CHAPTER I. INTRODUCTION

Flight in the nation's airspace is controlled and monitored by a system of 25 en route navigational centers, 188 terminal area approach stations, and 444 airport terminal control towers: the air traffic control system. In addition, 318 flight service stations provide aviation maps, weather reports, and other flight services to general aviation pilots--that is, operators of small planes used for private business or recreation. To equip, maintain, and staff this system, the Department of Transportation's Federal Aviation Administration (FAA) spent more than $2.4 billion in 1982, of which about 12 percent paid for capital improvements, and nearly 90 percent was devoted to air traffic controllers' salaries and other operating and maintenance costs. Although only about half of the FAA's operating expenses are financed by fees collected from aircraft operators and passengers, all capital investment is financed this way.

In 1981, the FAA published its National Airspace System Plan, a comprehensive strategy for improving the air traffic control system. The plan aims to accomplish four goals:

- o Reduce the cost of operating the system,
- o Accommodate anticipated growth in air traffic,
- o Improve the safety of air travel, and
- o Upgrade the quality of flight services.

Funding for the plan's first five years was authorized under the Airport and Airway System Development Act of 1982; in the coming years, the Congress will face major decisions regarding the annual appropriation of these investment dollars.

PLAN OF THE PAPER

The remainder of this chapter retraces the past two decades of air traffic control spending and outlines assumptions and factors that introduce uncertainty about the success of the FAA plan for the system's future. The economic and financial appraisal of the FAA plan begins in Chapter II. The chapter outlines the FAA's projections of the plan's costs and benefits and isolates factors that could cause the assumptions to go awry. Chapter III evaluates the economic performance of the plan, the timing of intended investments, and the effects of risk and uncertainty. In particular, the chapter examines what could happen to the investment value of the plan if things did not go as assumed. The chapter also outlines two ways the Congress could help minimize the economic and budgetary risks associated with the FAA's investment strategy. Chapter IV assesses the financial status of the plan's funding source, the Airport and Airways Trust Fund, evaluates the risk of trust fund receipts' being inadequate to pay for the FAA plan, and examines the possible implications of recent Congressional decisions regarding FAA's 1984 appropriations.

Appendixes A through E provide supporting data and display techniques for the analysis presented in the body of the paper. Appendix A presents the FAA's planned schedule for capital outlays, and Appendix B the expected time path of projected benefits. Appendix C reviews the FAA's past air traffic forecasting performance and outlines the methods now used to project future growth. In particular, the FAA projections are compared against alternative forecasts generated by the Congressional Budget Office on the basis of other methods. Chapter III uses these alternative forecasts in analyzing the economic risks underlying the FAA plan. Appendix D outlines the investment appraisal methodology used in the body of the report, while Appendix E reviews one of the most difficult valuation problems in investment appraisal--the value of time.

HISTORICAL PERSPECTIVE

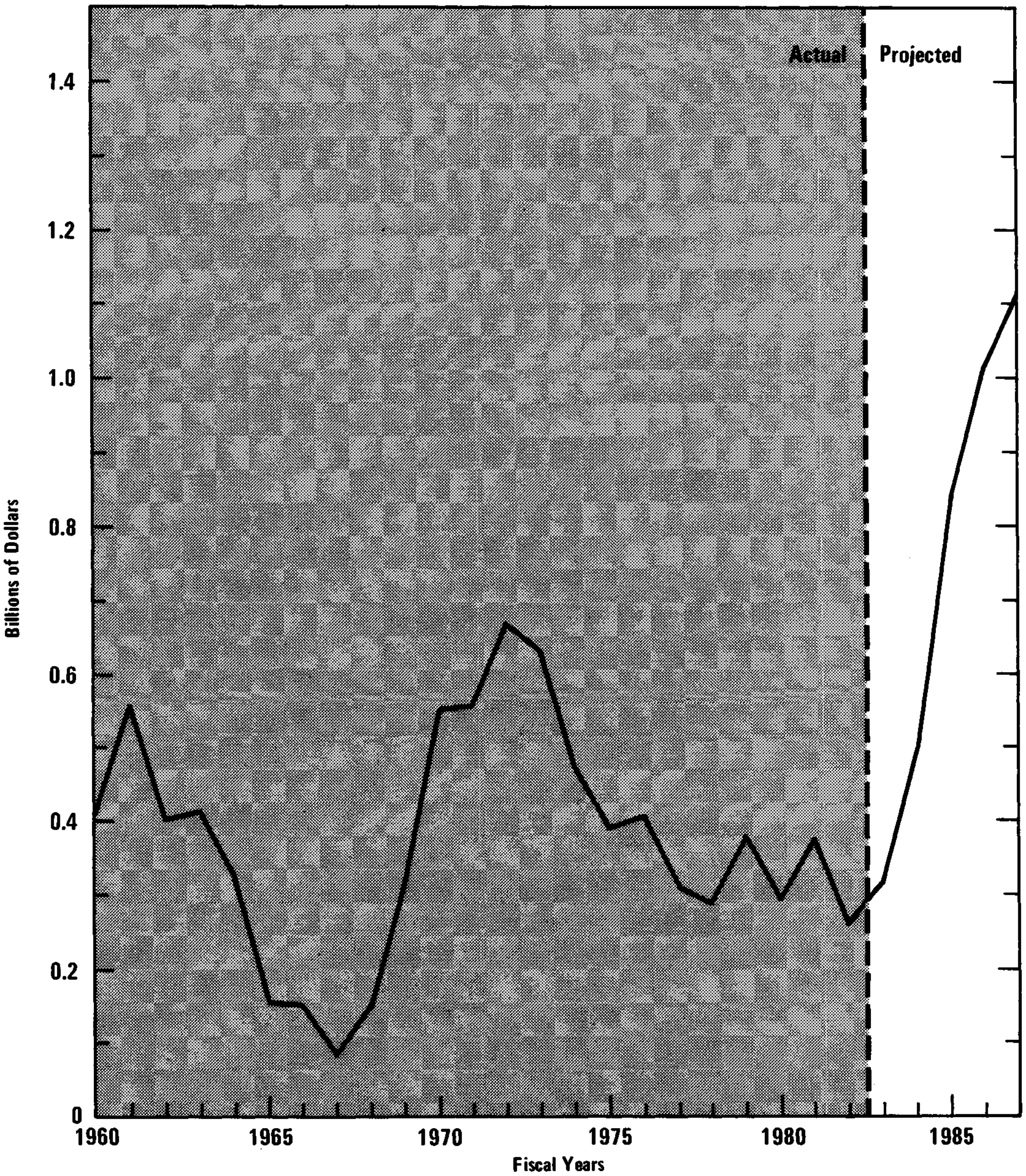
Today's air traffic control system is a blend of several generations' technologies and equipment, much of it labor intensive and obsolete by modern standards. Although air transportation remains a very safe means of travel, as air traffic continues to grow in the future, the present system may not be able to maintain the highest standards of safety. Already, limitations in the system cause delays for air travelers, as well as very high operating and maintenance costs for the FAA. These costs can be expected to rise in proportion with traffic growth.

System Development--1960-1973

Cumulative federal capital investment in the nation's air traffic control system since 1960 has totaled $8.5 billion (in 1982 dollars). Over the years, federal spending for air traffic control has displayed an erratic pattern, reflecting swings between periods of high-cost system expansion and periods of low-cost routine repair and replacement (see Figure 1). The

Figure 1.

Actual and Projected Federal Capital Spending on Air Traffic Control, 1960-1987 (In billions of 1982 dollars)



SOURCE: Congressional Budget Office from data provided by the Federal Aviation Administration.

NOTE: Outlay figures for 1983-1987 are based on authorizations in the Airport and Airway Improvement Act of 1982.

1950-1960 decade was one of expansion, as the system grew to accommodate the postwar boom in commercial aviation; the number of airports equipped with control towers rose by more than 50 percent, and five en route centers were added (see table below).

	1960	1973	1982
Number of Airport Towers	256	365	444
Percent change in ten years	+53	+43	+22
Number of En Route Traffic Control Centers	35	27	25
Percent change in ten years	+17	-23	-7
Number of Flight Service Centers	448	328	318
Percent change in ten years	-6	-27	-3

System capacity stabilized between 1960 and 1967, but growing numbers of reroutings, lengthy holding patterns, and forced airline schedule reductions necessitated another round of system expansion and automation from 1967 to 1972. By 1973, an additional 109 airports were equipped with control towers, and automation at en route control centers--by means of digital computers with more advanced software, and better displays--increased the hourly number of flights handled by 30 percent, while permitting an actual reduction in the number of centers from the 35 of 1960 to 27.

Declining Investment--1973-1982

The last ten years have witnessed a return to declining investment in the air traffic control system. Some equipment has been replaced only after it has physically worn out, even though replacement of functioning equipment might have been less costly on the basis of life-cycle costs. This means that the system has relied on system maintenance expenditures and the addition of more air traffic control personnel to handle growing demands for service. Since the Professional Air Traffic Control union (PATCO) walkout in 1981, the system has been kept operating with a reduced work force by the FAA's administratively limiting air traffic. As of February 1983, there were 23,257 air traffic controllers employed--10.9 percent fewer than the 26,088 authorized, owing to the lingering effects of the strike.

Since technological opportunities now permit greater automation, the air traffic control system could be operating with much greater efficiency than it does now. For example, controllers now manage their workload on the basis of flight plan data that are coded on paper strips torn by hand from teleprinters. 1/ This is a costly mechanical system requiring coordination and input by the air traffic controllers. The handoff by telephone of aircraft en route from one controller to another is also primitive by today's technological standards. Automating these functions would sharply reduce requirements for facilities and manpower while simultaneously curbing the reliability problems common in labor-intensive mechanical operations.

Compounding the problems of obsolete equipment, anticipated traffic growth--projected by the FAA to increase by 80 percent over the coming decade--promises to place demands on the system that it could not meet effectively with present capacity. The number of commercial jets is expected to rise by one-fourth, and the number of planes in the general aviation fleet could grow by up to 50 percent, with numbers of business jets--the most active general aviation users of air traffic control--more than doubling. In addition, greater use of avionics (radar transponders that enable pilots to communicate with approach stations, control towers, or en route centers) by existing general aviation planes could exert pressure on the system to expand.

The Prospective Cost of Declining Investment--From 1983

Without sufficient investment to modernize the air traffic control system, significant costs could arise in the form of higher system running costs and insufficient capacity. To maintain safe separations between aircraft during busy periods, traffic controllers require air carrier planes to use routings that require more fuel and time than would be the case if more modern equipment were available. Thus, failure to improve the system could result in significant costs for air carriers as well as general aviation. By the late 1980s, commercial airlines might be constrained to schedule some flights at inconvenient times. Inefficient routings could add millions of hours to passengers' flight times; airlines would waste an estimated

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1. For a description of how the air traffic control system operates, see Office of Technology Assessment, Airport and Air Traffic Control System (January 1982).

200 million gallons of jet fuel. And the FAA's operating costs would be some 30 percent higher than today's $2.5 billion. 2/

A NEW INVESTMENT STRATEGY--THE FAA PLAN

Approved by the Congress in 1982, the National Airspace System Plan charts a new investment strategy for the air traffic control system. 3/ With annual authorizations of roughly $1.2 billion--a four-fold increase over previous levels for capital spending on the air traffic control system (see table below)--the FAA plan would automate and consolidate its key components.

CAPITAL OUTLAYS FOR AIR TRAFFIC CONTROL, 1960-1986
(In millions of 1982 dollars)

Actual			Projected Under FAA Plan		
1970	1975	1980	1984	1985	1986
550	390	295	532	811	1,043

Through automation, the plan would increase traffic handling capacity, diminish the risk of mid-air collision and other hazards, and shorten flight times by allowing aircraft to use more direct routes. By consolidating

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2. From Federal Aviation Administration, Aviation Forecasts (February 1983); and U. S. Department of Transportation, National Airspace System Plan (December 1981, updated April 1983). The Congressional Budget Office has published a less detailed analysis of the FAA plan in Public Works Infrastructure: Policy Considerations for the 1980s (April 1983), Chapter VI on "Air Traffic Control." See also statement of Alice M. Rivlin, Director, Congressional Budget Office, before the House Committee on Appropriations, Subcommittee on Transportation (April 6, 1983).

3. See Federal Aviation Administration, National Airspace System Plan--Facilities, Equipment, and Associated Development (December 1981; updated April 1983).

facilities and reducing staff, the plan would lower FAA operating and maintenance costs by an estimated $24 billion (in 1982 dollars) over the 1983-2000 period, according to FAA estimates. 4/

Pending Congressional Decisions

The Congress now finds it necessary to consider the economic and budgetary implications of the FAA's plan. 5/ The costs of making the changes are projected by the CBO (on the basis of FAA data) to total about $10.7 billion (in 1982 dollars) over the next ten years--36 times the previous $295 million annual capital outlays for air traffic control, and one of the largest ever federal public works investments. The expenditures would include investment expense for the airline industry and for general aviation users.

CHOOSING AN INVESTMENT STRATEGY--SOME ASSUMPTIONS AND UNCERTAINTIES

The weight of technical opinion is that the nation needs a more modern air traffic control system. The economic question is how and when to make this effort. 6/ Any attempt to answer this question must rely on assumptions and forecasts that are inevitably uncertain. As with any long-range investment, the FAA plan is subject to a number of economic

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4. At the time this study was conducted, data were available from the National Airspace System Plan as reported in December 1981. The updated plan published in 1983 projects somewhat smaller savings in operating costs ($21 billion versus the $24 billion reported in 1981). Subsequent CBO analysis showed that this difference has no substantial significance for the results presented here.

5. For assessments of the technological and management issues associated with the FAA plan, see Office of Technology Assessment, Review of the FAA 1982 National Airspace System Plan (August 1982); U. S. General Accounting Office, Examination of the Federal Aviation Administration's Plan For The National Airspace System--Interim Report (April 20, 1982); and FAA's Plan To Improve The Air Traffic Control System: A Step In The Right Direction But Improvements And Better Coordination Are Needed (February 16, 1983).

6. See Office of Technology Assessment, Review of the National Airspace System Plan.

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assumptions and unpredictable factors, among which six are crucial to the plan's ultimate performance:

- **Consolidation and staff reduction.** The FAA plan assumes that hundreds of manned facilities would be closed as a result of automation. Institutional difficulties, however, could slow or completely obstruct the consolidation of facilities;

- **Growth in air traffic.** In forecasting the potential benefits of the plan, the FAA foresees rapid and sustained growth in air traffic. But growth that is slower than anticipated could diminish the benefits of the plan;

- **Capital costs.** The FAA assumes that planned expenditures are based on accurate cost projections, and that authorizations will suffice to cover the plan's costs. But few long-term federal or private undertakings have escaped cost overruns, which could also affect the FAA plan's cost effectiveness and financial outlook;

- **Technological change.** The FAA assumes that equipment introduced under the plan would serve for a period of at least 20 years. Earlier-than-expected technological obsolescence, however, could require system replacement on a hastened schedule;

- **Economics of major components.** The FAA assumes economic gains to result from the time saved by new equipment. The dollar value of time saved, however, may not in itself justify sizable investment; and

- **Pricing.** The FAA also assumes that federal subsidies to certain aviation users would continue. But federal subsidies that encourage aviation activity could necessitate a premature system expansion with poorly integrated, and thus inefficient, equipment.

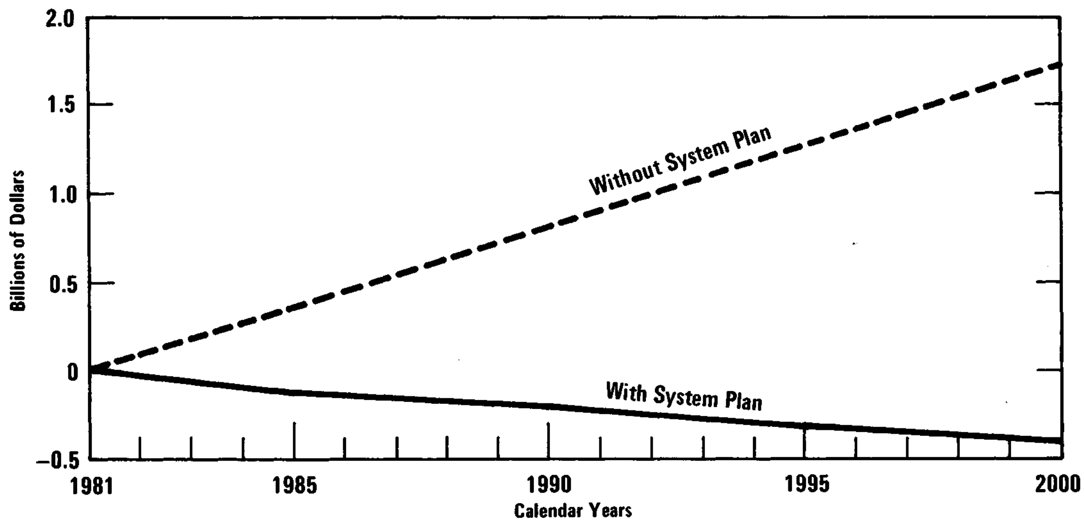
Compounding the plan's economic uncertainty is the financial outlook for the Airport and Airways Trust Fund, the principal source of revenue that pays for federal aviation investments. The trust fund is financed primarily with collections from an 8 percent federal excise tax on passenger tickets. Continuing price wars in airline fares, however, have diminished the value of this revenue source. The FAA forecasts sufficient trust fund revenues to pay for the FAA plan. But these projections assume an end to fare wars and a strong recovery in ticket prices; should these assumptions prove false, the trust fund might not be capable of supporting the FAA plan without an increase in the ticket tax.

In justifying the National Airspace System Plan, the Federal Aviation Administration has projected operating and maintenance cost savings to total $24 billion (in 1982 dollars) within two decades (see Figure 2). To illustrate the possible composition of these and other possible gains achieved by the plan, this chapter weighs the potential costs and benefits on the basis of FAA data. Such analysis must rely on assigning dollar values to the plan's several potential costs and benefits. (Supporting data are presented in Appendixes A and B.) The Congressional Budget Office analysis provides a basis for the economic appraisal and financial assessment presented in Chapters III and IV.

Figure 2.

Air Traffic Control Operation and Maintenance Costs With and Without National Airspace System Plan, FAA Forecast, 1981-2000

(In billions of 1982 dollars)



SOURCE: Congressional Budget Office adapted from FAA, *National Airspace System Plan* (April 1982).

COSTS

On the basis of FAA cost data, the CBO estimates the major cumulative cost of modernization at $10.7 billion (in 1982 dollars) over two decades, as shown in Table 1. 1/ Two kinds of capital costs are associated with the FAA's plan--capital expenditures by the federal government, and investment expenses for the airline industry and for general aviation users.

TABLE 1. PROSPECTIVE COST ESTIMATES OF IMPLEMENTING THE NATIONAL AIRSPACE SYSTEM PLAN, 1983-2005

	Total Costs 1983-2005 (In 1982 dollars)		Present Value with 10 Percent Discount Rate a/	
Sources of Costs	Dollars (In billions)	As Percent of Total	Dollars (In billions)	As Percent of Total
Federal Investments	7.65	71.7	5.73	82.7
Avionics Costs to Users				
Transponders and TCAS b/	2.42	22.7	0.88	12.7
Microwave Landing System	0.59	5.6	0.32	4.6
Total	10.66	100.0	6.93	100.0

SOURCE: Congressional Budget Office from FAA data.

a. Ten percent represents the minimum rate of return set by the Office of Management and Budget for capital investments.

b. Traffic Alert and Collision Avoidance System.

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1. For FAA cost data and analysis, see Federal Aviation Administration, National Airspace System Plan (December 1981), and Congressionally Requested Update (April 1983). See footnote 4 in Chapter I for explanation of update. See also Federal Aviation Administration, Preliminary Analysis of the Benefits and Costs to Implement the National Airspace System Plan (June 1982).

Costs to the Federal Government

Most of the cost, some $7.7 billion (in 1982 dollars), represents direct federal outlays: $5.9 billion would pay for new computers and related equipment and the costs associated with system consolidation, and $1.7 billion for ground installations associated with the microwave landing system, a new method of guiding planes in bad weather to automatic landings. On the basis of FAA equipment and software procurement schedules, about 90-95 percent of these budgetary expenditures would occur between 1983 and 1990. The remaining 5-10 percent represents future microwave landing system installations, introduction of advanced computer software, and consolidation costs that would continue through the turn of the next century. If costs beyond 1983 are discounted to their present-day value, at 10 percent a year, the present value of all federal investments would total $5.7 billion, as shown in Table 1. 2/

These cost estimates assume that all federal equipment and software installations would be in use for a period of 20 to 25 years, roughly equivalent to their engineered design lives. In economic terms, this assumes that new technologies--such as satellite versus ground-based navigation systems--would not be cost-effective over that period, or that, as a matter of policy, such technologies would not be introduced until the equipment it replaces is physically worn out.

Costs to Aviation Users

An estimated $3.0 billion (in 1982 dollars) represents equipage costs for aircraft owners and operators. They would have to install two types of cockpit equipment: a new radar transponder for improved route planning, weather information service, and collision avoidance; and a signal receiver for the microwave landing system.

The estimated user costs assume that all commercial aircraft operators and general aviation corporate jet owners would outfit their planes with both kinds of equipment. In addition, all other general aviation aircraft would carry a transponder (about 30 percent of propeller-driven aircraft are so equipped today), although at most half are assumed to purchase advanced transponders to receive the improved safety and weather information

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2. Ten percent represents the real rate of discount prescribed by the Office of Management and Budget for federal investments.

services planned by the FAA. 3/ Assuming a 20-year phase-in period for these users, the present value of total user investment costs is estimated at $1.2 billion.

BENEFITS

On the basis of FAA data, CBO projects $60 billion (in 1982 dollars) in quantifiable benefits associated with the FAA plan. Given the time path of these benefits, their discounted present value totals about $16 billion, of which about 67 percent represents savings to the FAA in reduced operating and maintenance costs, and 34 percent stands for direct gains to aviation users in the form of diminished fuel requirements, lower aircraft operating costs, and shortened delays (see Table 2).

Benefits to the Federal Government

Achieving the projected $10.6 billion (discounted) savings in the FAA's operating and maintenance costs will depend on improved labor productivity and staff reductions. Both of these are linked to facility consolidation.

Consolidation and Automation. At present, the FAA operates 20 automated air route traffic control centers in the continental United States, three automated off-shore centers, and two manual off-shore centers. Consolidation would lead to 18 continental and three off-shore centers by 1985, and 16 continental and two off-shore facilities by 1990. In addition, many terminal area navigation facilities would be merged into the air route centers, transforming today's system of 25 en route and 188 terminal centers into approximately 30 air traffic control facilities by the turn of the next century. Although each major airport would still be equipped with a traffic control tower for guiding planes within the immediate vicinity of the airport, automation would permit many of the activities now undertaken by tower staff to be performed instead at one of the 30 consolidated control centers.

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3. In the technical language of the FAA plan, the cost estimates assume that all aircraft would carry a Mode A/C/S transponder; all commercial (including commuter) aircraft, corporate jets, and 10 percent of all multiengine propeller general aviation aircraft would carry TCAS II; and half of all remaining multiengine and single-engine propeller general aviation aircraft would carry TCAS I.

TABLE 2. PROSPECTIVE BENEFIT ESTIMATES OF THE NATIONAL AIRSPACE SYSTEM PLAN, 1983-2005

Sources of Benefits	Total Benefits 1983-2005 (In 1982 dollars): Dollars (In billions)	Total Benefits 1983-2005 (In 1982 dollars): As Percent of Total	Present Value with 10 Percent Discount Rate: Dollars (In billions)	Present Value with 10 Percent Discount Rate: As Percent of Total
Savings in FAA Operating Costs from Increased Productivity	37.09 a/	62.2	10.64	66.5
Savings in Fuel				
Air carriers	11.29	18.9	2.62	16.4
General aviation	5.07	8.5	1.13	7.0
Savings from Microwave Landing System				
Improved safety	0.28	0.5	0.08	0.5
Reduced disruptions	2.52	4.2	0.66	4.1
Reduced outages	0.24	0.4	0.07	0.4
Reduced ground and air restrictions	1.99	3.3	0.50	3.1
Reduced path length	1.12	1.9	0.30	1.9
Total	59.60	100.0	15.99	100.0

SOURCE: Congressional Budget Office from FAA data.

NOTE: Details may not add to totals because of rounding.

a. The FAA estimates that savings in operating costs would total $24 billion by the year 2000. The CBO has projected another five years of savings to allow comparison of projections. However, the discounting of future costs makes this difference of very little significance (see Appendix B).

Automation could also permit a substantial consolidation of flight service stations. These stations offer a broad range of pre-flight and in-flight services for general aviation pilots; they prepare flight plans, provide en route communications with pilots flying under visual (rather than instrument-assisted) conditions, help pilots in distress, and operate a national weather reporting service. Today, most of these services are provided at 318 local stations around the country. Through automation and the provision of remote communication outlets, the FAA plan would eliminate 257 stations. To receive much of the information now obtained in person, users would connect by telephone with one of 61 regional computers.

Improved Productivity. Automation and consolidation would result in substantial gains in labor productivity, which is measured in numbers of operations per employee. For example, the average number of operations per controller at air route centers is projected to increase from 2,437 in 1981 to 4,274 in 1990, and to more than double by the year 2000 (see Table 3). The consolidation of air route and terminal control facilities

TABLE 3. PROJECTED PRODUCTIVITY IMPROVEMENTS FROM THE FAA PLAN, BY AIR TRAFFIC CONTROL SYSTEM COMPONENT, TO YEAR 2000

System Component	Actual 1981	Projected 1985	Projected 1990	Projected 2000
		(In operations per employee)		
Air Route System (En route navigation service)	2,437	3,415	4,274	5,914
Terminal Systems (Towers, terminal radar control)	5,470	7,749	9,293	12,420
Flight Service Systems (Flight plans, briefings)	12,044	16,355	25,432	53,640

SOURCE: Congressional Budget Office from Federal Aviation Administration, National Airspace System Plan--Facilities, Equipment, and Associated Development (December 1981, updated April 1983).

would allow airport tower controllers to handle more than 9,200 takeoffs and landings a year by the decade's end, compared to 5,470 in 1981--a 70 percent increase in productivity. And flight service specialists would improve their output four-fold by the turn of the century.

The productivity of maintenance staff is also projected to improve. For example, the FAA operates hundreds of unmanned radar stations that require close monitoring by peripatetic maintenance crews. When something goes wrong, personnel must visit the site, determine the problem, and possibly go away, and then come back with the appropriate tools and spare parts. Under the FAA plan, unmanned units would be equipped with microprocessors that relayed diagnostic information to remote maintenance facilities, eliminating the need for pre-checking and multiple personal visits.

Staff Savings. Improved labor productivity would permit significant long-term reductions in staff (see Table 4), and hence a substantially smaller wage bill. Staff savings are projected to occur as follows:

- **Air traffic controllers.** Compared to the current staffing level, the number of air traffic controllers would drop by 6.8 percent in 1985, by 14.7 percent in 1990, and by 30.0 percent in the year 2000.

- **Maintenance staff.** Maintenance staffing would be 14.8 percent lower in 1985 than the 1983 actual level, 26.8 percent lower in 1990, and 31.1 percent lower by the year 2000.

- **Total employment.** The FAA plan would reduce total system employment by 9.3 percent in 1985, compared to the 1983 actual level of 33,697 employees. By 1990, the total work force would be 26.0 percent smaller than in 1983, and by the year 2000, it would have dropped 36.8 percent from the 1983 staffing level.

- **Attrition.** FAA plans to make all staff reductions through attrition only. 4/

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4. Some analysts have questioned the feasibility of making all planned employment reductions through attrition. CBO has not examined this assumption in detail, however.

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TABLE 4. PROJECTED AIR TRAFFIC CONTROL EMPLOYMENT UNDER THE FAA PLAN, TO YEAR 2000

Type of Employee	1983 Authorized	1983 Actual	FAA Plan 1985	FAA Plan 1990	FAA Plan 2000
Air Traffic Controllers	26,088	23,257	21,669	19,841	16,282
Percent change a/	--	--	-6.8	-14.7	-30.0
Maintenance Staff	11,034	10,440	8,900	7,642	7,194
Percent change a/	--	--	-14.8	-26.8	-31.1
Total	37,122	33,697	30,569	27,483	23,476
Percent change a/			-9.3	-18.4	-30.3

SOURCE: Congressional Budget Office from Federal Aviation Administration, National Airspace System Plan--Facilities Equipment, and Associated Development (December 1981, updated April 1983).

a. Percent changes from the 1983 actual levels.

Direct Benefits to Aviation Users

Modernization of the air traffic control system would reduce fuel requirements and diminish aircraft operating costs and passenger delays.

Fuel Savings. By permitting flight paths to be less circuitous, automating air route traffic control centers would save fuel. The magnitude of these savings would depend, of course, on the volume of aviation activity. On the basis of its forecasts of aviation activity for 1993, the FAA foresees fuel consumption increasing 40 percent without system modernization but rising just 32 percent if the plan is phased in according to schedule. The present value of these savings would amount to some $3.8 billion, as shown in Table 2. 5/ Since commercial jets consume a great deal more fuel than general aviation aircraft, commercial airlines would benefit from about 70 percent of the fuel costs saved.

Shortened Delays. Ascertaining the value of reduced aircraft operating costs is fairly straightforward; it depends largely on fuel and aviation labor costs. Shortened delays would stem chiefly from introduction of the newly developed microwave landing system. Today, an aircraft making an instrument landing receives fixed beam radio signals from transmitters located near the runway, and it follows the signals from a distance of about six miles from the airport to a precision touch-down on the runway pavement. A constraint under current technology is that aircraft must line up six miles from the runway and follow a straight-line path to touch-down, a time-consuming activity unless a flight en route happens to be along this path anyway. Microwave technology (using a scanning beam rather than a fixed beam) would permit angled or curved approaches and would reduce the number of flight and ground procedural restrictions. The new technology, based on advanced solid state componentry, is also thought to be more reliable than the existing systems, most of which are still powered by vacuum tubes. Improved reliability would reduce system outages and disruptions. Together, shortened approach paths and improved reliability would diminish landing times and thus reduce aircraft operating costs and passenger delays. On the basis of the projected future number of landings, FAA data translate these savings into a present value of $1.6 billion by the year 2005 (see Table 2).

A secondary benefit claimed for the microwave landing system is reduced air and noise pollution. By shortening landing time, the system will also shorten the airborne time of in-bound aircraft, thus diminishing the period when a plane emits noxious exhaust fumes in close proximity to communities lying near to airports. Similarly, with incoming planes approaching in a radial pattern around a runway rather than queued up on a single path, the objectionable engine noise of landing jets would be dispersed over a broad area rather than concentrated along one approach route. Such environmental benefits are, however, almost as difficult to quantify as the value of time.

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5. Estimated fuel savings are reported in Federal Aviation Administration, Preliminary Analysis of the Benefits and Costs to Implement the National Airspace System Plan (June 1982). Commercial aviation jet fuel cost $1.00 per gallon in 1982; general aviation jet fuel cost $1.73 per gallon in that year, while general aviation gasoline used in propeller planes cost $1.92 per gallon.

Assigning a value to time is far less straightforward than assessing aircraft operating costs. Time is an intangible commodity, the value of which is determined largely subjectively. It is an economic resource, however, in the sense that delay reduces time spent in productive work or other activities; its monetary worth depends on the estimated value of time savings. Taking one objective approach, the FAA has valued time savings at workers' average hourly earnings. On that basis, the FAA estimates the present value of benefits from the microwave landing system to total $1.6 billion by the year 2005. Other analysts, however, estimate the value of time savings at as little as one-third of hourly earnings. 6/ If that lower value were assumed, the benefits of MLS would be reduced by some 35 percent to just more than $1 billion, and the system's cost effectiveness--taken up in the next chapter--might thus be brought into question.

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6. Analysts at the World Bank, for example, apply this lower measure (see Appendix E).