.0	71.0	71.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1452	63.1	63.1	71.0	71.0	71.0	71.0	71.0	71.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1453	63.1	63.1	71.0	71.0	71.0	71.0	71.0	71.0	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1454	63.1	63.1	71.0	71.0	71.0	71.0	71.0	71.0	0.0	0.0	0.0	0.0	0.0
TOTALS			252.	252.	284.	284.	284.	284.	284.	284.	0.	0.	0.	0.	0.
B727-200	P	N1471	148.0	157.3	170.8	189.8	189.8	189.8	199.3	199.3	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	148.0	157.3	170.8	189.8	189.8	189.8	199.3	199.3	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	148.0	157.3	170.8	189.8	189.8	189.8	199.3	199.3	0.0	0.0	0.0	0.0	0.0
TOTALS			444.	472.	512.	569.	569.	569.	598.	598.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	386.5	390.6	407.6	377.6	339.7	339.7	339.7	339.7	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	386.5	390.6	407.6	377.6	339.7	339.7	339.7	339.7	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	386.5	390.6	407.6	377.6	339.7	339.7	339.7	339.7	0.0	0.0	0.0	0.0	0.0
TOTALS			1159.	1172.	1223.	1133.	1019.	1019.	1019.	1019.	0.	0.	0.	0.	0.
DC-10-30	P	NC001	0.0	0.0	354.8	473.0	520.3	520.3	520.3	520.3	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC002	0.0	0.0	283.8	473.0	520.3	520.3	520.3	520.3	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC003	0.0	0.0	0.0	315.4	520.3	520.3	520.3	520.3	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC004	0.0	0.0	0.0	0.0	346.9	520.3	520.3	520.3	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC005	0.0	0.0	0.0	0.0	0.0	0.0	520.3	520.3	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	NC006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	520.3	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	639.	1261.	1908.	2081.	2602.	3122.	0.	0.	0.	0.	0.
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GR. TOTALS			2903.	2943.	3464.	3324.	3780.	3954.	4502.	5023.	0.	0.	0.	0.	0.

** ABC AIRLINES **

AVAILABLE TON MILES (000,000)

12 MONTHS ENDING 12/31			1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	V	N1421	36.3	36.3	19.1	40.9	35.8	35.8	35.8	35.8	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1422	36.3	36.3	19.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1423	36.3	36.3	31.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1424	36.3	36.3	31.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B707-100	P	N1425	36.3	36.3	38.1	13.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			181.	181.	140.	54.	36.	36.	36.	36.	0.	0.	0.	0.	0.
DC-9-10	C	N1451	14.7	14.7	16.7	17.5	17.5	17.5	17.5	17.5	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1452	14.7	14.7	16.7	17.5	17.5	17.5	17.5	17.5	0.0	0.0	0.0	0.0	0.0
DC-9-10	Q	N1453	14.7	14.7	16.7	17.5	17.5	17.5	17.5	17.5	0.0	0.0	0.0	0.0	0.0
DC-9-10	C	N1454	14.7	14.7	16.7	17.5	17.5	17.5	17.5	17.5	0.0	0.0	0.0	0.0	0.0
TOTALS			59.	59.	67.	70.	70.	70.	70.	70.	0.	0.	0.	0.	0.
B727-200	P	N1471	20.5	21.8	23.7	26.3	26.3	26.3	27.6	27.6	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1472	20.5	21.8	23.7	26.3	26.3	26.3	27.6	27.6	0.0	0.0	0.0	0.0	0.0
B727-200	P	N1473	20.5	21.8	23.7	26.3	26.3	26.3	27.6	27.6	0.0	0.0	0.0	0.0	0.0
TOTALS			61.	65.	71.	79.	79.	79.	83.	83.	0.	0.	0.	0.	0.
DC-8-61	P	N1401	58.6	59.2	61.8	57.2	51.5	51.5	51.5	51.5	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1402	58.6	59.2	61.8	57.2	51.5	51.5	51.5	51.5	0.0	0.0	0.0	0.0	0.0
DC-8-61	P	N1403	58.6	59.2	61.8	57.2	51.5	51.5	51.5	51.5	0.0	0.0	0.0	0.0	0.0
TOTALS			176.	178.	185.	172.	154.	154.	154.	154.	0.	0.	0.	0.	0.
DC-10-30	P	N0001	0.0	0.0	72.3	96.4	106.0	106.0	106.0	106.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0002	0.0	0.0	57.8	96.4	106.0	106.0	106.0	106.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0003	0.0	0.0	0.0	64.2	106.0	106.0	106.0	106.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0004	0.0	0.0	0.0	0.0	70.7	106.0	106.0	106.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0005	0.0	0.0	0.0	0.0	0.0	0.0	106.0	106.0	0.0	0.0	0.0	0.0	0.0
DC-10-30	P	N0006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	106.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	130.	257.	389.	424.	530.	636.	0.	0.	0.	0.	0.
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPARE ENG	E	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GROUND EQ	G	DC10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS			0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
GR. TOTALS			477.	483.	593.	632.	728.	763.	873.	979.	0.	0.	0.	0.	0.

SALE OF AIRCRAFT AND RELATED TAX
(THOUSANDS OF DOLLARS)

EXHIBIT 26

12 MOS ENDING		NUMBER	PHASE OUT	TOTAL PROCEEDS	NON TAXABLE PORTION	BOOK GAIN	TAXABLE GAIN	TAX
12/31/73	DC-10-30	N0001	3/73	21748.	21000.	-0.	748.	359.
	B707-100	N1423	11/73	3500.	832.	-513.	2668.	1281.
	B707-100	N1424	11/73	3500.	933.	-684.	2567.	1232.
				28748.	22765.	-1197.	5983.	2872.
12/31/74	B707-100	N1425	5/74	3000.	722.	-963.	2278.	1094.
				3000.	722.	-963.	2278.	1094.
12/31/75	B707-100	N1422	7/75	2350.	407.	-652.	1943.	932.
				2350.	407.	-652.	1943.	932.

AIRCRAFT TOTALS

12 MONTHS ENDING 12/31

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
B707-100	5	5	5	5	2	1	1	1	1	1	1	1	1	1	1
DC-9-10	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
B727-200	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DC-8-61	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
DC-10-30	0	0	0	0	2	3	4	4	5	6	6	6	6	6	6
TOTALS	12	15	15	15	14	14	15	15	16	17	17	17	17	17	17

7.6 A Look to the Future

7.6.1 General. - The long run economic viability of STOL transportation rests on its ability to recover average total operating costs. These costs are defined in the economic sense including a return to capital sufficient to cover capital risk using the CAB Phase 7 fare structure specified. It is mandatory to examine the fundamental components of an equilibrium analysis as developed during Phase II in order to outline this work. Since extensive work has been done on cost related fares, the discussion follows this development, then turns to consideration of the demand problem considering, in particular, the interrelationships between price, frequency, and load factor. Finally, these are related to return on investment.

7.6.2 Alternative Fare Structures. - Although the study uses CAB Phase 7 fares as the basis for financial analysis, other fare structures could be used. All acceptable structures must be designed to recover full costs and all should be non-discriminatory, i.e., the user should only pay for the service used. Even so, the use of different costs as a base, produces different fare structures. There are at least three cost bases that fulfill the recovery and non-discrimination criteria:

1. Total Operating Cost - including both Direct and Indirect Operating Cost
2. Direct Operating Cost - including Depreciation
3. Direct Operating Cost - excluding Depreciation

The first alternative argues that indirect operating costs are variable with aircraft procurement and route operating policy. The second argues indirect costs are primarily determined by system organizational policy and are, therefore, fixed in the short run. The third argues that the aircraft fleet is a function of system policy and that the only variable costs are crew, insurance, maintenance and fuel. Each of these can be criticized on theoretical grounds and more alternatives can be proposed. The point for the present discussion is that each of the three lead to different fare structures and offer different abilities to develop the various segments of a regional market.

For each cost base there exists a yield/cost ratio which would recover average costs based on the average investment - long term debt plus shareholder equity - during the tenth-year plus the CAB guideline rate of return - 12.35 percent. The three cost base fare structures can then be displayed, along with the CAB Phase 7 structure, as a function of stage length. (The theoretical rationale for these ratios is proved in Reference 54.) Table VII-1 derives the yield/cost ratios for each of the three fare structures based on the tenth-year capital structure described in Section 4.3.

TABLE VII-1

FARE STRUCTURE CALCULATIONS FOR 12.35% RETURN
[Chicago Region]

TENTH YEAR

Debt	$180,000,000	
Equity	159,573,000	
Total	$339,573,000	
12.35% Return on Investment[a]	$339,573,000	$ 66,525,000
Plus Costs		
Direct Operating Cost		$ 92,867,000
Depreciation		33,310,000
Indirect Operating Cost		114,756,000
Subtotal		$240,933,000
Required Revenue		$307,458,000
Less Beverage Sales		3,998,000
Required Ticket Yield		$303,460,000

Price/Cost Factors	12.35%	
DOC w/o Depr	303,460,000/ 92,867,000	= 3.27
DOC[b]	303,460,000/126,603,000	= 2.40
TOC	303,460,000/240,933,000	= 1.26

Rate of Return CAB Phase 7 Fares[c]

Ticket Yield	$327,309,000
Plus Beverage Sales	3,998,000
	$331,307,000
Less Costs	240,933,000
Operating Profit	90,374,000
Less Interest	15,300,000
Profit Before Taxes	75,074,000
Income Taxes	36,036,000
Net Profit	39,038,000
Return on Investment (incl. interest)	54,338,000
Return on Investment (percent)	16

[a]After tax. The $66.525 million includes 48% corporate income tax.

[b]Includes fleet amortization of $.427 million.

[c]No dilution.

The CAB ROI short form at a 12.35 percent return on investment after taxes implies a profit before taxes of $51.225 million plus $15.3 interest. This, when added to the operating costs of $240.5 million, requires total ticket yield of $303.5 million after an allowance for beverage sales. The yield/cost ratios for each of the three cost based fares are shown. The CAB Phase 7 fares provide a return on investment of 16.0 percent.

A more detailed examination of the Chicago region fare structure derived from the operating data for the twelve city pairs in the region, Table VII-2. The cost per available seat mile, the yield cost ratios, and the system average and route load factors may be used to calculate fare structure. Figure 7-1 presents the CAB Phase 7 fare structure, derived from Table VII-2 and an approximate TOC based fare structure obtained by fairing the cents per seat mile curve through route prices calculated using both the system average and individual route load factors.

These results together with the other two alternative fare structures are displayed in Figure 7-2.

All three cost based fare structures intersect the CAB Phase 7 fare structure to the left of the average stage length point. This shows the fare effect of changing the rate of return to 12.35 percent from 16.0 percent. Since all three fare structures produce the same total revenue, by construction, the choice among these depends upon the price elasticity of demand among the various city pairs. If travel along a specific segment is primarily for business purposes then the demand along the segment is fairly inelastic. Therefore, no additional revenue can be captured by small fare reductions. As personal travel becomes a higher proportion of the total city pair travel

TABLE VII-2

COST DATA FOR CHICAGO REGION FARE STRUCTURE DEVELOPMENT
[E150.3000 systems analysis airplane]

City pair,	Stage length, st.mi.(km)	Load factor, %	Trip costs,								CAB Phase 7 Fare, ¢/rpsm (¢/rpkm)
			$/trip				¢/assm(¢/askm)				
			DOC (w/o dep)	DOC	IOC	TOC	DOC (w/o dep)	DOC	IOC	TOC	
BKL-DET	92(148)	70.0	479	608	887	1495	3.47(2.16)	4.41(2.74)	6.43(4.00)	10.84(6.74)	20.65(12.83)
CGX-IND	163(262)	60.0	577	752	860	1612	2.36(1.47)	3.08(1.91)	3.52(2.19)	6.60(4.10)	14.11 (8.77)
CPS-IND	223(359)	73.0	659	876	1016	1892	1.97(1.22)	2.62(1.63)	3.04(1.89)	5.66(3.52)	11.66 (7.25)
CGX-CPS	265(426)	59.0	715	957	923	1880	1.80(1.12)	2.41(1.50)	2.32(1.44)	4.73(2.94)	10.94 (6.80)
CPS-CVG	298(480)	60.0	763	1028	956	1984	1.71(1.06)	2.30(1.43)	2.14(1.33)	4.44(2.76)	11.07 (6.88)
CGX-DSM	313(504)	52.0	786	1064	893	1957	1.67(1.04)	2.27(1.41)	1.90(1.18)	4.17(2.59)	10.86 (6.75)
MDW-MIC	361(581)	64.0	851	1160	1041	2201	1.57 (.98)	2.14(1.33)	1.92(1.19)	4.06(2.52)	10.25 (6.37)
CGX-MKC	413(665)	61.0	916	1257	1047	2304	1.48 (.92)	2.03(1.26)	1.69(1.05)	3.72(2.31)	9.68 (6.01)
BUF-CGX	459(739)	54.0	980	1351	1007	2358	1.42 (.88)	1.96(1.22)	1.46 (.91)	3.42(2.13)	9.59 (5.96)
BKL-CPS	493(793)	57.0	1024	1416	1061	2477	1.38 (.86)	1.91(1.19)	1.43 (.89)	3.34(2.08)	9.53 (5.92)
CGX-ROC	513(826)	54.0	1055	1462	1043	2505	1.37 (.85)	1.90(1.18)	1.36 (.85)	3.26(2.03)	9.36 (5.82)
DEN-MKC	550(885)	68.0	1094	1520	1222	2742	1.33 (.83)	1.84(1.14)	1.48 (.92)	3.32(2.06)	9.09 (5.65)
DESIGN STAGE	575(926)	60.7	1133	1579	1162	2741	1.31 (.82)	1.83(1.14)	1.35 (.84)	3.18(1.98)	8.87 (5.51)

CHICAGO REGION CAB AND APPROXIMATE TOC FARE STRUCTURES vs STAGE LENGTH

60.7% LOAD FACTOR

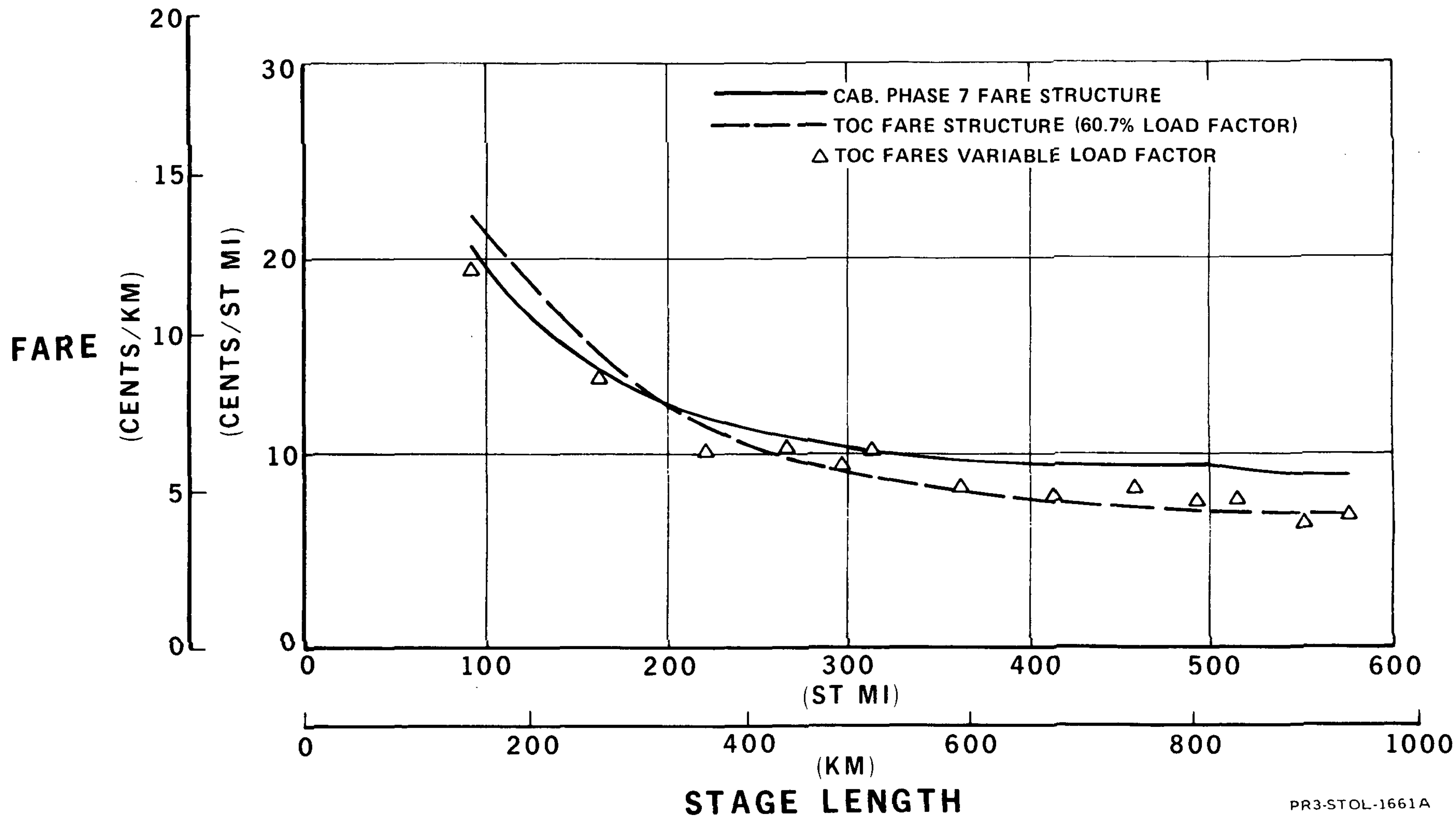

FIGURE 7-1

CHICAGO REGION ALTERNATIVE FARE STRUCTURES vs STAGE LENGTH

60.7% LOAD FACTOR

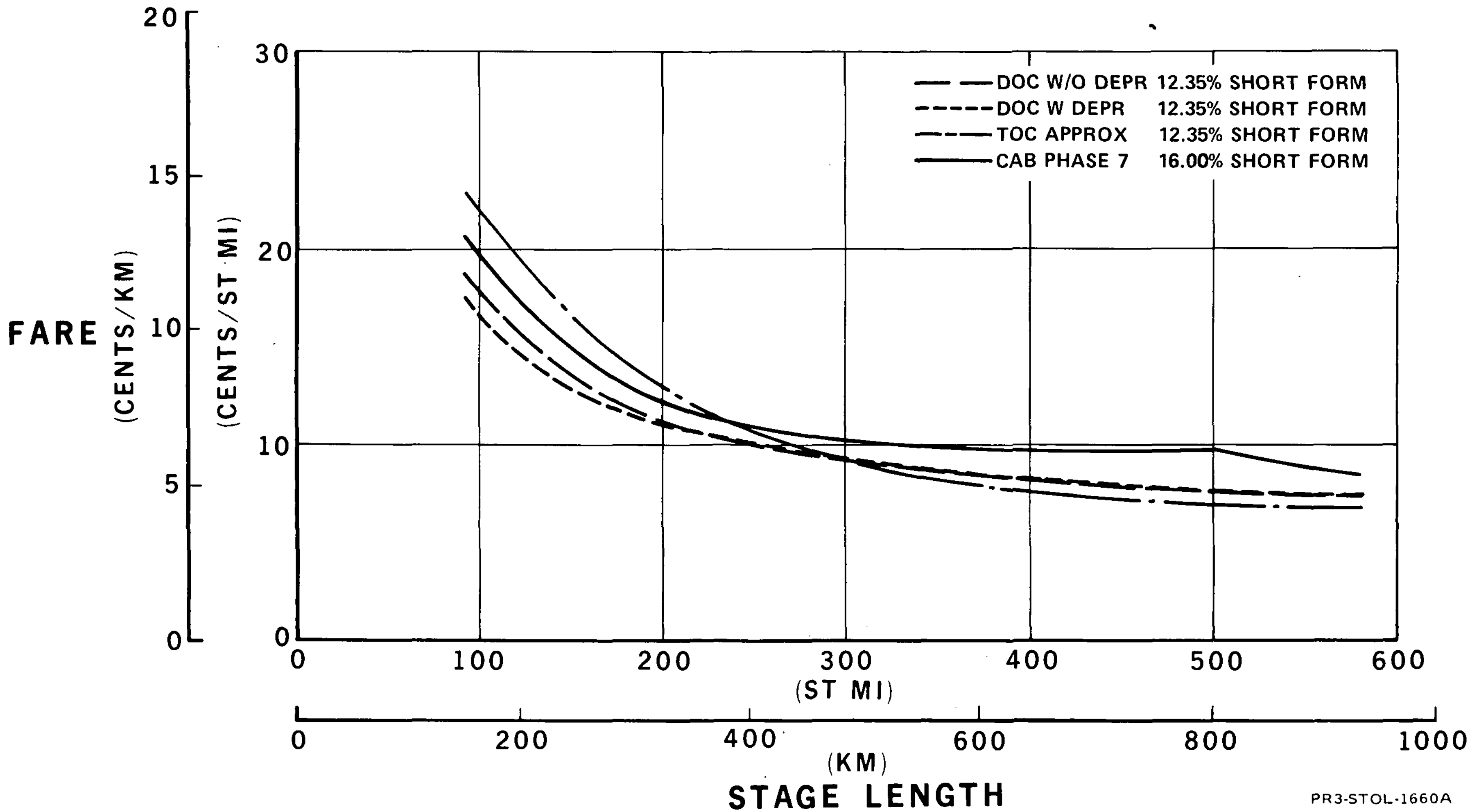

FIGURE 7-2

demand becomes more elastic. These observations permit the knowledgeable operator to take advantage of the market to increase revenues along selected segments without utilizing expensive service or discriminatory pricing practices.

7.6.3 Fares, Frequencies, and Load Factors. - Restriction of the demand analysis to CAB Phase 7 fare levels precluded extensive investigation of demand and therefore a complete analysis of the supply and demand curves. The data previously presented raises the question of theimpact of the different fare structures and frequency upon segment demand taking segment load factors as an analytical output. The hypothesis is, that for each region there is an "optimum" fare structure-frequency relationship giving rise to maximum revenue at a given system average fare. This produces a load factor which in turn determines the average and marginal revenue and cost curves, the essential ingredients of an equilibrium analysis.

Repeated for each region STOL system, these analyses would provide both system and industry analyses providing simultaneous solutions of fare levels, frequencies, load factors and therefore the passenger market determined requirement for STOL aircraft. This is illustrated in Figure 7-3. This figure shows the level of operations (revenue passenger miles) of a regional carrier and the fare level being set by the intersection of the marginal revenue (MR) and marginal cost (MC) curves. Where these curves are customarily defined respectively as the first derivative of total revenue and total cost with respect to revenue passenger miles. The extension to the multi-regional STOL industry is obvious. Regulation may be required to constrain fare levels to preclude excessive monopoly profits,

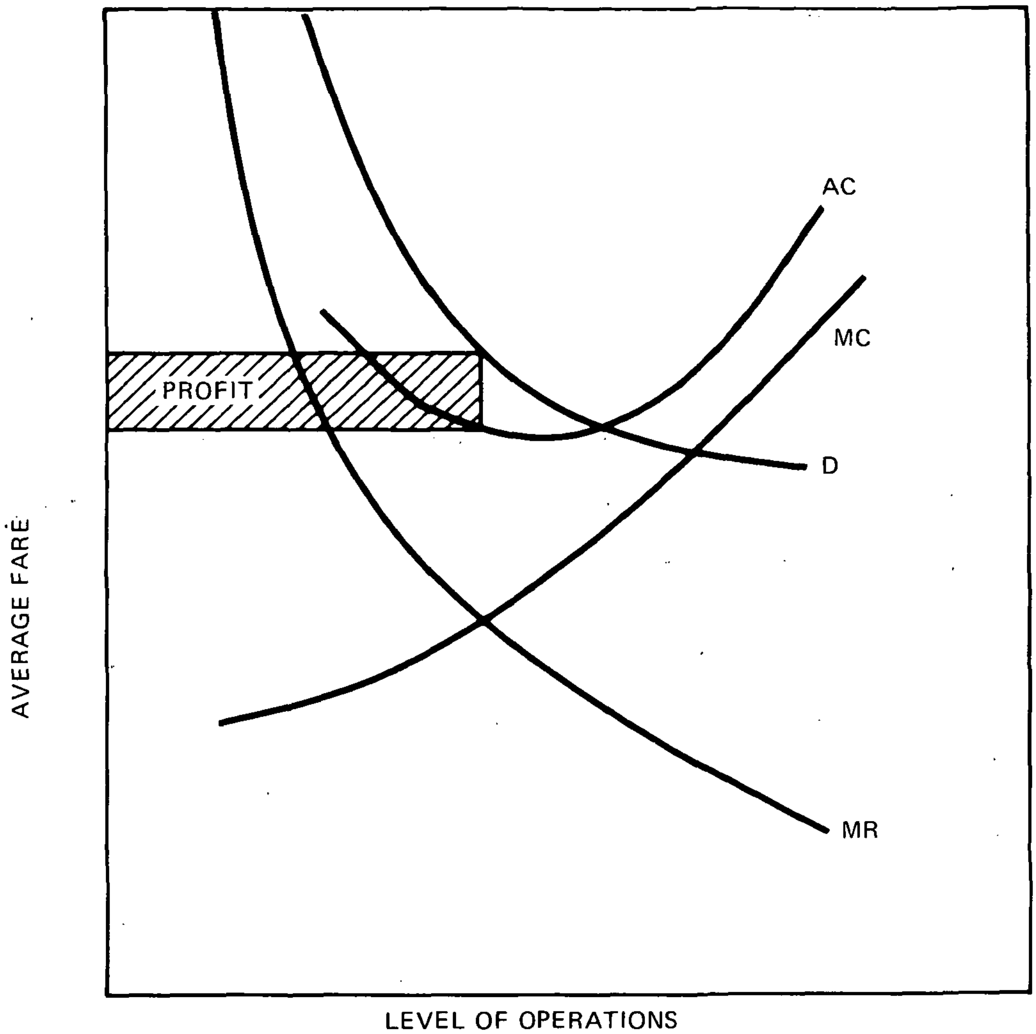

FIGURE 7-3. AIRLINE PROFIT MAXIMIZATION

a limitation explicitly employed in the earlier development of the fare structures.

7.6.4 Load Factors and Return On Investment. - Instantaneous STOL system financial success cannot be anticipated. Rather the development of regional STOL systems will approach each limiting demand schedule at a different rate depending upon the flight preference patterns of and marketing policies in region. Over the early years subsidies must be anticipated. The subsidy required to induce the investment is determined by the load factor and the rate of return as reflected in the fare to cost ratio.

Let C_1 = Annual Direct Operating Cost excluding Depreciation

C_2 = Annual Aircraft Depreciation

C_3 = Annual Indirect Operating Cost

I = Annual Interest

P = Profit

A = Total Average Investment

R = Annual Operating Revenue

F = Average Fare

N = Number of Passengers

L = Actual Load Factor

L_o = Planned Load Factor

r = Rate of Return

and K_j = Revenue Cost Multiplier

$j = 1$ DOC excluding Depreciation Base

$j = 2$ DOC with Depreciation Base

$j = 3$ DOC + IOC Base

By Definition (1) $R = FNj$

(2) $R = K_j \sum_1^j C_i{}^3$

(3) $R = P + I^1 + \sum_1^3 C_i$

(4) $r = (P + I)/A$

Combining (1) and (2)(5) $F = K_j \sum_1^j C_i/N$

And When $L_o = L$ (6) $F = L_o K_j \sum_1^j C_i/LN$

Now Rearranging (7) $R = L_o K_j \sum_1^j C_i/L$

Substituting (7) and (3) in(4)(8) $r = (L_o K_j \sum_1^j C_i/L - \sum_1^3 C_i)/A$

And Rearranging (9) $K_j = L(rA + \sum_1^3 C_i)/L_o \sum_1^j C$

For a representative STOL airlines typical values in millions (except as noted) might be:

C_1 =	30	A =	\$100
C_2 =	15	I =	5
C_3 =	30	L_o =	60 percent

Figure 7-4 provides an indication of the interrelationship of the price/cost factor, load factor and rate of return. Suppose the particular regional system uses a DOC + IOC cost base for determining the fare/cost ratio, e.g. 2.0, at an average load factor of 60 percent. This provides a 0% rate of return. If the load factor increases to 70 percent, the rate of return would increase to 15 percent. A 10 percent increase, around the base of 3.5, in the price/cost multiplier increases the rate of return from 11 to about 11.5 percent discounting demand effects. A 10 percent increase in load factor from 60 to 66 percent would increase the rate of return to about 11.5 percent, showing the two changes have an equal effect on rate of return for the "typical" data used.

The financial leverage afforded by the debt structure must also be considered. At a 10 percent rate of return as calculated using the CAB formula and 7 percent simple interest debt, the actual equity rate would be leveraged to about 16.5 percent assuming a 40-percent equity-to-total investment ratio. On the other hand equity profits would vanish at a 4.2 rate of return on total investment. Despite the fact that the 12 percent CAB objective has rarely been realized a high equity rate of return implying a high fare/cost ratio or alternatively government subsidy initially may be necessary to attract investment in extensive regional STOL systems.

7.6.5 The Sensitivity of the Interrelationships. - The mechanics of the price, load factor, frequency fare, demand and return on investment interactions have been ably investigated in Reference 56. The results, for a single origin and destination and without explicit consideration of the details of fare structures, show the effect upon the internal rate of return of probabilistic variations among the various primary economic variables.

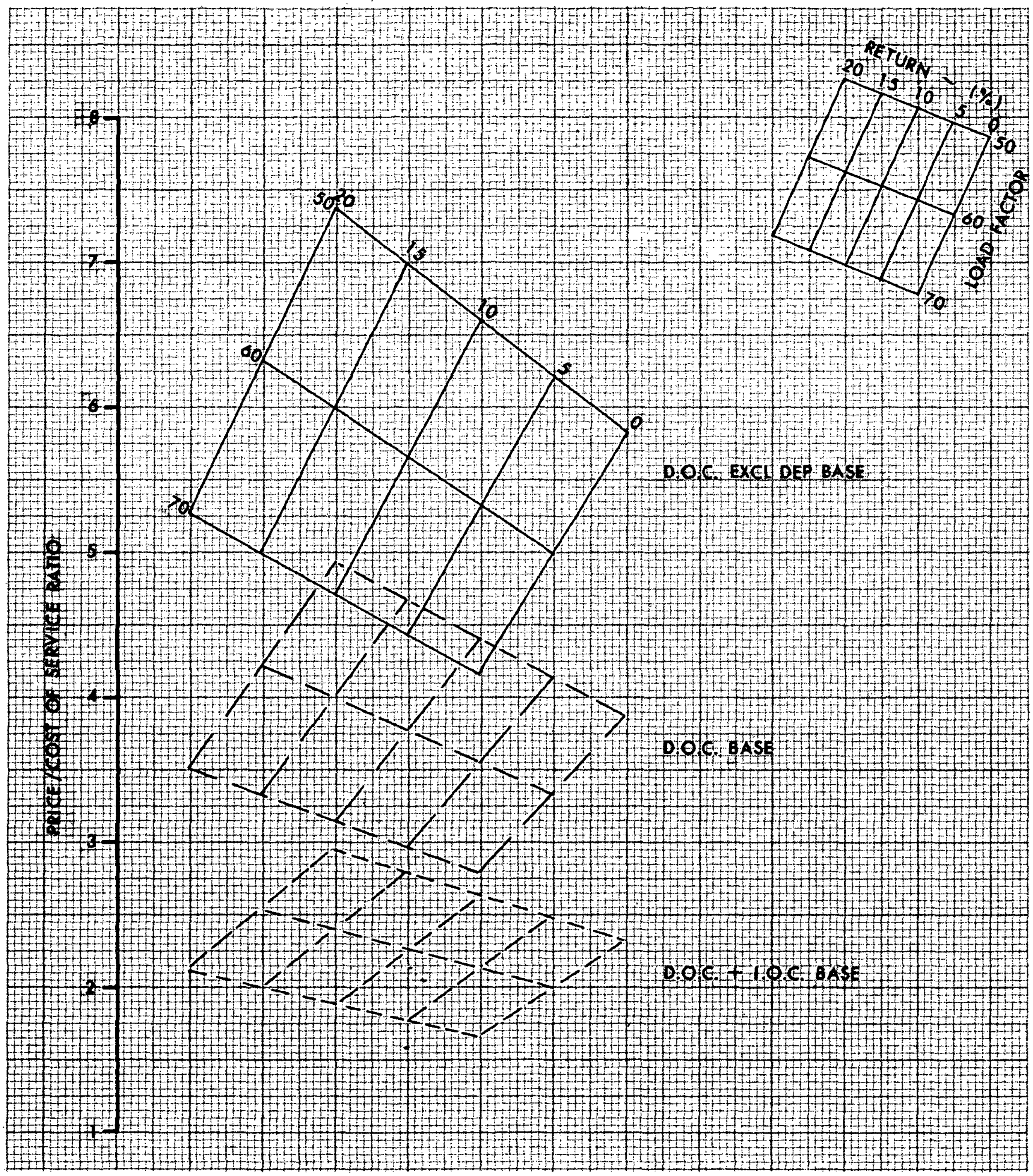

FIGURE 7-4. PRICE/COST RATIOS FOR SELECTED RATES OF RETURN AND LOAD FACTOR

From the graphic material the change of the expected annual rate of return by independently changing the operating parameters may be approximated, viz:

1% Change In	Percent Change Rate of Return
Frequency	1.5
Fare	1.8
Load Factor	1.9
Fleet Size	-1.0

These values hold for the area around the nominal points but should not be taken as an estimate of the exchange ratios across the operating parameter spectra.

Unfortunately the exchange ratios for the single segment may not hold over a regional network let alone other regional networks. Therefore considerable fundamental work and additional sensitivity studies are required before definitive fare, frequency, equipment qualities, and load factor guidelines can be determined.

APPENDIX 7.7

TABLE VII-3. TURBINE TRANSPORT PRICE TREND ANALYSIS

Airplane	Type (a)	Capacity (b)	OWE,		1969 Price, $M
			lb	kg	
707-120B	TF	174	118,000	53,524	7.72
707-320B	TF	189	140,000	63,503	8.88
720B	TF	149	115,000	52,163	7.40
727-100	TF	119	87,000	39,463	5.63
727-200	TF	166	95,000	43,091	6.69
737-100	TF	101	56,700	25,719	3.86
737-200	TF	117	58,200	26,399	4.57
747	TF	480	324,000	146,964	22.30
BAC111-400	TF	E 79	49,600	22,498	3.18
BAC111-500	TF	E104	54,600	24,766	3.56
F227B	FP	48	27,510	12,478	1.86
F28	TF	E 60	33,800	15,331	2.83
Trident IC	TF	E103	68,000	30,844	4.24
Trident IE	TF	E115	72,000	32,659	6.25
Caravelle III	TJ	E 94	58,600	26,580	3.18
Super Caravelle	TF	E104	67,825	30,765	5.02
Super VC-10	TF	E169	149,000	67,585	7.64
L1011	TF	334	225,491	102,281	16.60
Beech 99	TP	15C	5,675	2,574	0.414
DHC-6	TP	E 17C	6,297	2,856	0.370
HP Jet Stream	TP	E 15C	7,800	3,538	0.690
HS 748-100	TP	E 40	23,467	10,644	0.890
YS-11A-200	TP	A 60	33,945	15,397	1.46
Skyvan III	TP	E 17C	7,835	3,558	0.412
A-300	TF	E306	195,219	88,550	12.35
VFW 614	TF	E 40	24,250	11,000	2.12
Sabreliner 40-8	TJ	11C	10,250	4,649	1.165
Jet Falcon	TF	E 12C	16,000	7,257	1.44
G1159	TF	30C	32,900	14,923	2.76
HS 125	TJ	E 10C	11,600	5,262	0.940
HFB 320	TJ	E 11C	12,500	5,670	0.875
CL 1329	TJ	10C	21,500	9,752	1.91
Turbo Commander	TP	9C	6,000	2,721	0.365
King Air 90	TP	10C	5,900	2,676	0.483
Lear 25	TJ	12C	7,350	3,334	0.864
G159	TP	24C	21,500	9,752	1.188
MU-2	TP	A 7C	5,850	2,654	0.354
Nord 262	TP	E 26C	15,373	6,973	0.545
Jet Commander	TJ	E 7C	10,500	4,763	0.840
L188C	TP	99	61,500	27,896	3.47
V810	TP	E 71	43,200	19,596	2.00
DC-9-30	TF	110	59,600	27,034	4.30
DC-8-62	TF	189	144,000	65,317	9.21
DC-8-63	TF	251	157,000	71,214	10.36

[a]TF denotes turbofan, TJ - turbojet, TP - turboprop.
[b]Max. density seating. Prefixes represent origin of manufacturer: A - Asia, E - Europe. Suffix "C" shows corporate designs.