Chapter 7

POLICY IMPLICATIONS

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INTRODUCTION

The letter from the House Committee on Appropriations requesting this assessment indicated the following areas of concern:

- scenarios of future air transportation growth;
- alternative ways to increase airport and terminal capacity;
- proposed modifications of air traffic control (ATC) system technology; and
- alternatives to the present ATC process.

OTA's analysis of these subjects is presented in chapters 4, 5, and 6; this chapter summarizes the major points emerging from those analyses and examines their implications in terms of congressional interests. The intent is to highlight those aspects of air system evolution that may be of particular concern to the Congress in evaluating the Federal Aviation Administration's (FAA) 1982 National Airspace System (NAS) Plan .

The following discussion is organized under three major headings. Under each heading is a brief statement of findings followed by a discussion of specific problems and implications. A fourth section deals briefly with the related questions of funding and cost allocation, which must also be addressed in the years ahead. The final section reviews recent congressional reports on these subjects and identifies the relevant legislation now pending before Congress.

AIR SYSTEM GROWTH

Findings

Chapter *4* compares recent FAA *Aviation Forecasts* and those of several other sources. The following major points emerge from that comparison:

- FAA projections of future demand have consistently been too high in the past, in part because of the way they are made: they assume that past trends will continue, that there will be no constraints on continued rapid growth, and that proposed ATC improvements will in fact be made when and where needed to accommodate that growth. However, other sources (including Rolls Royce and the Air Transport Association) feel that the airline industry is already approaching its mature size; this could lead to a leveling off or even a decline in air carrier operations. There is also considerable uncertainty about a number of other factors that might affect future aviation activity, such as changes in U.S. economic or regulatory policy, the long-term impacts of airline deregulation and the PATCO strike, and the ability of airlines to finance new equipment, Given these uncertainties and the questionable economic assumptions underlying the 1981 baseline projection on which the 1982 NAS Plan will be based, Congress may wish to reexamine the deployment schedule proposed by FAA for major ATC system improvements.
- There will be some growth in the system, but the rate of growth will be slower than **was** experienced in the past and **may be** slower than has been anticipated even in recent forecasts. The various scenarios suggest that a 2- or 3-percent annual growth rate for total operations at FAA-towered airports would be a reasonable expectation, although the rate might be as low **as —1** percent or as high as +5 percent, depending on a variety of economic, regulatory, and operational factors that cannot be reliably predicted. En route and flight service workloads are likely to increase as fast or faster than tower operations.

- There is disagreement about the exact distribution of this future growth among user groups, but the forecasts generally agree that general aviation (GA), and especially air taxis and corporate aircraft equipped for IFR operations, will be the fastest growing category. GA may account for as much as 75 percent of the increase in tower workload, particularly if FAA (as planned) increases the number of towered GA and reliever airports. Commuter operations will increase moderately, on the other hand, and air carrier operations (not passenger traffic) may actually decline at some hubs.

- The relatively rapid growth of GA demand, combined with the slower growth of commuter and air carrier operations, could have several effects on the U.S. airport and ATC system:
  - —Unconstrained growth of operations at major hubs would lead to saturation at 15 to 20 airports by 2000, compared with 5 to 10 airports today. Growth rates above 4 percent annually, which are possible but unlikely, might result in saturation at
  - —all 50 of the top air carrier airports by the end of the century.
  - —In the absence of capacity improvements at saturated hubs, increasing congestion and delay will probably result in further redistribution of air carrier operations (especially transfer functions) away from saturated major hubs to "second tier" hubs where surplus capacity still exists.
  - –Similarly, GA traffic is likely to be shifted out of more and more air carrier hubs to reliever and other GA airports. This will create a demand for improved facilities at those airports.
  - —As a result, the principal opportunities for capacity expansion will come not at the major hub airports but rather at the second-tier hubs and at GA and reliever airports, as well as at the air route traffic control centers and flight service stations. If these increases in ATC system capacity are to be provided without greatly increasing FAA's operation and maintenance (O&M) expenditures, expanded use of automated and remote facilities will be required.

Discussion

Forecasts of aviation activity are subject to three principal kinds of uncertainties, **all of** which affect the accuracy and usefulness of the resulting projections of airport and ATC system demands:

- There is no common purpose or focus—airline forecasts concentrate primarily on measures of carrier profitability, aerospace forecasts on potential aircraft markets, and FAA forecasts on ATC workloads.
- All of the projections nevertheless employ a similar methodology and rely on similar demographic and economic expectations. Specifically, the forecasts assume a continuation of the past relationship between gross national product growth and increased demand for air travel. As a result, common-mode failure is possible—the forecasts could all be wrong for the same reason.
- All of the forecasts are subject to factors whose future influence can only be guessed at, including the price and availability of fuel, the effects of airline deregulation, the resulting changes in industry structure, the long-term impacts of the air controllers strike, the uncertain availability of financing for reequipping airline fleets, and future changes in Federal aviation policy or cost allocation.

As a result, there is general agreement on the likelihood of future growth, but little certainty about its magnitude, and still less about the more important questions of when and where growth will occur or what its impact will be on the Nation's airport and ATC system.

Continued growth along historic patterns would exacerbate congestion and delay at hubs that are already saturated and would probably spread these problems to additional airports. This would present two possible courses of response:

- accommodate the growth wherever it occurs (as FAA has done in the past) by attempting to expand the capacity of affected hubs; or

- channel the growth, either actively or passively, so that it can be accommodated at other hubs.

Neither of these courses will be applicable in all situations, and in most cases the solution will involve some combination of the two; finding the proper balance will require a case-by-case analysis of their relative costs and benefits.

Adding new capacity at congested hubs—in the form of new runways or entirely new airports—could be extremely expensive in relation to the number of additional operations that can be accommodated. There are, however, a number of traffic management techniques that could increase the efficiency with which existing capacity is utilized at airports and terminal areas that are already saturated.

There are clear indications that market forces have already begun to alter the historical patterns of demand distribution. Some airlines, faced with high delay costs and strike-related restrictions at congested hubs, are finding it attractive to move some of their "hubbing" or transfer operations to well-equipped second-tier hubs where available capacity exists and delay costs can be avoided. Local service airlines, with the new route and entry freedom of deregulation, are beginning to increase the number of direct-service flights, and, consequently, to decrease the number of transfer operations. New entrants and low-cost carriers, unencumbered by large investments in facilities at congested hubs, are basing their operations at second-tier hubs. Although this trend may involve a small decrease in the operational efficiency of system users, it would greatly increase the efficiency with which the airport and ATC system's aggregate capacity is utilized.

Growing congestion could have serious implications for commuter and GA users, who would beat a considerable disadvantage in any competition for access to congested hubs. Neither user group is likely to be completely priced or regulated out of major hubs, but growing congestion may nevertheless prove to be a significant constraint on their future growth. Additional GA operations might be accommodated at reliever and other GA airports; this would make more capacity available at existing hubs, but it could also lead to additional FAA investments and operating costs for new towers at lightly used GA airports. (FAA plans have called for as many as 50 new towers by 1993, but its experience in closing over 60 low-volume towers since the PATCO walkout justifies a review of these plans.) Commuter carriers, on the other hand, will continue to require access to hub airports, since most of their passengers transfer to other flights, Rehubbing by major airlines will not change this requirement and might even create additional complications in commuter routes and operations, although it might also create new market opportunities for commuter airlines. In addition, commuter and GA users will generate most of the new demand for en route and flight services.

AIRPORT CAPACITY ALTERNATIVES

Findings

The committee asked OTA to examine the "relative merits of alternative ways of increasing airport and terminal capacity to meet future demands and reduce safety hazards. " The tools that can be used to increase capacity or reduce delay are examined in chapter 6, where the major findings and implications are:

- Changes in ATC equipment or procedures can produce small increases in airside capacity by helping aircraft use available airspace and runways more efficiently. However, large capacity improvements, such as would result from greatly reducing the distance between aircraft on landing and takeoff, must await technological breakthroughs like improved prediction of wake vortices.
- Where ATC improvements are made, they

would not necessarily eliminate the problem of delay: latent demand at a popular airport could quickly consume new capacity, and the length of delay would remain the same.

- Major increases in the physical capacity of a hub would require building new runways or entire new airports. Such major improvements are unlikely to be made in the near future because of the unavailability or high price of land, costs of construction, and noise and other environmental constraints.
- If growth continues, however, some new major airports may have to be built. Since they are likely to be some distance from the center city, the success of these airports will depend upon suitable high-speed ground access. (Dunes International Airport demonstrates the need for such access.)
- Congestion at large hub airports may induce use of a variety of techniques to maximize effective capacity, including hourly quotas and peak-hour pricing. GA users are likely to be the major losers in competition for slots at congested airports, although these restrictions might also constrain the growth of commuter carrier operations.
- If air carriers continue to redistribute their transfer operations to second-tier hubs, some added investment will be required at these airports.
- In the near term, two forms of capacity expansion can be helpful: 1) construction at congested airports of separate, short runways, equipped for instrument operations, for use by small aircraft; and 2) construction or improvement of reliever airports to accommodate GA traffic diverted from congested commercial airports.

Discussion

Some improvements can be expected from changes in ATC equipment or procedures in congested terminal areas; but the net effect on delay would be quite small. For instance, computerized airfield / airspace management might allow better utilization of existing physical capacity, so that actual operations would approach the theoretical maximum for each combination of weather and traffic conditions. The Microwave Landing System (MLS) might also allow a small increase in the number of Instrument Flight Rules (IFR) operations under certain conditions of traffic mix. In general, mostly because of the separation required by the danger of wake vortex, there will be no significant ATC-related increase in the number of aircraft operations that can be handled by a given runway, airport, or terminal area.

Past Federal, State, and local airport policy has been to provide new capacity where demand seemed to warrant it, if at all possible. Most of today's congested airports have gone through periods of major expansion, only to become saturated by subsequent growth. As urban transportation planners have discovered, *additional capacity is not always the solution to the problem of delay.* Building a new lane does not appreciably ease traffic jams on a busy freeway, for instance, because new traffic is attracted by the improved link and delays quickly reach the previous level. The same principle applies to many hub airports: the busier an airport is, the more demand there is for access to it, simply because it *is* busy and thus offers a wide choice of connections and services. Adding new capacity may merely tap this latent demand—the airport can accommodate those it couldn't handle before, but the new traffic quickly saturates the additional capacity and delay soon rises to previous levels. This doesn't mean that expansion is futile, but it should be evaluated in terms of its benefits and the available alternatives.

If expansion proves impractical, the 15 to *20* airports that will become saturated by the end of the century will probably have to make wider use of demand-managing alternatives—peak-hour pricing, quotas, or access restrictions—to deal with the problems of congestion and delay. These tools do not increase peak capacity; they shift traffic to a time or place where it can be better handled, thus increasing effective capacity. Pricing schemes to ration scarce landing slots place the greatest burden on operators of small aircraft, since they have a smaller base of passengers over which to spread cost. Administrative quotas may also tend to favor larger aircraft, which serve more passengers and generate higher landing fees. In either case, commuters and GA users will have the greatest difficulty in competing for slots at crowded airports. Not all GA activity could be displaced, since some GA flights must use the main airport to deliver passengers connecting with commercial flights. Even at the busiest airports GA operations currently tend to average about **10** percent of total operations.

The separation of fast and slow (or jet and prop) traffic is one ATC procedure that could benefit both types of traffic. Most GA and commuter aircraft can use shorter runways than those required for large jet liners, and at some busy commercial airports the construction of short runways equipped for instrument operations could allow continued accommodation of commuter and GA aircraft, and at the same time, could also allow some secondary increase in jet aircraft operations. These separate, short runways would be especially important for commuter carriers whose business depends on being able to land at major airports, and in many cases they would add more capacity relative to cost than a new mixed-traffic runway.

Another means of separating traffic that will become increasingly important is the diversion of some GA traffic from commercial airports to reliever airports. This technique has some drawbacks. For example, users may resist going to a "second best" airport which may not offer the same services or ground access as the commercial airport. On the other hand, a properly equipped GA reliever can often provide better service to nonscheduled private traffic than the main airport could. Constructing, improving, or upgrading these airports would be largely the responsibility of local authorities, but Federal assistance (in the form of the Airport Development Aid Program (ADAP) or other grants) is currently available for the 155 reliever airports included in the NAS Plan. The level of funding for relievers in the recent past has been a little under *25* percent of all grants for GA airports, or *4* to *6* percent of all airport grants.

ATC SYSTEM IMPROVEMENTS

Findings

Future improvements in the ATC svstem will be directed toward three general objectives:

- replacing obsolete equipment with improved technolog y that is more effective and reliable and less costly to operate and maintain;
- expanding system capacity to accommodate expected growth; and
- adding new capabilities to increase the productivity of the system and the efficiency of its users.

Two improvements are basic to this process: 1) achieving higher levels of automation on the ground, and 2) taking advantage of the capabilities of flight-management avionics that are appearing in the user fleets. In the *1980's*, the major effort will be devoted to replacing the computers in the en route centers, modernizing the flight service stations, and beginning the deployment of the MLS, the Discrete Address Beacon System (DABS, now Mode S), and the Traffic Alert and Collision Avoidance System (TCAS). For the *1990's*, the FAA's plans included further implementation of the Mode S data link and MLS and the start of a long-range program of automation in en route and terminal **area ATC centers. The FAA plans are undergoing a major review,** however, and there are indications that the FAA's *1982* **NAS Plan will include changes** in both technology and timing.

In general, OTA finds that the ATC system improvements previously proposed by FAA in the areas studied are technologically feasible. In four of the five major areas addressed by OTA, however, detailed cost and benefit information is not yet available. This information will be needed on all major programs before final judgment can be made on FAA proposals. The specific findings and potential issues in the five program areas studied by OTA are set forth under separate headings below.

Computer Replacement

The computers used in en route ATC centers will need to be replaced within the next 10 years because the present IBM 9020 computers do not have the computing speed or storage capacity needed to accommodate the expected growth in air traffic at the most heavily used en route centers. These computers also lack the capacity to support more automated modes of operation that FAA estimates will be needed to assure future system safety or to increase ATC system productivity. There is also concern that the cost of repairing and maintaining the present computers will become excessive, largely because the IBM 360 series computers used in the 9020 are no longer in production and replacement parts would ultimately have to be specially made.

An important issue in the computer replacement program is the procurement strategy to be followed. The program previously recommended by FAA was a total replacement strategy which would require about 10 years to complete and would entail specially designed ATC hardware and software to meet near-term needs and serve as the foundation for more advanced automation in the 1990's and beyond. The schedule called for the first operational contract to be let in **1988, with installation of production systems starting in the 1990's.** The costs of this program were at one time estimated at nearly $1.7 billion (1980 dollars), over the 1982 to 1991 period.

Alternatives to this total replacement strategy include incremental approaches which could provide relief to computer capacity problems in **a** shorter time—perhaps 3 to 4 years as compared to 10 years for total replacement. For example, a "software first" approach would focus on rewriting ATC software to reflect modern modular programing techniques. Then software for particular ATC functions could be gradually transferred to new computers which would at first supplement and finally replace the 9020s. A "hardware first" strategy would involve transferring (rehosting) the existing software package to a new computer. Later this software could be modified along more modern lines or totally replaced to support new functions and services.

There are technical difficulties to be overcome in each of these incremental strategies, but they have the advantages of allowing the replacement process to begin quickly. The use of off-the-shelf hardware would appear to offer some cost savings over specially designed equipment. Further it would ensure that compatible hardware is available to upgrade or expand the system at a future date.

Automated En Route Air Traffic Control (AERA)

Part of the rationale for en route computer replacement is to satisfy the long-term evolutionary requirements that are now defined in a general way under the concept of AERA. The essence of this concept is to transfer from controllers to computers some routine activities, such as separating and metering aircraft or formulating and delivering clearances. Relieved of these routine tasks, the controller's role would be primarily to handle exceptions and emergencies and to oversee (manage) the operation of automated ATC equipment. Automation could achieve several benefits: increasing controller productivity and reducing FAA personnel costs; reducing user costs by permitting wider use of fuel-efficient flight profiles; accommodating more operations; and reducing system errors.

The AERA concept requires a great amount of ground-based data processing to perform extensive and detailed management of aircraft flight paths. It could also reduce many of the procedural constraints now imposed on the use of airspace. In effect, it would be a system of management by exception: intervention by a controller would be limited to circumstances or localities where conflicts could not be reliably resolved by computer algorithms.

The major advantage claimed for AERA, aside from more comprehensive management of traffic, would be a substantial increase in controller productivity. It is contemplated that AERA control sectors would be staffed by one or perhaps two (rather than the present three) controllers and that the volume of airspace controlled would be several times the size of present en route sectors. A substantially greater number of aircraft could thus be handled by a controller team. On the other hand, this load would almost certainly be heavier than human operators could handle in the event of computer failure. As a result, the AERA concept includes provisions for automated backup for automated functions, as well as a computer design that will allow the system to "coast" safely while backup procedures are being initiated.

It must be emphasized that at present AERA is only in an early stage of development. Extensive efforts over perhaps 5 to 10 years will be needed to bring AERA to a precise and detailed definition of requirements and equipment specifications.

Three major features of AERA are already apparent. First, AERA would require computer capacity and software substantially beyond that now available in ATC applications, although not beyond the present or readily foreseeable state of technology. Second, AERA will require a two-way data link capable of rapid and extensive exchange of information between the air and the ground. FAA now envisions that Mode S will provide this data link, but other possibilities could be considered. Third, AERA implies a like degree of automation in the terminal areas and in a central flow management facility capable of coordinating traffic throughout the ATC system. This last point is particularly important for both short-term computer replacement *and* long-term system design, since it implies the advisability of procuring a computer having a modular architecture. This would make it possible for en route and terminal facilities to utilize similar hardware and software; it would also encourage a flexible system design, in which individual modules would be capable of mutual support and backup in the event of partial equipment failure.

Close scrutiny by Congress will be needed as FAA's plans mature. One major issue is likely to be the acceptability to the users and controllers of an ATC system automated to the degree envisioned in the AERA concept, especially its safety and operational reliability. A second major issue will be evaluation of the savings in operation and maintenance ascribed to AERA, compared to the needed investments in facilities and equipment to implement the system. A corollary issue will be the costs and benefits to various classes of airspace users. The information to support judgments on these matters is not now available, and OTA can reach no conclusion beyond the general observation that resolving these issues is likely to be far more important than seeking answers to the rather narrow question of technical feasibility.

Mode S Data Link

Another key element in the FAA's overall plan for improving the ATC system is the Mode S data link, an improvement to the secondary surveillance radar that allows properly equipped aircraft to be interrogated selectively by ground stations. Mode S provides greater surveillance accuracy than the present Air Traffic Control Radar Beacon System (ATCRBS) equipment and avoids the problem of "synchronous garble" that occurs when more than one aircraft respond simultaneously to interrogation. The discrete address capability also provides a two-way ground-to-air data link to transmit clearances, weather information, traffic advisories, control instructions, and flight data automatically in a digital format without using VHF voice channels. The Mode S data link feature provides the basis for automation of ATC functions and other system improvements in the years beyond 1990.

Mode S has been under development by FAA for nearly 10 years at an estimated cost to date of $58 million. The first prototype unit was delivered for test and evaluation in 1978, and a contract for initial production will be awarded in 1982. FAA has not yet issued a formal implementation plan, but the preliminary plan calls for a multiyear procurement and deployment starting in 1986, at 197 sites—97 in terminal areas and 36 in the en route system, plus 60 **for low-altitude coverage and 4 at support facilities.**

Deployment at these 197 sites would not constitute full implementation of Mode S. Additional installations, which would not be completed until early in the next century, might be

needed at another 100 sites to provide coverage down to *6,000* ft for the continental United States and perhaps portions of Hawaii and Alaska.

An issue that will need to be addressed during examination of the plans for Mode S has to do with the extent to which a Mode S transponder would be required before permitting an aircraft to enter airspace or receive services (e.g. access to and operation in a terminal control area [TCA]). Mode S and ATCRBS Mode C are compatible, so that in the short run either system would qualify users to operate in TCA. GA operators, however, have expressed concern **that the Mode S format would eventually supplant ATCRBS Modes A and C and that they would be required to reequip their aircraft with Mode S transponders. This concern would be reduced by assurances that ATCRBS could be utilized for an extended period following the initial implementation of Mode S.**

Collision Avoidance

The primary function of air traffic control is to assure the safe separation of aircraft. In the present system, this is accomplished by controllers on the ground using surveillance radar and computer aids; when conflict is detected, the controllers use voice radio to advise pilots of traffic or instruct them to perform appropriate avoidance maneuvers. At present, the pilot has no instrument or display in the cockpit to identify potential threats or to indicate a maneuver that would resolve a conflict.

For many years, FAA (in cooperation with the aviation community) has investigated a number of collision avoidance systems that would provide a backup (rather than a substitute) for the current ATC procedures and ground-based separation assurance service. During the summer of **1981, FAA selected a system known as TCAS. FAA plans for TCAS to be operational by the end of 1984, a goal that is considered by some to be optimistic. FAA has justified the choice of TCAS on the following grounds**:

- **it does not require ground-based equipment;**
- it is compatible with the present ATC system and is a logical extension of it;
- it offers a range of capabilities suitable to the needs of the various classes of airspace users; and
- it is more suitable for use in high-density traffic than the Beacon Collision Avoidance System (BCAS), the system that was favored by the FAA prior to the TCAS decision.

TCAS provides the user with protection from other aircraft regardless of whether they are equipped with TCAS or the standard ATCRBS transponder. In the active mode, TCAS interrogates other aircraft to determine whether they are threats. TCAS also identifies potential threats from ATCRBS-equipped aircraft by monitoring their replies to interrogations from the ground. A central feature of TCAS is the use of the Mode S transponder for the communication of data between aircraft. TCAS 1, the system intended for use by general aviation, provides general Mode S capability and would cost $2,500 to $3,500 per aircraft. TCAS II, the version intended for use by commercial aircraft, would cost between *$40,000* and $50,000 per set, plus the cost of antennas and installation. Some believe these estimates to be low. TCAS requires essentially no expenditures by FAA, except for development and certification costs; but since it will require Mode S for identification and data link, aircraft equipped with TCAS will be prepared to take advantage of any new services requiring **data link that may be offered by FAA.**

Although FAA has decided that it will certify TCAS as the collision avoidance system to be used in the United States, not all features of the system have been developed and demonstrated. The TCAS II direction-finding antenna is of critical importance: there is some question regarding the aerodynamic effects of the antenna on aircraft performance, particularly the performance of tactical military aircraft. TCAS I, on the other hand, has been demonstrated; but it is not clear how useful this more basic form will be since it only indicates the proximity of another aircraft without providing either bearing or range.

Prior to selecting TCAS, FAA was pursuing development of active BCAS. Because there was concern that omnidirectional BCAS might interfere with the surveillance system in congested areas by saturating ATCRBS transponders, FAA was also planning to base conflict resolution in areas of high traffic density on DABS/Automatic Traffic Advisory and Resolution Service (ATARS), a ground-based system that would require expenditures of **$518 million to equip terminal and en route facilities.** The decision to adopt TCAS has led FAA to reevaluate the need for DABS/ATARS.

Microwave Landing System

Another important component in the FAA's development plans is MLS, a precision landing aid designed as a replacement for the Instrument Landing System (ILS) that has been in use since the early *1940's.* MLS is less sensitive to interference and distortions than ILS and will work at sites where it is difficult or impossible to install ILS. It is also anticipated that MLS equipment will be more reliable than ILS. The chief operational advantage of MLS is that it permits variable glide slopes, curved and segmented approaches, and precision missed approaches, where ILS does not. This would allow traffic to be routed around noise-sensitive areas and would also allow greater flexibility in handling traffic in crowded TCAS. MLS can operate on *200* channels (compared to *20* for ILS) making it possible to provide precision landing aid in **areas** where closely spaced airports limit the availability of ILS channels.

FAA has announced plans to implement MLS in three phases over the coming 11 to **16 years,** with *1,200* to 1,400 systems eventually installed. In the first phase, between 10 and *25* systems will be installed at selected airports in order to develop a base of experience and reach an empirical determination of the benefits that can be realized. The second phase would be the installation of 900 MLS units at the rate of 100 to *150* per year for a period of 6 to 9 years, with priority given to large and medium hub airports and those where ILS siting problems exist. The third phase would consist of installing of an additional 300 to 500 systems to meet the growth in demand anticipated during the remainder of this century. FAA estimates the cost of 1,425 MLS ground systems to be $1.332 billion (1981 dollars), and users will be required to spend an additional $895 million for avionics if they wish to take advantage of this service.

OTA finds that the FAA's analysis of MLS benefits and costs does not establish a clear and universal case for MLS as opposed to ILS, and that for this reason the FAA plan for a first phase to gain the operational experience before the full deployment of MLS is entirely reasonable. However, at the end of the initial phase, it would be appropriate to conduct a comprehensive review of the MLS program before proceeding with further implementation. A part of this review should be development of additional increments or intermediate steps between the *25* sites planned for **Phase I and the 900 planned for Phase II. Another part of this review should be** more specific benefit-cost analyses that differentiate and specify the **benefits at** various airports in terms of levels of traffic, the types of users served, and the resulting reductions in noise, delay, or fuel consumption.

FUNDING AND COST ALLOCATION ISSUES

Findings

The program of airport development and ATC system improvement through 1991 previously proposed by FAA would require an expenditure of *$1.6* billion to $1.9 billion per year, or about *50* to 75 percent above the spending level of recent years in real terms. Implicit in these figures is a commitment to spend roughly equal sums annually from 1992 to 2000 in order to complete programs already initiated and to undertake further improvements of the airport and airways system. These figures may change, however, as a result of changes in the forthcoming NAS Plan.

Historically, such expenditures have been financed from the Airport and Airways Trust Fund, which lapsed in October 1980 but had an uncommitted balance of about $3 billion at the end of fiscal year 1981. This sum would cover less than *20* **percent of the 1982-91 programs contemplated by FAA.**

Congress has two basic options to provide funding for the developing airports and airways over the coming years. One would be to cover these expenditures wholly by appropriations from general funds. The other involves funding through user charges by reestablishment of the trust fund in some form, including:

- Reestablishment of the trust fund with a revenue and user charges similar to those which existed prior to October 1980. This *would not cover the 1982-91 program of capital spending if—as in the past—some trust fund revenues were also spent* for O&M.
- Reestablishment of the trust fund, retaining the present forms of funding but increasing user charges to make revenues match projected expenditures. Rates could be raised either uniformly (across the board) or selectively (to alter the mix of contributions from various user classes).
- Reestablishment of the trust fund, but with a different form of user charges. Existing excise taxes might be replaced with user levies that would reflect more accurately the magnitude of the benefits received by various classes of users, or by a system that would charge individual users in relation to the costs they impose on the airport and airways system.

All of these options would be controversial and would exacerbate many long-standing issues pertaining to access to the system, user cost allocation, and subsidies to aviation. The search for a solution is further complicated by the fact that the cost of operating the airport and airways system would also be rising at the same time.

The disagreements over funding airport and airways improvements are so wide, and the sums so large, that the debate could conceivably extend over a number of years. To the degree that such a stalemate delays the funding of the FAA's proposed programs, some of the following courses of action might have to be considered:

- keep the existing equipment running as well as possible, with administrative restrictions on traffic levels as needed to keep demand within capacity;
- cut back on the proposed plans, dispensing with some improvements and funding only those for which there is the greatest or most immediate need;
- stretch out the procurement process over a longer period of time, in order to hold expenditures within the available revenues; or
- consider alternative technologies or funding mechanisms that shift more of the cost of the system to airspace users.

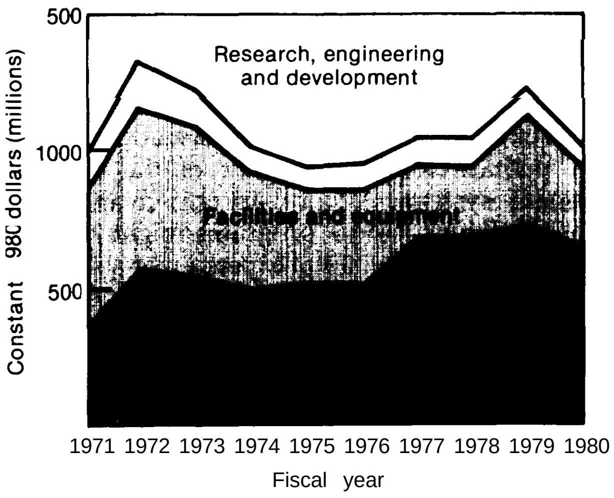
Discussion

Capital expenditures for airport capacity improvements and new ATC technology planned for the coming decade would result in a sharp increase in the FAA budget compared to the funding levels of the past 10 years. The combined expenditures for airport grants-in-aid, for ATC facilities and equipment (F&E), and for associated research, engineering, and development (RE&D) were in the range of $0.95 billion to $1.35 billion **per year (in** constant 1980 dollars) between 1971 and 1980 (see fig. 29). * Capital expenditures for fiscal year 1982 to fiscal year 1991 could total between $16 billion and $19 billion (1980 dollars), with *$4.5* billion to *$6* billion allocated to airport grants in aid, $10 billion to $11 billion for F&E, and $1.5 billion to $2 billion for RE&D. The combined outlay in these categories would amount to $1.6 billion to $1.9 billion per year, a real increase of 50 to 75 percent over the 1971-80 average.

A large part of airport expenditures throughout the 1982-91 period would be allocated to capacity increases at congested hub airports and development of GA reliever airports to take some of the pressure off large and medium hubs.

*In fiscal year 1980, the total in these three categories was **$950 million;** in fiscal year **1981, $885** million.

Figure 29.—Airport and Airways Trust Fund Expenditure 1971-80*



*Appropriations in various years for operating and maintenance expenses, totaling $3,370 million, are not shown. **They amount to about 30 percent of all trust fund expenditures.**

SOURCE: *FAA Monthly Management Report,* March 1981.

In the near term, the bulk of the F&E expenditures would be for replacement of en route computers, the first stages of MLS and Mode S implementation, and modernization of flight service stations. Beyond 1990, the major F&E expenditures would be for completion of en route automation, initiation of terminal area automation, and further deployment of MLS. Programs such as MLS, Mode S, and terminal and en route automation would not be completed by 1991; there would be a foIlow-on requirement for an additional funding in the 1990's to carry these programs to completion and to initiate further ATC technology improvements.

The FAA's justification for these planned expenditures is that they will be needed to relieve airport congestion, to enable the ATC system to handle higher traffic levels without compromise of safety, and to improve the efficiency (productivity) of the ATC system. Increasing productivity is especially important in view of the projected increase in aircraft operations and the resulting rise in ATC costs that would occur over the next 10 years if automated en route, terminal, and flight service station equipment were not installed.

Since establishment of the Airport and Airways Development Program in 1970, expenditures for airport improvements and ATC facilities and equipment, including the associated RE&D, have been financed by the Airport and Airways Trust Fund. Between fiscal year 1971 and fiscal year 1980, the trust fund provided $4 billion in airport grants, $2.6 billion for F&E, and $0.7 billion for RE&D. During the same period, the trust fund also provided almost $2.2 billion for O&M expenses of the ATC system. Expenditures from the trust fund have never exceeded revenues, and as of the end of fiscal year 1981 the trust fund had an uncommitted balance of about $3 billion.

The principal source of revenue for the trust fund through fiscal year 1980 was an 8-percent tax on domestic airline tickets. Other taxes contributing to a lesser extent were a 5-percent waybill tax on air cargo, a 7 cents per gallon tax on jet fuel and gasoline used by GA, a $3 international departure tax, an aircraft use tax for propeller aircraft, and taxes on airplane tires and tubes. In fiscal year 1980, these taxes contributed $1.87 billion to the trust fund, with 85 percent coming from the domestic airline passenger ticket tax.

On October 1, 1980, the legislative authorization of ADAP and the trust fund expired and Congress declined to pass reauthorizing legislation. Since then, receipts from the passenger ticket tax (reduced to 5 percent) have been remitted to the general fund. The air cargo waybill, international departure, and aircraft use taxes have been abolished. Revenues from the tax on aviation gasoline *(4* cents per gallon) and tube and tire taxes have been remitted to the Highway Trust Fund.

There are now several bills before Congress that would restore the trust fund. These proposals include provision for airline passenger ticket taxes between 4 and *6.5* percent, taxes on GA fuel, an air cargo waybill tax of 2 to 5 percent, and a **$1 to** *$5* **international departure** tax. *

● Generally, the Administration's proposal provides for higher tax rates than any of the House or Senate bills. The tax rate for GA jet fuel under the Administration's proposal would be **20 cents per** gallon initially, rising to **65 cents** per gallon by fiscal year **1986.** The tax on aviation gasoline would rise from 12 cents per gallon in fiscal year **1982 to 36 cents** per gallon in fiscal year 1986. In congressional proposals, the tax on fuel ranges from 4 cents to 8.5 cents per gallon.

Many Members of Congress have voiced strong opposition to reestablishing the trust fund or increasing the present user taxes so long as there is a large uncommitted balance in the trust fund. Sponsors of the various bills have pointed out that reauthorization of trust fund taxes in some form will be necessary to provide revenue for projected airport and ATC capital improvements. They also point out that the trust fund is consistent with the position of the present Administration that, e.g., whenever the Federal Government provides a service directly to a particular industry, those who receive the benefit should bear the cost.

Regardless of the action taken on these proposals, the Administration and Congress will, in the long run, have to grapple with the question of how to finance planned airport and ATC capital expenses. The balance in the trust fund now would cover less than *20* percent of the outlays by FAA for 1982-91. If these funds were to be expended at the fiscal year 1981 rate of $1.6 billion annually and no new taxes were authorized, the trust fund would be exhausted by the end of 1983. Even if the most ambitious of the current tax proposals were to be enacted and if trust fund moneys **were also used to defray about one-quarter of** O&M **expenses (as** they were in fiscal **year 1980), trust fund revenues would probably be insufficient to meet planned capital expenditure and O&M costs beyond 1987 or 1988.**

Some of the implications of providing funding for FAA airport and airways programs by appropriations from the general fund or, alternatively, by reauthorization of the trust fund are discussed below.

General Fund

Capital expenditures for airports and airways could be financed from general revenues through annual appropriations. There are numerous precedents for this in other areas although it runs counter to the 10-year Federal policy of financing airport and airways improvements through a dedicated trust fund supported by user charges. Funding from general revenues has the basic advantage of giving the Congress close control of FAA capital programs through the annual appropriations process. On the other hand, financing from general revenues has several major disadvantages: it introduces additional uncertainty in to the funding process and might make it difficult to plan and implement long-range programs, which might be canceled or delayed during periods of budget austerity, perhaps to the detriment of the national airspace system. A corollary disadvantage is that the FAA's capital programs might have to compete with operational expenses for a share of the FAA budget and (if a choice had to be made) operational expenditures would probably receive first consideration since they cannot be deferred or curtailed as easily as capital expenditures.

Perhaps the greatest objection to general fund financing, however, has been that it would constitute a subsidy of aviation by the public, many of whom would receive no direct benefit: one-third of the adult population in the United States has never flown, and fewer than 10 percent use commercial or general aviation on a regular basis. Such an approach, it is argued, would also contradict the economic precept that the users of a special service should bear the cost of that service—a view that the present Administration has advocated strongly. It is argued by some, however, that the general public also benefits in many indirect ways from services provided to the aviation community, including mail service and air freight as well as use of the system by military aircraft.

Trust Fund

Financing airport and airways improvements from a trust fund, either like that which existed prior to October 1980 or in a modified form, is an approach favored by many observers. It provides a continuing and stable source of funds earmarked for capital programs, and it secures those funds directly from users of the system. On the other hand, it has the general disadvantage of any sort of trust fund: the statutory restrictions on the purposes for which moneys may be used might limit Congress' flexibility in meeting other, perhaps more pressing, needs. The long-standing controversy over use of Airport and Airways Trust Fund monies for meeting annual O&M expenses of FAA is a clear illustration of this.

If Congress elects to continue the trust fund approach, as most of the pending bills pertaining to funding FAA's capital programs now propose, there are several options open:

- *Reauthorize the Airport and Airways Trust Fund as it existed before October 1980,* This fund, supported by various user excise taxes, would provide for some or all of FAA's capital expenditures over the coming decade. Whether it could also meet some portion of operating expenses would depend on the rates established for the various user taxes. Much of the current debate in Congress is on this specific point: i.e., the appropriate amount of taxation to be imposed on each class of airspace user.
- *Retain the tax mechanisms of the former trust fund but substantially alter the scheme of taxation, so* that each category of users would pay a share more nearly proportionate to the benefits they received. In the trust fund as constituted before October 1980, commercial aviation (domestic and international air carriers and air cargo airlines) contributed 93 percent of the revenues but, according to cost allocation studies by DOT and FAA, received a smaller share of the benefits—in effect, cross-subsidizing GA. Since nearly all of the revenues from commercial aviation were derived from the tax on airline tickets, *the subsidy to GA was actually provided by airline passengers,* not airlines. The Administration's recent proposal would redress this imbalance somewhat by greatly increasing the tax on fuel for GA aircraft, but it would probably still fall short of levying charges on GA commensurate with the benefits received, especially by business aircraft operating in and out of hub airports.

  Private GA operators and the makers of GA aircraft have vigorously opposed such tax schemes, on the *grounds* that Visual Flight Rules (VFR) and IFR users impose greatly different costs on the ATC system, and that high fuel taxes would reduce aircraft utilization in the short run and reduce sales of GA aircraft in the long run. They also state that the ATC system was designed to meet the needs of air carriers, and a few hub airports, with facilities and services that GA users neither asked for, nor want, nor need. In this sense, some GA users claim that they subsidize commercial air traffic. A third, and perhaps more fundamental, objection raised by GA is that there is no accurate method of determining the value of the benefits received by GA or any other class of airspace user, and hence no sound basis for establishing an appropriate level of taxation.
- Levy charges on users, either based on the actual use they make of the airport and airways system or based on the burden they place on the system to provide various types of services. The United States maybe the only major nation that does not routinely charge for the use of its airspace; many countries in Europe and elsewhere in the world levy charges for the use of terminal and en route airspace (based on distance, time, and type of service provided), in addition to landing fees like those collected in this country to defray the costs of airport construction, maintenance, and operation. The chief conceptual problem is how to quantify user benefits or determine the cost of a service. Two major attempts by FAA and the Department of Transportation (DOT) to develop such a methodology, the cost allocation studies of 1973 and 1978,'[2] met with major objections from various aviation groups on the grounds that costs could not be determined with sufficient accuracy and that an equitable formula for allocating costs had not been developed.

Assuming that the methodological problems could be overcome, there would still remain practical problems of how to assess user charges. The simplest and most direct method would be a

'*Airport and Airway Cost Allocation Study: Determination, Allocation, and Recovery of System Costs* (Washington, D. C., U.S. Department of Transportation, September 1973).

'*Financing the Airport and Air-may System: Cost Allocation and Recovery*, FAA-AVP-78-14 (Washington, D. C.: Federal Aviation Administration, November 1978).

charge for service at the time a flight plan is filed. While this would capture fees from IFR users, it might encourage some GA operators to fly "off the system" (i.e. VFR to smaller airports) in order to avoid airport and airway charges, perhaps to the detriment of safety. It would also create a bookkeeping and administrative task for FAA in levying charges for use of the system.

A second possibility would be to require all aircraft to have a transponder and to use surveillance data to compute charges based on the time in the system and the type of service received. While this would free users from financial transactions when they file flight plans, it would still impose on the ATC system a requirement for recording and billing user charges. In addition, the universal requirement for a transponder would be viewed by many owners of small GA aircraft as an extreme form of regimentation. A third possibility involves approximation of user costs through a combination of fixed and variable assessments on aircraft owners: fixed charges could be collected in the form of annual taxes based on aircraft occupants (including flight crew) according to aircraft characteristics or type of use.

Operating Costs

A corollary problem that Congress will have to deal with is how to meet the operating costs of the system. (Many of the planned capital improvements are intended to *reduce* these costs in the long term.) If these costs are covered primarily by appropriations from general revenues (the practice of many years), the taxpayers would be subsidizing special services for a mode of transportation that only a few use directly, although they may receive some indirect benefit. If paid wholly or largely by disbursements from the trust fund, as the Administration proposes and many Members of Congress oppose, the pressures on the trust fund would be greatly intensified. Over two-thirds of the FAA's annual budget goes to meet operating costs, but disbursements from the trust fund have covered only about 15 percent of these expenses in the past. To take a more substantial portion of operational expenses from the trust fund, as it is presently structured, would exhaust the current surplus in a very short time. To prevent this, and at the same time provide for needed capital investments, the taxes supporting the trust fund would have to be increased to yield significantly more revenue than contemplated by any of the legislative proposals before the Congress at this time. A tax increase of this magnitude would raise all of the issues cited earlier in connection with capital funding options and greatly exacerbate the conflict among the various stakeholders in the aviation community.

PENDING LEGISLATION

Areas of congressional interest in the airport and air traffic control system include system modernization (especially system automation and the replacement of the en route computers), airport development, trust fund usage, and user charges. This section briefly reviews congressional activities in the past 2 years, outlines the positions taken by various congressional committees on key issues, and identifies the major legislation now before Congress.

System Modernization

Major capital expenditures like the en route computer replacement have been the subject of several congressional hearings and investigations. A recurring question has been the FAA's ability to plan and manage such a complex procurement.

In October 1980, the investigations staff of the Senate Committee on Appropriations released a report criticizing the FAA's management of the existing ATC computer system. The report cited weaknesses in the reporting of equipment outages, a lack of planning, and the absence of a well-defined approach to managing system operations and software changes. The investigators recommended the Congress withhold funding for computer replacement until the FAA had demonstrated a better understanding of the capabilities and limitations of the existing system.

The report outlined specific actions FAA should take to improve its performance and evaluation methods.[3]

After two sets of hearings on the safety aspects of computer outages, the House Committee on Government Operations raised many of the same questions in October 1981. Their report found that the FAA's management information system did not provide accurate data on which to base important decisions about the reliability of the computer. The committee also questioned the FAA's ability to plan and manage the development and procurement of a new computer system. The report directed the General Accounting Office (GAO) to initiate a "comprehensive investigation of the FAA's planning, management, and acquisition of automated information systems."[4] The GAO final report, due in October 1982, will cover FAA planning and management for acquisitions in three areas: ATC system automation, management information systems, and peripheral equipment.

The Subcommittee on Transportation of the House Committee on Science and Technology, which has shown a continuing interest in the ATC computer question, has stated that the current computer system needs to be replaced and that unnecessary delay in doing so would pose safety risks and increase the chances of further breakdowns. in reviewing the alternatives for replacing the system, the subcommittee's report of August 1981 favored a full modernization of the computer system, as opposed to an interim replacement followed by a long-range procurement. The full committee recommended that FAA publish a management plan detailing the costs, schedules, milestones, and funding plans for the computer replacement.'

'U.S. Congress, Senate Investigations Staff, ***FAA En Route Air Traffic Control* Computer System,** submitted to the Subcommittee on Transportation and Related Agencies, Committee on Commerce, Science and Transportation, Rpt. No. 80-5, October 1980.

'U.S. Congress, House, Committee on Government Operations, *Air **Traffic** Control **Computer*** Failures, Rpt. No. 97-137, June 11, 1981.

'U.S. Congress, House, Committee on Science and Technology. Subcommittee on Transportation, Aviation and Materials, Air *Traffic Control En Route Computer Modernization*, Rpt. No. 97-12, August 1981.

To give further emphasis to these findings and recommendations subcommittee chairman, Representative Dan Glickman introduced **H. Res.** *202* in October 1981, which expressed the sense of the House that FAA should consult with the Committee on Science and Technology as it develops plans for the future ATC system. It also directed FAA to make regular reports to the committee, commencing with a system description in December 1981 and a preliminary subsystem description in June 1982. This resolution was passed by the House on October 19, 1981.

Airport Development Aid

The Federal role in airport development was previously governed by the Airport and Airways Development Act of *1970,* which expired in October *1980* when the Congress could not agree to new authorizing legislation. Projects extending into fiscal year *1981 were* funded, but no authorizations have been made for future years. In writing new authorizing legislation in 1981, the question of "defederalization" has been a major issue. Defederalization would remove large and medium hub airports from eligibility for ADAP funding, on the grounds that these airports generate enough revenues to be self-supporting without Federal aid.

The Senate version of the authorizing legislation, *S.508,* would make the top *69* air carrier airports ineligible for airport development and planning grants. The Administration position, as contained in H.R. 2930 called for a more modest defederalization measure, making the top *42* airports ineligible for aid. These airports would be permitted to impose a limited passenger facility charge (head tax) to make up lost revenues (head taxes are currently forbidden at all airports that have received Federal aid). The report on S.508 by the Senate Committee on Commerce, Science, and Transportation supports the defederalization concept and notes that ADAP funds make up a fairly small proportion of the total capital and operating budgets of larger airports. If they were made ineligible, the report points out, more Federal funds would be available for small airports unable to generate their own funds. Because the Senate bill limits the total authorization to $450 million annually for 5 years (1981-86), it is necessary to make those funds available to those who need them most.[6]

The House version of the authorizing legislation, H.R. 2643, contains no provision for defederalization, and members of the Committee on Public Works who sponsored the House version have expressed opposition to the concept. Questions of equity are involved: opponents of defederalization are concerned that passengers using major airports would have to bear a double tax—the Federal ticket tax in addition to any local passenger facility charge. Further, the ticket tax on passengers at large airports already generates the bulk of revenues in the Airport and Airways Trust Fund, and it seems unfair to forbid these airports the use of those funds. The House bill proposes a $450 million annual authorization for 3 fiscal years. ’

Trust Fund Usage

The uncommitted balance in the trust fund (about *$3 billion at the* end of fiscal year 1981) has long been a cause of controversy in Congress and among users. The Senate Committee on Commerce, Science, and Transportation attributes this balance to the fact that the OMB under previous administrations has sought to keep trust fund revenues high and expenditures low. The current administration has proposed drawing down the balance significantly by funding *85* to 100 percent of the FAA's operations and maintenance costs out of the trust fund, in addition to capital costs. For example, the administration budget recommended financing expenditures such as aviation security and aircraft inspection from the trust fund. Both Senate and House Committees on Appropriations, however, have continued to allow these regulatory and police functions to be funded from general funds.[8]

The Senate Committee on Commerce, Science, and Transportation stated that the airport and airway system provides benefit to the general public and therefore the general fund should continue to contribute to its operation.[8] Although many in Congress agree that something should be done to reduce the balance, some Members feel that taking operating costs out of the trust fund constitutes "raiding" the users' funds, which were collected for the purpose of improving the airways system, to subsidize activities that should be paid for out of general revenues. The DOT appropriations bill for fiscal year *1981,* in both House and Senate versions, appropriated funds from the trust fund to cover about one-third of operating costs, about double the average share of the past 10 years. **H.R. 2643, as reported by the Committee on Public Works, authorizes a ceiling of 50 percent on operating costs to be taken from the trust fund in future years; S.508 authorizes a ceiling of about one-third on operating costs to be taken from the trust fund.**

User Taxes

Current proposals for reestablishing the trust fund call for no major changes in the user tax structure. **In general, the House, Senate, and administration positions on user charges have simply been differences in the level of tax in the traditional categories:**

- **The administration proposal, embodied in S. 1047, calls for the greatest increase in user taxes. It differentiates between GA gas taxes and GA jet fuel taxes, taxing gas at 12 cents per gallon (rising to** 36 cents in fiscal year 1986) and jet fuel taxes at 20 cents (rising to *65* cents). The passenger ticket tax would be set at 6.5 percent, the waybill tax at 5 percent, and an international facilities charge of $3 per passenger would be authorized.
- Another bill, S. 1272, cosponsored by several members of the Senate Committee on Commerce, Science, and Transportation, calls for an 8.5 cent tax for all GA fuels, a 3 percent ticket tax, a 2 percent waybill tax, and a $1 international facilities charge.

‘U.S. Congress, Senate, Committee on Commerce, Science, and Transportation, Report to Accompany S.508, Airport and Airway System Development Act of 1981, S. Rpt. 97-97, May 15, 1981.

‘U.S. Congress, House, Committee on Public Works and Transportation, Report to Accompany H.R. 2643, Airport and Airway Improvement Act of 1981, H. Rpt. 97-24 (Part II), May 19, 1981.

‘U.S. Congress, House, Committee of Conference for the Department of Transportation and Related Agencies for the fiscal year ending Sept. 30, 1982, Conference Report to Accompany H.R. 4209, H. Rpt. 97-331, Nov. 13, 1981.

‘Senate Commerce, Science and Transportation, S. Rpt. 97-97 op. cit.

- A House bill, H.R. 4800, calls for a 12.5 cents tax on all GA fuels, a 5 percent ticket tax and a $5 international facilities tax.

These measures are still under consideration by the Senate Committee on Finance and House Committee on Ways and Means, and it is uncertain how they will appear after committee markup. Part of the difficulty in reaching a decision on the tax level is the current uncommitted balance in the trust fund and the unwillingness of both past and present administrations to spend the money for its specified purposes. Members of the Senate Commerce Subcommittee on Aviation and the House Science and Technology Subcommittee on Transportation, Aviation, and Materials have stated they do not favor sharp increases in user charges until some use is made of the existing balance.[10]

The uncertainty about the costs and timing of future capital expenditures also clouds the discussion of tax levels. The options appear to be: 1) increase taxes to maintain a substantial balance in the trust fund in anticipation of large future expenditures, recognizing that the current balance could not cover the proposed program of system modernization; or 2) allow the trust fund to be depleted, knowing that revenues will have to be greatly increased later if these future expenditures are to be paid for by user taxes.

[10] *Aviation Daily*, Nov. 19, 1981, p. 102.

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