United States General Accounting Office

GAO

Report to Congressional Committees and the National Civil Aviation Review Commission

April 1997

AIRPORT DEVELOPMENT NEEDS

Estimating Future Costs

GAO/RCED-97-99

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-275248

April 7, 1997

Congressional Committees and the
National Civil Aviation Review Commission

There has been an ongoing debate in recent years over the amount of capital investment required at the nation's airports. While no one disputes that upholding the integrity of the nation's airport system requires continual capital investment, from repairing runways to constructing new terminals, the estimates of how much this is likely to cost have varied widely. In 1996, airport representatives estimated costs at $10 billion per year, while airline representatives estimated costs at $4 billion per year. The Federal Aviation Administration (FAA) estimated that airport capital needs were roughly between the two other estimates, at $6.5 billion annually.

As part of the FAA Reauthorization Act of 1996 (P.L. 104-264, section 274(e)), the Congress directed us to provide an independent assessment of airport development needs to it and to the National Civil Aviation Review Commission established by the same act. A clear understanding of these capital development needs is an important step in agreeing on the future funding levels for airport grants and on passenger facility charges. On the basis of our discussions with the House and Senate aviation subcommittees, we agreed to the following objectives for our review:

- Compare the estimated capital development needs made by airport and airline groups and FAA to determine why they differ.
- Provide an up-to-date range of estimates of what airport capital development needs are likely to be for the 5-year period from 1997 through 2001.
- Identify the key factors that affect airport capital development needs and determine how these factors are likely to affect such needs during the next 5 years.

Results in Brief

The main reason for the differences in the airports', the airlines', and FAA's estimates of airport capital needs is that they are based on widely divergent views about which types of development projects and airports to include in their estimates. In estimating annual needs of $10 billion, airport representatives defined needs broadly to include all projects, whether they are eligible for federal grants or not, at the more than 3,300 airports that make up the national airport system. Conversely, in arriving at an estimate

of about $4 billion annually, the airlines defined needs more narrowly to include almost exclusively those projects eligible for federal grants at the 421 largest commercial airports. FAA's estimate of $6.5 billion annually was based only on those projects eligible for federal grants but at all airports in the national system.

Using the most current and complete data—compiled from FAA, airports, state aviation agencies, and private sources—we developed four estimates ranging from $1.4 billion to $10.1 billion annually for the 5-year period from 1997 through 2001, depending on how needs are defined. We believe that providing a range of estimates for future airport capital needs is more useful than a single estimate because it provides various perspectives for policymakers to consider. The estimate of $1.4 billion per year is based on narrowly defining needs to include only projects eligible for federal grants to meet safety, security, and environmental needs as well as to maintain the existing infrastructure at the airports in the national system, but it does not include the bulk of other needs, such as projects to improve or expand airport infrastructure. The estimate of $10.1 billion per year is based on broadly defining needs to include all projects, regardless of priority or grant eligibility, at all airports that are, or are currently planned to become, eligible to receive federal or state support. Regardless of how needs are defined, estimates will not necessarily correspond to how much airports will ultimately spend on capital development because of limitations in estimating future needs and projected costs, unanticipated needs, complexities in decision-making, and funding constraints.

Several key factors influence airport capital development needs, most notably growth in aviation activity and meeting FAA-recommended design standards (such as runway length) to achieve full productivity for the aircraft already using the airport. These two factors account for two-thirds of the estimated $30.6 billion in projects eligible for federal grants over the next 5 years at airports in the national system. Three other factors—the reconstruction of existing infrastructure that is beyond its useful life, upgrades to the existing infrastructure to prepare the airport facilities to accommodate the introduction of different aircraft, and addressing safety, security, and environmental concerns—account for the remaining one-third of planned capital development projects.

Background

Understanding the differences between the capital needs estimates requires some knowledge about the various types of U.S. airports, FAA's system for tracking airport capital development needs and providing

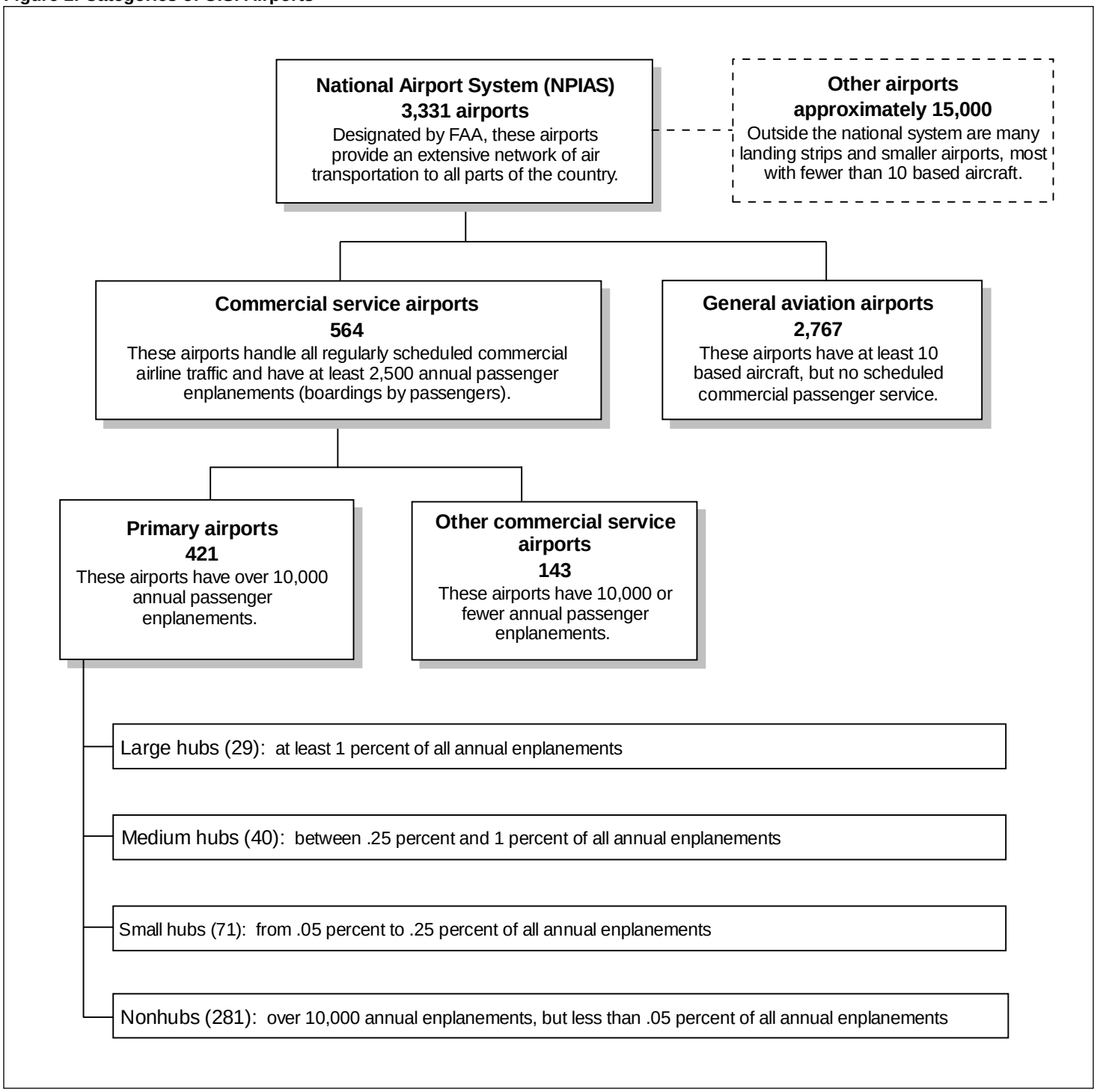
federal grants, and other sources of capital funding used by airports. The sections that follow present an overview of these topics.

The Multitiered System of U.S. Airports

The United States accounts for approximately 40 percent of all commercial aviation activity and 50 percent of all general aviation activity in the world. As of March 1997, there were 18,224 public and private airports in the United States, from large commercial airports, such as Chicago O'Hare International Airport that handles more than 30 million passenger enplanements per year, to small, privately owned grass landing strips in rural areas that may serve only a few aircraft each year.

Of the 18,224 airports, FAA considers 3,331 to be part of a national system providing an extensive network of air transportation to every part of the country. This national system, called the National Plan for Integrated Airport Systems (NPIAS), is depicted in figure 1 and is based on FAA's 1996 data. The airports that are part of NPIAS are categorized into two main groups: commercial service and general aviation. FAA further divides commercial service airports into primary and other commercial service airports. The 421 airports that FAA considered primary airports in fiscal year 1996 are divided into various classes of hubs (see fig. 1), depending on the number of annual passenger enplanements at each airport. Nearly all commercial passenger enplanements in the United States occur at the primary airports. FAA designates some general aviation airports as reliever airports to reduce congestion at the commercial service airports.

Figure 1: Categories of U.S. Airports



FAA's Role in Funding Airport Capital Development Needs

The airports included in the NPIAS are eligible for federal Airport Improvement Program (AIP) grants. These grants are awarded by FAA and funded through the Airport and Airway Trust Fund that is financed by taxes on domestic airline tickets, international air travel from the United States, domestic cargo transported by air, and noncommercial aviation fuel. During fiscal year 1996, FAA awarded about $1.375 billion in AIP grants.[1]

FAA relies on airports, through their planning process, to identify individual projects for funding consideration. A federal statute and FAA's rules establish which types of airport development projects are eligible for AIP funding.[2] Generally, most types of airfield improvements, such as runways, lighting, navigational aids, and land acquisition, are eligible, while hangars and interest expense on airport debt are not. AIP-eligible projects for airport areas serving travelers and the general public—called "landside development"—include entrance roadways, pedestrian walkways and movers, and space within terminal buildings that does not produce revenue and is used by the public, such as waiting areas. AIP-ineligible landside development projects include revenue-producing terminal areas, such as ticket counters and concessions, and the interest on construction bonds. Because the estimated cost of eligible airport projects greatly exceeds the available grant funding, FAA uses a priority system based on airport and project type to ration the available funds.

FAA maintains a substantial database to support its airport planning and funding efforts. The NPIAS database includes individual airport projects from approved airport master plans, system plans, and discussions with airport officials.[3] It shows these needs for up to 10 years in the future. However, because the legislative mandate to compile the NPIAS only requires that it contain AIP-eligible projects, and because the NPIAS is FAA's source for identifying the projects eligible for grant funding, the NPIAS contains relatively few of the capital needs projects that are not eligible for

[1]There are two categories of AIP grant funds—apportionment and discretionary. Apportionment funds are distributed by formula to commercial service airports and states. Discretionary funds can generally be used for any eligible airport. All airports receiving AIP grants must provide a "matching share," ranging from 10 percent to 25 percent of a project's total cost, depending on the type of project and size of the airport.

[2]These development projects are listed in the AIP Handbook (Order 5100.38A). Projects to plan development are also eligible for AIP funding.

[3]Airport master plans identify the development needed at individual airports on the basis of forecasts of aviation activity and the consideration of environmental impacts, community compatibility, and financial feasibility. Airport system plans identify the aviation facilities required for the needs of a state, region, or metropolitan area.

AIP grants. Thus, while the database is substantial, it does not reflect the total development needs at airports.

Role of Other Funding Sources

AIP grants are only part of the funding picture for airport capital development needs. Another source of funding for some airports are passenger facility charges (PFC). In 1990, the Congress authorized commercial service airports to charge each passenger a $1, $2, or $3 facility charge per trip segment up to a maximum of four charges per round trip. These airports must apply to the FAA for approval to levy a PFC. Generally, PFC collections can only be spent on AIP-eligible projects, with three exceptions: Airports can use PFC funds for interest on airport bonds, for terminal gates and related areas, and for noise mitigation projects that are not part of an FAA-approved noise program. In 1996, 238 airports collected over $1.1 billion in PFCs.

Collectively, U.S. airports also fund billions of dollars of capital projects each year from other funding sources. Projects that are not eligible for AIP grants or PFCs, such as parking facilities or access for local transportation, must be financed in some other way. Other sources of funding include grants from state and local governments, tax-exempt bonds, or revenues generated by the airport. Airports generate revenues from four general sources: landing fees and rentals from terminal leases (both paid by airlines), concessions (such as parking), and other income (such as advertising). Finally, airlines and other tenants have also privately financed the construction of their terminals, hangars, and other facilities.

Differences in Estimates Stem Mainly From Which Types of Projects and Airports Are Included

The wide variance in the estimates of capital development needs provided by the airports, the airlines, and FAA is mainly the result of the differences in the types of projects and airports they include. The estimate prepared by airports defined needs the most broadly of the three to include all projects, regardless of whether they were eligible for AIP grants or not. The airports' estimate also included all airports in the national system. By contrast, the airlines' estimate is based almost exclusively on AIP-eligible projects and is limited to the primary airports, which numbered 421 at that time. FAA's estimate covers all airports in the national system, but only for AIP-eligible projects. The three groups also differed somewhat in the databases they used, the manner in which they treated inflation, and other factors. Figure 2 compares the three estimates in these various respects.

Figure 2: Comparison of Three Estimates of Airport Capital Development Needs

	Estimate made by airports	Estimate made by airlines	Estimate made by FAA
How large is the total estimated need?	$60 billion	$19.8 billion	$32.7 billion
What period does the estimate cover?	1997 through 2002	1996 through 2000	1996 through 2000
What is the average annual amount?	$10 billion	$4 billion	$6.5 billion
How many airports were included?	The over 3,300 existing airports in FAA's national airport system	The 421 largest commercial service airports	The over 3,300 existing airports in FAA's national airport system
What types of projects were included?	All projects, whether eligible for federal Airport Improvement Program grants or not	Almost exclusively those projects eligible for federal Airport Improvement Program grants	Only those projects eligible for federal Airport Improvement Program grants
What information was used to develop the estimate?	Industry associations developed estimates for 140 hub airports through a survey and estimates for the remaining airports using data from FAA's 1996 National Plan for Integrated Airport Systems	Industry association used a private database (Airport Marketing Information System) based on FAA's 1994 National Plan for Integrated Airport Systems	1996 National Plan for Integrated Airport Systems

Airports' Estimate

The airports' estimate was prepared by two industry associations, the Airports Council International—North America (ACI), which represents many commercial service airports in the United States and Canada, and the American Association of Airport Executives (AAAE), which represents airport managers. In arriving at its estimate of $60 billion over 6 years, ACI/AAAE relied mainly on a survey of 140 large, medium, and small hub airports in the United States, supplemented by FAA's data for smaller U.S. airports.[4] ACI/AAAE asked its airport members for an estimate of their capital needs, including those projects not eligible for AIP funding. Eighty-eight airports responded, and ACI/AAAE extrapolated the results to all 140 hub airports existing at the time.[5] For information on all of the other 3,000 plus airports in the national airport system, ACI/AAAE used FAA's NPIAS database for fiscal year 1996. ACI/AAAE also adjusted its estimate to reflect future inflation of 3 percent per year.[6]

As part of our analysis of each estimate, we attempted to replicate the calculations to determine if they had been accurately made. Using ACI/AAAE's data and strictly adhering to its method of analysis, we calculated total needs of $55.9 billion over 6 years, $4.1 billion less than ACI/AAAE reported. The $4.1 billion includes $3.1 billion in estimated needs and $1 billion in inflation adjustment. Most of the difference resulted from the way AIP-eligible and -ineligible projects were calculated and the cost figures attributed to the FAA for nonhub primary airports and general aviation airports. We discussed these differences with the ACI and AAAE officials responsible for their estimate, who concurred with our conclusion.

Airlines' Estimate

The airlines' estimate was prepared by the Air Transport Association of America (ATA), the industry association that represents major U.S. airlines. ATA used a commercial database that blends NPIAS with some airport and state development plans. ATA's annualized estimate of airport capital development needs was less than half of ACI/AAAE's estimate—$4 billion

[4]ACI/AAAE initially provided this estimate in testimony before the House Committee on Transportation and Infrastructure, Subcommittee on Aviation, on March 13, 1996.

[5]Using information from the 88 airports that responded to the survey, ACI/AAAE extrapolated the needs of all 140 hub airports by using the ratio of the responding airports' passenger enplanements to total passenger enplanements at hub airports. ACI/AAAE also subtracted some airport projects after the survey was completed on the basis of their judgments about the likelihood that some projects would be undertaken.

[6]Airports estimated their future development needs in 1996 dollars. ACI/AAAE then totaled these for each year and converted the total to current, inflation-adjusted dollars using a 3-percent rate of inflation.

versus $10 billion.[7] Five major factors account for the $6 billion annual difference between ATA's and ACI/AAAE's estimates:

- ATA included only the 421 primary airports. ATA's justification for doing so was that these airports accounted for more than 99 percent of all commercial passenger enplanements. ATA's inclusion of only primary airports led ACI/AAAE's estimate to be about $1.35 billion greater than ATA's.
- ATA included only a few projects that did not qualify for AIP funding at the 421 primary airports. This led ACI/AAAE's estimate to be about $3.4 billion greater than ATA's.
- ATA used a database that had older information. ATA's database, which it purchased from a private vendor, was based mainly on the data compiled in 1994 for the NPIAS, whereas the ACI/AAAE estimate used data compiled in 1996. This led ACI/AAAE's estimate to be about $1.3 billion greater than ATA's.[8]
- ATA did not explicitly adjust its estimates for inflation.[9] ACI/AAAE's use of a 3-percent inflation factor across the much broader range of airports and projects led its estimate to be about $1 billion greater than ATA's.
- The sum of all other differences, including the differences in the number and valuation of individual projects at the same airports, led ACI/AAAE's estimate to be about $1 billion less than ATA's estimate.

We were able to replicate ATA's estimate exactly.[10]

FAA's Estimate

FAA's April 1996 estimate placed airport capital development needs at an annualized amount of about $6.53 billion—over $2.5 billion larger than ATA's and about $3.5 billion smaller than ACI/AAAE's. FAA's annual estimate was larger than ATA's for three main reasons:

[7]ATA initially provided this estimate in testimony before the House Committee on Appropriations, Subcommittee on Transportation and Related Agencies, on March 20, 1996.

[8]We based this estimated difference on a comparison of the 1994 and 1996 NPIAS databases. The 1996 NPIAS shows planned 5-year development costs that are about $6.5 billion more than the 1994 NPIAS shows for the same time period, 1996 through 2000. This occurred because neither FAA's NPIAS database nor ATA's AMIS database includes many projects beyond a 5-year time frame.

[9]According to the airport consultants we interviewed, most but not all of the master plans and capital improvement plans that feed into the AMIS and NPIAS databases provide project costs in constant, non-inflation-adjusted dollars.

[10]In March 1997, ATA updated this estimate to $6 billion annually for the 5 years from 1997 through 2001. Unlike the previous estimate of about $4 billion annually, this estimate included all NPIAS airports and was based on an updated AMIS database. The updated AMIS database was compiled using FAA's 1996 NPIAS and airports' capital improvement plans. However, the revision came too late in our work for us to analyze it in detail.

- Unlike ATA, which included only the 421 primary airports in its estimate, FAA included all 3,331 airports that are part of the national airport system. Including all national system airports led FAA's estimate to be about $1.35 billion greater than ATA's.
- FAA based its estimate on its 1996 NPIAS information, while ATA used 1994 information. This led FAA's estimate to be about $1.3 billion greater than ATA's.
- The sum of all other differences, such as ATA's inclusion of a small number of AIP-ineligible projects, led FAA's estimate to be about $70 million less than ATA's and accounted for the remaining difference between the two estimates.[11]

Four main reasons explain why FAA's annual estimate was about $3.5 billion smaller than ACI/AAAE's:

- FAA excluded all AIP-ineligible projects, while ACI/AAAE included them. This led ACI/AAAE's estimate to be about $3.4 billion greater than FAA's estimate.
- We found ACI/AAAE's estimate to be overstated, which led it to be about $500 million (before inflation adjustment) greater than FAA's.
- FAA did not explicitly adjust its estimates for inflation like ACI/AAAE did. Not adjusting for inflation accounts for ACI/AAAE's estimate being about $1 billion greater than FAA's.
- The sum of all other differences between FAA's and ACI/AAAE's estimates, including the differences in the time period covered and the number and valuation of individual projects, account for the remainder of the difference. In sum, these differences led ACI/AAAE's estimate to be about $1.4 billion less than FAA's.

We were able to replicate FAA's 5-year estimate to within about $8 million (or 0.02 percent). The difference we found is attributable to slightly different versions of the NPIAS. (A more detailed reconciliation of the three estimates appears in table I.5 in app. I.)

Comparison of Like Airports and Projects Further Clarifies the Disparity Between Estimates

If the analysis is narrowed to those projects and airports that are common to all three estimates, the differences among the estimates decrease. Table 1 shows that when comparing the same projects (AIP-eligible projects at primary airports), the estimates range from about $4 billion to $5.2 billion per year, a $1.2 billion, or 31 percent, difference. This result supports our contention that the main reason for the differences among the three

[11]The sum of these three differences does not exactly equal the difference between FAA's and ATA's annual estimates because of rounding.

estimates is the treatment of projects ineligible for AIP grants and the scope of airports included. This result also highlights other factors contributing to the differences in estimates, such as FAA's reliance on more current data and differences in source data and methods. (Table I.4 in app. I provides a more extensive comparison of the three estimates on the basis of the types of projects and airports each estimate considered.)

Table 1: Comparison of Estimates for AIP-Eligible Projects at Primary Airports

Dollars in millions

Primary airport category	Number of airports (1996)	Annual average		
		ACI/AAAE	ATA	FAA
Large hub	29	$2,600	$2,256	$2,930
Medium hub	40	900	705	1,021
Small hub	71	400	584	637
Nonhub	281	550	420	599
Total	**421**	**$4,450[a]**	**$3,965**	**$5,187**

[a]This figure represents ACI/AAAE's reported estimate. GAO's recalculated total based on ACI/AAAE's data is $4,153 million.

The valuation of the individual projects within each database also accounts for some of the difference in the three estimates. Quantifying the overall magnitude of this difference among the estimates would be nearly impossible because there are some 45,000 airport projects in the NPIAS database and because there is no unique project identifier by which to compare the same projects among the databases. However, to provide some indication of whether the same project was valued equally in all three estimates, we selectively compared the same projects at a large, medium, and small hub airport.[12] As table 2 shows, the three estimates contained different valuations for the same projects. Differing cost estimates for the same projects are likely the result of varying time periods and sources for the data.

[12]We did not compare other categories of airports, such as general aviation, because ATA did not include other categories of airports and ACI/AAAE did not survey these airports, instead relying on FAA's estimates.

Table 2: Comparison of Individual Project Valuations at Selected Airports, AIP-Eligible Portion

Dollars in millions

Airport	Hub size	Project	ACI/AAAE's estimate	ATA's estimate	FAA's estimate
John F. Kennedy International	Large	International Arrivals Building	$537.6	$555.7	$512.4
Reno/Tahoe International	Medium	Noise mitigation	11.7	14.5	12.5
Billings Logan International	Small	All projects	13.3	19.5	25.6
Total			**$562.6**	**$589.7**	**$550.5**

Future Airport Capital Development Needs Depend on the Scope of Projects and Airports Considered

The capital development needs for the nation's airports over the 5-year period from 1997 through 2001 will vary according to how narrowly or broadly needs are defined. A narrow definition yields a much lower estimate than one that includes all airports and projects. However, regardless of how needs are defined, none of these estimates may represent how much airports will actually spend on capital development during this period because of data limitations, unanticipated needs, airline and community influence, and funding constraints.

Airport Capital Development Needs Vary Considerably Over the Next 5 Years, Depending Upon How Needs Are Defined

To provide an up-to-date range of estimates for airport capital development needs for the period from 1997 through 2001, we applied ever-widening criteria of needs to the most current data we could obtain. Using FAA's preliminary 1997 NPIAS database supplemented by ACI/AAAE and state aviation data, we determined a range of estimates from $1.4 billion annually to $10.1 billion annually over the 5-year period, depending on what types of airports and projects are included. A range of estimates, rather than a single estimate, provides various perspectives on airport needs for policymakers to consider. Table 3 shows the four estimates we developed on the basis of varying criteria, which are discussed below.

Table 3: Range of Airport Capital Needs, 1997 Through 2001

Dollars in millions

Scope of projects and airports included in the estimates	Number of airports (1997)	Total, 1997 through 2001	Annual average
All AIP-eligible projects to maintain current infrastructure and meet safety, security, and environmental needs at existing NPIAS airports, but not address capacity or other needs	1,846	$7,069	$1,414
All AIP-eligible projects to meet high-priority needs at existing NPIAS airports[a]	2,084	$13,873	$2,775
All AIP-eligible projects to meet needs at existing NPIAS airports	3,331	$30,550	$6,110
All AIP-eligible and most AIP-ineligible projects at existing and proposed NPIAS airports and existing state system airports	4,664	$50,646	$10,129

[a]We defined high-priority projects as those receiving a score of less than 140.2, the average priority score computed under FAA's Airport Capital Improvement Plan (ACIP) process for each project in FAA's preliminary 1997 NPIAS database. Under FAA's ACIP process, limited grant funds are ranked according to a formula that assigns point values to projects on the basis of the type of airport and type of project. The lower the point value, the higher the priority of a project. For example, a runway safety project at a large hub airport would score fewer points, and accordingly have a higher priority, than a terminal upgrade at a smaller airport. The FAA uses the ACIP process as a guide, but not the sole criteria, for awarding discretionary grants.

AIP-eligible projects to meet safety, security, and environmental needs, as well as maintain the existing infrastructure of airports, total $1.4 billion per year. This amount would include $161 million per year for safety and security projects, many of which are for federally mandated programs;[13] $422 million per year for environmental projects, mostly for noise compatibility programs;[14] and $831 million per year for reconstruction projects to maintain the existing airport infrastructure. However, this estimate does not include the bulk of airports' other needs, such as projects that would improve existing infrastructure or add additional infrastructure to meet future demands. The next highest estimate of about $2.8 billion per year includes all projects with an Airport Capital Improvement Plan (ACIP) score of less than 140.2, the average score of all the projects contained in FAA's preliminary 1997 NPIAS database. This estimate, therefore, reflects the projects that FAA considers to be of a

[13]The regulations for safety and security programs may be found at title 14, sections 139 and 107, respectively, Code of Federal Regulations.

[14]The regulations for noise compatibility programs may be found at title 14, section 150, Code of Federal Regulations. Noise compatibility programs are not mandated but are voluntary.

higher priority—which in addition to meeting all AIP-eligible safety, security, environmental, and reconstruction needs, covers a portion of airports' other needs. For example, at this level, almost 30 percent of airports' AIP-eligible planned capacity needs would be met.

Including all AIP-eligible projects at existing national system airports yields an estimate of $6.1 billion annually. In the scope of projects and airports included, this estimate is comparable to FAA's earlier estimate of $6.5 billion for 1996 through 2000, and in its size, it approximates ATA's recently revised annual estimate of $6 billion for 1997 through 2001. The fourth and most inclusive estimate of $10.1 billion annually includes all projects, whether eligible for AIP or not, and all existing and proposed NPIAS airports and existing state-funded airports. Including AIP-ineligible projects at NPIAS airports accounts for $3.7 billion of the $4 billion annual difference between this estimate and the next highest estimate.[15] The remaining difference stems from adding airports proposed for inclusion into the NPIAS and non-NPIAS state-funded airport needs. Although the federal government is not responsible for funding AIP-ineligible projects or state airports, we included them in our range of estimates because ineligible projects compete with eligible projects for airport financing and NPIAS airports compete with non-NPIAS airports for limited state funds.

Majority of Planned Capital Development Needs Is at the Largest Airports

The nation's 29 large hub airports account for a significant share of the planned capital development for the period from 1997 through 2001. Specifically, these airports account for 28 to 52 percent of total planned capital needs across the four estimates we developed. General aviation airports, including reliever airports, varied between 15 and 22 percent of total needs, depending upon the estimate. Table 4 shows the planned capital development by type of airport for the four estimates.

[15]The majority of AIP-ineligible projects were based on ACI/AAAE's earlier survey of hub airports and our reconstructed estimate of AIP-ineligible needs discussed earlier. However, another $392 million of AIP-ineligible projects for nonhub, other commercial service, and general aviation airports were drawn from FAA's preliminary 1997 NPIAS database.

Table 4: Planned Development by Type of Airport Under Various Capital Needs Estimates, 1997 Through 2001

Dollars in millions; Percentage of total by type of airport in parentheses.

	Type of airport							
Scope of projects and airports included in the estimates	Large hub	Small hub	Medium hub	Nonhub	Other commercial service	General aviation	State funded	Total, 1997 through 2001
All AIP-eligible projects to maintain current infrastucture and meet safety, security, and environmental needs at existing NPIAS airports, but not address capacity or other needs	$2,002 (28)	$1,320 (19)	$901 (13)	$1,022 (15)	$261 (4)	$1,564 (22)	N/A[a]	$7,069
All AIP-eligible projects to meet high-priority needs at existing NPIAS airports[b]	$5,305 (38)	$2,954 (21)	$1,115 (8)	$1,524 (11)	$366 (3)	$2,068 (19)	N/A	$13,873
All AIP-eligible projects to meet needs at existing NPIAS airports	$13,543 (44)	$4,547 (15)	$2,795 (9)	$2,841 (9)	$728 (2)	$6,096 (20)	N/A	$30,550
All AIP-eligible and most AIP-ineligible projects at existing and proposed NPIAS airports and existing state system airports	$26,153 (52)	$9,258 (18)	$3,783 (8)	$2,946 (6)	$729 (1)	$7,329 (15)	$447 (1)	$50,646

Note: Percentages may not sum to total because of rounding.

[a]N/A means not applicable.

[b]We defined high-priority projects as those receiving a score of less than 140.2 under FAA's ACIP process.

Estimates Are Subject to Certain Limitations

While our estimates of capital needs, as well as previous estimates, are useful indicators of future development activity, it is important to recognize that the actual level and types of development that ultimately result may be different for several reasons:

- Limitations on the accuracy of the data collected. According to FAA planners and consultants, the accuracy of airport master plans and system plans diminishes significantly beyond 3 to 5 years into the future. Two studies have shown that final project costs may be about one-third higher than original planned costs,[16] partly because of the difficulty in predicting future growth in aviation activity and actual project costs and outcomes. For example, according to ACI, AAAE, and Airport Consultants Council (ACC)

[16]These are Richard de Neufville, Airport System Planning: A Critical Look at the Methods and Experience (M.I.T. Press and MacMillan, 1976); and Edward W. Merrow, Understanding the Outcomes of Megaprojects, A Quantitative Analysis of Very Large Civilian Projects (RAND, Mar. 1988). According to Richard de Neufville and some airport consultants, final project costs continue to be about one-third higher than original planned costs.

officials,[17] development costs may be understated because master plans and system plans are preliminary estimates and are not based on detailed design and engineering plans, which provide more precise cost estimates.

- Unanticipated needs. Airports must also adjust their capital spending to respond to federal or local mandates and to changes in the market. For example, following an accident in 1990, in which two aircraft collided on the ground, FAA imposed new requirements for runway and taxiway signs that airports had not previously planned for. Similarly, if some of the White House Commission on Aviation Safety and Security's recommendations for improved airport security are implemented, unforeseen security-related costs may occur.[18]
- Complexities of the decision-making process. While airport master plans and system plans may represent airports' estimates of future development, that does not necessarily mean that airlines or local communities concur. For example, some airport development has been prevented on the basis of input from airlines and communities about airline competition, development costs, and environmental issues, including noise.
- Availability of funding. Even if the demand for projects were fully anticipated, accurately measured, and not opposed, they still may not be financially feasible. Constraints on funding sources, whether they be legislatively imposed, such as AIP and PFCs, or imposed by market forces, such as airport bonds, will vary among airports and projects and may mean that not all projects can be funded. For example, in a prior GAO report, we determined that the large and medium hub airports rely less on AIP funds than do smaller airports, but AIP remains an important funding source, representing almost one-fourth and one-third, respectively, of their total capital funds.[19] Our analysis also showed that as the total number of passengers at an airport decreases, the airport's reliance on AIP funds increases. Similarly, a 1996 FAA study found that small hub airports rely on AIP funds more than large or medium hub airports.[20]

We were not able to compare the various estimates of capital needs to actual levels of historical spending because no reliable data on airports' capital spending currently exist. We found no data that track airport

[17]ACC represents consulting firms that specialize in serving the airport industry.

[18]Among the recommendations of the Commission are federally mandated security systems, including explosives-detection system machines; improved training; and passenger identification. At this time, FAA has not determined the total costs to implement the Commission's recommendations, although it is expected to be several billion dollars. Also, it is unknown how the costs may be funded. Final Report to President Clinton, White House Commission on Aviation Safety and Security (Feb. 12, 1997).

[19]AIP Funding for the Nation's Largest Airports (GAO/RCED-96-219R, July 31, 1996).

[20]Innovative Approaches for Using Federal Funds to Finance Airport Development (Mar. 1996).

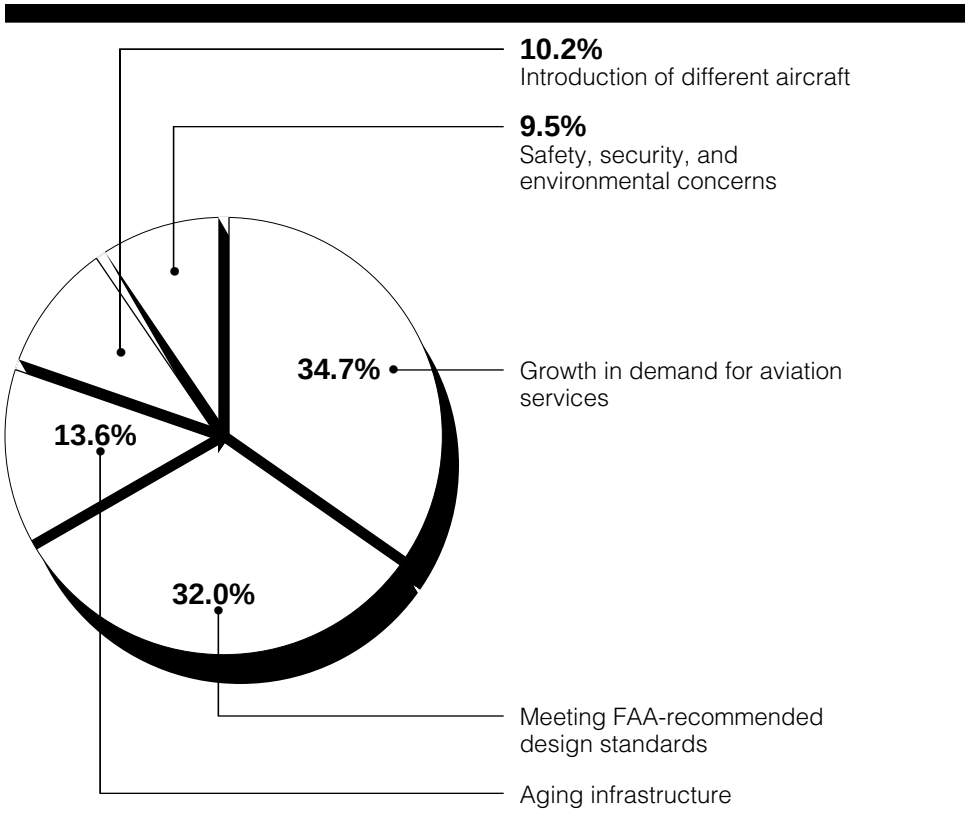
capital expenditures in the aggregate. While FAA tracks which projects receive AIP funds, it does not track airports' entire capital programs or the relationship of these programs to previously stated needs in the NPIAS. Furthermore, we found no data that track projects that do not receive federal funding. AAAE estimated that airports' total capital spending was about $10 billion in 1992. However, double counting of capital and operating expenditures and limited coverage of all airports means this estimate is not fully reliable as a gauge of capital spending. In a more recent study, Coopers & Lybrand L.L.P. estimated that airport expenditures increased from $4.5 billion to $6.9 billion between 1993 and 1996, averaging $5.92 billion annually.[21] However, this estimate is based on aggregate funding from airport bonds, AIP, PFCs, and states, rather than actual expenditures; also, it does not include funding from local government or airport operating income directed to capital spending.

Several Factors Affect Airport Capital Development Needs

Five key factors are reflected in FAA's preliminary 1997 NPIAS database as influencing airport capital development needs eligible for AIP funding. In the NPIAS database, projects are classified according to their main purpose, and in descending order for dollar volume of projects, these key factors are (1) growth in the demand for aviation services, (2) bringing an airport up to FAA-recommended design standards to achieve full productivity of aircraft using the airport, (3) the reconstruction of aging airport infrastructure, (4) upgrades to infrastructure to accommodate the introduction of different aircraft, and (5) safety, security, and environmental concerns. Together, as figure 3 depicts, the first two factors represent two-thirds of airports' planned development costs in FAA's preliminary 1997 NPIAS database. The reconstruction of aging infrastructure (such as restoring airfield pavements), upgrading intended to allow an airport to accommodate different aircraft (such as larger or heavier aircraft), and projects to address safety, security, and environmental concerns (including aircraft noise) make up the remaining one-third. Development needs included in the preliminary 1997 NPIAS to address these factors total about $30.6 billion over the 5-year period from 1997 through 2001.

[21]Federal Aviation Administration: Independent Financial Assessment (Feb. 28, 1997). This study was required by the Federal Aviation Reauthorization Act of 1996 (P.L. 104-264, section 274).

Figure 3: Factors Contributing to AIP-Eligible Airport Needs, 1997 Through 2001



Source: Preliminary 1997 NPIAS database.

Anticipated Growth Generates Projects for New Capacity

Projects intended to expand an airport's capacity are the largest single category of AIP-eligible needs in FAA's preliminary 1997 NPIAS database. About $10.6 billion, or 34.7 percent, of FAA-projected capital development costs are for projects to expand an airport's capacity beyond its current design. Most of these projects are to expand airfield capacity and terminal buildings. According to FAA, the main objective of enhancing capacity is to reduce congestion resulting from flight delays. In 1994, FAA designated 23 airports as the most congested, and by 2004, FAA expects that number to rise to 29 if additional capacity is not added.[22] However, ACI, AAAE, and ACC officials noted that FAA's designation of most congested airports does not

[22]FAA designates airports as the most congested airports if they exceed 20,000 hours of annual flight delays.

include capacity limitations in terminals and other landside areas, such as entrance roadways. Some landside and terminal area development projects are not eligible for AIP funding.

The eventual effect on congestion and delays of completing capacity-related projects is not clear. All the current and the expected most congested airports are large or medium hub airports, and 82 percent, or $8.6 billion, of the total dollar spending planned for capacity-related projects is directed to those airports. However, even if additional capacity is added, it may not significantly reduce delays. According to FAA, three-quarters of all delays are caused by weather, while traffic volume accounts for delays only 19 percent of the time.[23]

The demand for passenger and cargo service at commercial airports is expected to continue to grow over the next decade, stretching airports' current capacity. At commercial airports, passenger enplanements have increased by an average of about 4 percent annually since 1990, and FAA estimates that this pace will continue through 2008. Domestic cargo activity, which is concentrated at busy commercial service airports, is expected to grow at 6 percent per year for the next decade, according to The Boeing Company's 1996/1997 World Air Cargo Forecast. In contrast to commercial airports, activity at general aviation airports has declined since 1990, but FAA expects about a 1-percent annual growth rate through 2008.

To examine whether the forecasted growth in aviation activity influences airport capacity projects, we performed a regression analysis relating capacity needs to the forecasted growth in aviation activity. We found a positive and statistically significant relationship between forecasted activity growth, measured either as aircraft operations (take-offs and landings) or passenger enplanements, and the dollar value of capacity-related projects in the NPIAS.[24] This relationship among the 69 large and medium hub airports, and among all 421 primary airports, is statistically significant, but there are differences in magnitude. For all 421 primary airports, the dollar value of capacity-related projects in the NPIAS is considerably more sensitive to changes in the forecasted level of passenger enplanements than to changes in the forecasted level of aircraft

[23]1995 Aviation Capacity Enhancement Plan, U.S. Department of Transportation and Federal Aviation Administration (Dec. 31, 1996).

[24]A more complete discussion of the regression analysis's methodology and results is presented in app. II.

operations;[25] we expect this is because, on average, smaller airports have greater excess capacity on their airfield. Examining just the 69 large and medium hub airports, we found that the dollar value of planned capacity projects is equally sensitive to changes in enplanements and operations.[26]

Maximizing Airport Capabilities Generates Projects to Meet Recommended Design Standards

Projects intended to bring existing airports up to FAA-recommended design standards, on the basis of the current use of the airport, are the second largest category of AIP-eligible needs reported in FAA's preliminary 1997 NPIAS database. About $9.8 billion, or 32 percent, of FAA's projected capital development costs for airports are for these types of projects. For example, at an airport now serving aircraft that are larger and faster than what the airport was originally designed for, aircraft fuel or passenger loads must be limited, causing them to operate below their full operational capabilities. FAA has guidance on airport design, such as runway specifications for serving various types of aircraft. Nearly three-quarters of the money in this category is intended for projects that would improve runways and taxiways, expand terminals, and purchase land so that the aircraft using the airport could operate more productively.

Aging Infrastructure Generates Projects for Reconstruction

The reconstruction of aging airport infrastructure is the third largest category of AIP-eligible needs. About $4.15 billion, or 13.6 percent, of FAA's projected airport capital development costs is for the reconstruction of existing infrastructure that has deteriorated due to weather or use and has reached the end of its useful life. Typical projects include the rehabilitation of airfield pavements or the replacement of airfield lighting systems.

Ninety-one percent of all planned reconstruction costs are for projects to repair airfield pavements. The rehabilitation of airfield pavements, according to FAA, is generally done on a 15- to 20-year cycle. According to

[25]For the 421 primary airports, we estimate that a 1-percent increase in forecasted enplanements is associated with nearly a 0.75-percent increase in projected spending for capacity-related projects, while a 1-percent increase in forecasted aircraft operations is associated with an increase in projected spending for capacity-related projects only about half that large. Technically, this percentage change, or elasticity, applies only for airports that have values of forecasted growth in enplanements or operations and dollar values of capacity-related projects that are close to the mean values of those measures for all airports included in the regression. In dollar terms, each additional operation is associated with about $1,000 in additional planned capacity spending, while each additional passenger is associated with about $50 in additional planned capacity spending.

[26]For the 69 large and medium hub airports, we found a 1-percent increase in either enplanements or operations is associated with slightly more than a 0.5-percent increase in projected spending for capacity-related projects. In dollar terms, each additional operation is associated with about $1,500 in additional planned capacity spending, while each additional passenger is associated with about $40 in additional planned capacity spending.

FAA, failure to replace deteriorating pavement increases an airport's maintenance costs, limits aircraft operating loads, and can result, for example, in potholes that can damage aircraft landing gear. According to airport officials and consultants, the reconstruction of aging infrastructure will continue to be a significant capital development cost.

The Introduction of Different Aircraft Generates Projects to Upgrade Facilities

The estimated cost of upgrading existing facilities to accommodate the introduction of different types of aircraft not yet using the airport is the fourth largest factor affecting AIP-eligible needs. About $3.1 billion, or 10.2 percent, of FAA's projected airport capital development costs is for upgrading existing facilities. In contrast to design standards, which address current deficiencies, upgrades are intended to provide for changes anticipated in the future. Such changes include, for example, aircraft that are being developed or existing aircraft not currently serving an airport. Typical projects include increasing the length of runways and strengthening runways and taxiways so that airports will be able to accommodate in the future aircraft that the airports cannot now serve. Nearly half of the costs for planned upgrades is for runways, while just over one-third is for access roads. If airlines and manufacturers eventually introduce larger aircraft with heavier payloads and wider wingspans, airports may be faced with considerably greater upgrade costs.

Safety, Security, and Environmental Concerns Have Generated Special Programs

Projects intended to address safety, security, and environmental needs are among FAA's top funding priorities and account for $2.9 billion, or 9.5 percent, of total AIP-eligible needs. Of this total, about $807 million, or 2.6 percent, of FAA's projected capital development costs are for safety and security projects, including projects for federally-mandated safety and security programs. Safety and security projects, which have FAA's highest AIP funding priority, include purchasing fire and rescue equipment and installing security checkpoints. The costs of implementing the recommendations of the White House Commission on Aviation Safety and Security, which were issued on February 12, 1997, are not reflected in these estimates because projects to implement the recommendations have yet to be developed.

In addition, $2.1 billion, or 6.9 percent, of total planned costs for development needs is for environmental protection, mainly aircraft noise mitigation projects. These projects include, for example, the acquisition of noise-impacted land and the soundproofing of residences and public buildings in the areas underlying aircraft approach and departure routes.

Unlike safety and security programs, noise compatibility programs are voluntary.

Agency Comments

We provided the Department of Transportation, FAA, ACI, AAAE, ATA, and ACC with a copy of our draft report for review and comment. Agency and association officials, including FAA's Deputy Associate Administrator for Airports; ACI's President; AAAE's Senior Vice President, Federal Affairs; ATA's Managing Director, Airports; and the Chairman of ACC's Governmental Affairs Committee, generally agreed with the facts presented and provided some clarifying comments and information, which we included in the report as appropriate. Agency and association officials also stated that the report was a thorough and balanced representation of the facts.

We performed our review from December 1996 through March 1997 in accordance with generally accepted government auditing standards. Additional details on our scope and methodology are contained in appendix III.

We are sending copies of this report to other interested congressional committees; the Secretary of Transportation; the Administrator, Federal Aviation Administration; and the Director, Office of Management and Budget. Copies will be made available to other interested parties on request.

Please call me at (202) 512-2834 if you or your staff have any questions about this report. Major contributors to this report are listed in appendix IV.

John H. Anderson Jr.
Director, Transportation Issues

List of Recipients

The Honorable John McCain
Chairman
The Honorable Ernest F. Hollings
Ranking Minority Member
Committee on Commerce, Science,
and Transportation
United States Senate

The Honorable Slade Gorton
Chairman
The Honorable Wendell H. Ford
Ranking Minority Member
Subcommittee on Aviation
Committee on Commerce, Science,
and Transportation
United States Senate

The Honorable Bud Shuster
Chairman
The Honorable James L. Oberstar
Ranking Democratic Member
Committee on Transportation
and Infrastructure
House of Representatives

The Honorable John J. Duncan, Jr.
Chairman
The Honorable William O. Lipinski
Ranking Democratic Member
Subcommittee on Aviation
Committee on Transportation
and Infrastructure
House of Representatives

The Honorable Norman Y. Mineta
Chairman, National Civil Aviation Review Commission

Contents

Figures

Abbreviations

AAAE	American Association of Airport Executives
ACC	Airport Consultants Council
ACI	Airports Council International—North America
ACIP	Airport Capital Improvement Plan
AIP	Airport Improvement Program
AMIS	Airport Marketing Information System
ATA	Air Transport Association of America
FAA	Federal Aviation Administration
GAO	General Accounting Office
NASAO	National Association of State Aviation Officials
NPIAS	National Plan of Integrated Airport Systems
PFC	passenger facility charge

Calculation, Comparison, and Reconciliation of the Estimates of Airport Capital Development Needs

In order to discern the nature and extent of the differences among the three capital needs estimates, it was necessary to understand how the respective databases were compiled and the estimates were calculated. Only then could we compare the results and begin the process of reconciling the estimates.

Airports' Estimate

In March 1996, the airports, through the Airports Council International—North America (ACI) and the American Association of Airport Executives (AAAE), estimated airport capital development needs at $60 billion for the 6-year period from 1997 through 2002. In 1996, ACI/AAAE conducted a survey of 140 hub airports to derive an estimate of airport capital needs. The survey sought information on hub airports' total capital needs, including AIP-ineligible projects, and asked airport officials to estimate how much would be eligible for AIP funds and whether financing had been committed to the project. Using information from the 88 airports that responded to the survey, ACI/AAAE extrapolated needs for all 140 hubs on the basis of their relative number of passenger enplanements. ACI/AAAE relied upon the Federal Aviation Administration's (FAA) National Plan of Integrated Airport Systems (NPIAS) to estimate the capital needs for all other categories of airports. ACI/AAAE also subtracted some airport projects after the survey was completed on the basis of their judgments about the likelihood that these projects would be undertaken. Finally, ACI/AAAE converted estimates to future costs by adding a 3-percent annual inflation factor. Table I.1 shows ACI/AAAE's reported estimate of airport capital development needs for 1997 through 2002 and our reconstruction of that estimate, by category of airport.

Table I.1: ACI/AAAE's Estimate and GAO's Recalculation of Airport Capital Development Needs, 1997 Through 2002

Dollars in millions

Airport type	Number of airports[a] (1996)	Source	ACI/AAAE's estimated 6-year total	GAO's reconstructed estimated 6-year total
Large hub	29	Survey	$28,900	$28,598
Medium hub	40	Survey	11,600	10,344
Small hub	71	Survey	3,500	3,211
Nonhub and other commercial service	435	FAA	3,300	3,249
Reliever	325	FAA	2,800	2,209
General aviation	2,429	FAA	4,000	3,373
Inflation adjustment		ACI/ AAAE	5,900	4,936
Total	**3,329**		**$60,000**	**$55,920**

[a]As reported by ACI/AAAE.

In reconstructing ACI/AAAE's estimate, and strictly adhering to its method of analysis, we calculated total needs of $55.9 billion over 6 years, $4.1 billion less than ACI/AAAE reported. The $4.1 billion includes $3.1 billion in estimated needs and $1 billion in inflation adjustment. Most of the difference resulted from different calculations for hub airport costs, cost figures attributed to FAA for nonhub primary and general aviation airports, and the inflation adjustment. We discussed these differences with the ACI and AAAE officials responsible for their estimate, who concurred with our conclusion.

Airlines' Estimate

In March 1996, the airlines, through the Air Transport Association of America (ATA), estimated airport capital development needs to be about $20 billion for the 5-year period from 1996 through 2000. ATA defined airport capital needs more narrowly than ACI/AAAE, including almost exclusively AIP-eligible projects at the nation's 421 largest commercial service airports, or primary airports. To derive its estimate, ATA relied on a database, called Airport Marketing Information System (AMIS), purchased from a private vendor. AMIS extensively uses the NPIAS for its structure and much of its information but also updates it using airport master plans, system plans, and capital improvement plans developed by airports and states, which detail the projects that are likely to be funded and completed. The version of AMIS used by ATA is based on the 1994 NPIAS,

instead of the 1996 NPIAS update used by FAA.[1] Furthermore, because AMIS is largely derived from the NPIAS, it does not generally include projects not eligible for AIP grants. Less than 1 percent of ATA's total estimate included AIP-ineligible projects. We reconstructed ATA's estimate, using the same AMIS database and ATA's methods, and found that they had accurately calculated their estimate. Table I.2 below presents ATA's estimate of airport capital development needs for 1996 through 2000.

Table I.2: ATA's Estimate of Airport Capital Development Needs, 1996 Through 2000

Dollars in millions

Airport type	Number of airports (1996)	5-year total
Large hub	29	$11,279
Medium hub	40	3,523
Small hub	71	2,921
Nonhub	281	2,101
Total	**421**	**$19,824**

FAA's Estimate

In April 1996, FAA estimated airport capital development needs to be $32.7 billion for the 5-year period from 1996 through 2000. In making its estimate, FAA relied on the NPIAS database of AIP-eligible projects at the 3,331 national system airports. The NPIAS is a compilation of FAA's regional office data on individual airport projects from approved airport master plans, system plans, and discussions with airport officials. Under FAA's guidance, all airport projects for up to 10 years in the future are entered into the NPIAS database and coded according to project type, estimated cost, year of planned expenditure, project description, and grant eligibility.

In deriving its estimate of airport capital needs, the FAA defined capital needs as development projects that are eligible for AIP funding at any of the national system airports. FAA excluded AIP-ineligible projects because the agency is not responsible for funding these projects. FAA also excluded projects to plan development because they do not represent infrastructure development. Table I.3 presents FAA's estimate of airport capital development needs for the 5-year period from 1996 through 2000.

[1]In total, for the same 5-year period and categories of projects and airports, the AMIS and the 1994 NPIAS differed by about $108 million, or 0.5 percent.

Table I.3: FAA's Estimate of Airport Capital Development Needs, 1996 Through 2000

Dollars in millions

Airport type	Number of airports (1996)	5-year total
Large hub	29	$14,650
Medium hub	40	5,105
Small hub	71	3,183
Nonhub	281	2,995
Other commercial service	143	692
Reliever	330	2,238
General aviation	2,437	3,808
Total	**3,331**	**$32,671**

We verified FAA's estimate by reconstructing it using the NPIAS and following FAA's methodology. We were able to closely, but not exactly, match FAA's estimate of $32.671 billion. Our total, using the same criteria, was $32.679 billion, for a total difference of $8 million over 5 years. The difference we found is attributable to slightly different versions of the NPIAS.

To the extent, however, that any estimate of planned development uses the NPIAS database, it should be noted that about 14 percent of the FAA field offices that update the NPIAS screen projects for their likelihood of receiving AIP grants before including those projects in the NPIAS database. Thus, the representation of need in the NPIAS may be less comprehensive for airports in those locations in comparison to other locations where FAA field offices include all AIP-eligible projects without regard to expectations of funding. Also, about 18 percent of FAA field offices include projects ineligible for AIP funding in their NPIAS database; for example, 7.3 percent of the projects in the 1996-through-2000 NPIAS were ineligible for AIP funding. While FAA screened these projects out of the 1996-through-2000 NPIAS when preparing its estimate of planned development needs, ATA did not screen out AIP-ineligible projects.

Comparison of the Estimates of Airport Capital Development Needs

Once we had reconstructed each of the three airport capital development needs estimates, we compared them across airport categories and by types of projects. Table I.4 compares the total and average reported estimates of each.

Table I.4: Comparison of Estimated Capital Needs Reported by ACI/AAAE, ATA, and FAA

Dollars in millions

Airport type	Number of airports (1996)	Project type	Total estimated needs			Annual average		
			ACI/AAAE[a] 1997-2002	ATA 1996-2000	FAA 1996-2000	ACI/AAAE	ATA	FAA
Large hub	29	E	$15,600	$11,279	$14,650	$2,600	$2,256	$2,930
Medium hub	40	E	5,400	3,523	5,105	900	705	1,021
Small hub	71	E	2,400	2,921	3,183	400	584	637
Nonhub	281	E	3,300	2,101	2,995	550	420	599
Total primary airports	**421**	**E**	**26,700**	**19,824**	**25,933**	**4,450**	**3,965**	**5,187**
Other commercial service	143	E	N/A[b]	N/A	692	N/A	N/A	138
Reliever	330	E	2,800	N/A	2,238	467	N/A	448
General aviation	2,437	E	4,000	N/A	3,808	667	N/A	762
Total primary and other airports	**3,331**	**E**	**33,500**	**N/A**	32,671	**5,583**	**N/A**	**6,534**
Total hub airports	**140**	**I**	**20,600**	**N/A**	**N/A**	**3,433**	**N/A**	**N/A**
Total needs		**E and I**	**54,100**	**19,824**	**32,671**	**9,017**	**3,965**	**6,534**
Inflation adjustments		IA	5,900	N/A	N/A	983	N/A	N/A
Total estimate			**$60,000**	**$19,824**	**$32,671**	**$10,000**	**$3,965**	**$6,534**

Legend

E = AIP-eligible.

I = AIP-ineligible.

IA = Inflation adjustment.

[a]ACI/AAAE combined the needs of primary nonhub and other commercial service airports in its estimate.

[b]N/A means not applicable and indicates that the estimate did not include this category of airport or project.

As the preceding table shows, ACI/AAAE's estimate of needs is greater than the others because it includes AIP-ineligible projects that account for more than $20 billion over 6 years. Similarly, FAA's estimate of capital needs exceeds ATA's estimate because it includes a broader range of airports. We were not able to compare the various estimates according to project type because ACI/AAAE coded projects differently from ATA or FAA.

Reconciliation of ATA's, FAA's, and ACI/AAAE's Estimates

The process of reconstructing and comparing the three total capital needs estimates—$19.8 billion for ATA, $32.7 billion for FAA, and $60.0 billion for ACI/AAAE—allowed us to measure the source and magnitude of their differences. Combining the various effects and eliminating double counting resulted in the reconciliation scheme appearing in table I.5.

Table I.5: Reconciliation of the 1996 Estimates of Total Airport Capital Development Needs

Dollars in millions

Source	Description	Total estimate
ATA	**Primary airports**	**$19,824**
Add items in FAA's estimate that are not in ATA's		
	Update from 1994 to 1996 NPIAS	6,460
	Other commercial service airports	692
	Reliever airports	2,238
	General aviation airports	3,808
Subtract items in ATA's estimate that are not in FAA's		
	AIP-ineligible projects	(193)
	Projects to plan development	(43)
	All other differences	(115)
FAA	**All airports, AIP-eligible only**	**$32,671**
Add items in ACI/AAAE's estimate that are not in FAA's		
	AIP-ineligible projects	20,600
	Overstatement in ACI/AAAE's estimate (before inflation adjustment)	3,116
	ACI/AAAE's inflation adjustment	5,900
Subtract items in FAA's estimate that are not in ACI/AAAE's		
	All other differences	(2,287)
ACI/AAAE	**All airports, all projects**	**$60,000**

To reconcile ATA's and FAA's estimates, four adjustments had to be made. First, the ATA estimate, which is based on the AMIS database, is in turn a derivative of the 1994 NPIAS. The 1994 NPIAS is about $6.5 billion less than the 1996 NPIAS for the same 1996-through-2000 time period because the NPIAS does not account for many projects beyond 5 years. Second, FAA included all other commercial service airports (between 2,500 and 10,000 annual enplanements), reliever airports, and general aviation airports in its estimate, whereas ATA included only primary airports (enplanements greater than 10,000). Third, ATA's estimate included a small number of planning projects and AIP-ineligible development projects that FAA did not include. Finally, the remaining difference of $115 million cannot be

specifically attributed to a single factor but is likely caused by the differences in the number and valuation of the projects between the two databases.

To reconcile FAA's and ACI/AAAE's estimates, four adjustments had to be made. First, and most significantly, ACI/AAAE included $20.6 billion of AIP-ineligible projects that FAA did not include. Second, the errors we found in ACI/AAAE's estimate that led to an overstatement did not occur in FAA's estimate. To avoid double counting when calculating the inflation adjustment, we used the pre-inflation amount of the overstatement, $3.1 billion. Third, ACI/AAAE's estimate includes a 3-percent inflation adjustment of $5.9 billion that FAA did not include in its estimate. Finally, the remaining difference between the two estimates, about $2.3 billion, cannot be specifically attributed to a single factor but is due to differences in the time periods covered (1996 through 2000 for FAA and 1997 through 2002 for ACI/AAAE) and differences in the number and valuation of the projects in the two databases.

Regression Model and Results

This appendix describes the regression model that we developed to estimate the association between forecasted growth in aviation activity and the dollar value of capacity-related projects. Regression modelling is a technique that identifies the strength of association of one explanatory factor with the dependent variable, while controlling for the influences of other external factors. Using this model, we found a positive and statistically significant relationship between forecasted activity growth (the relevant explanatory factor), measured either as aircraft operations or enplanements, and planned capacity spending (the dependent variable). Time and data limitations precluded testing more elaborate specifications, and therefore, our results should be taken as suggestive rather than conclusive evidence. The following sections discuss the regression data, model, and results.

Data

All of the data we used came from FAA's 1996 NPIAS database. NPIAS contains data on, among other things, individual airport characteristics, such as the type of airport and the current and forecasted level of aircraft operations and enplanements, and projected capital spending over 5 years. For our analysis, we computed the level of forecasted activity growth in aircraft operations (take-off and landings) and enplanements by subtracting current levels from levels forecasted for 5 years in the future. We also created a measure of each airport's current congestion level to serve as a control variable, by dividing each airport's actual operations by its capacity number of operations. For the dependent variable, we summed projected spending for capacity-related projects for 5 years, 1996 through 2000.

Model

For our analysis, we regressed planned capacity spending on one of two explanatory factors—forecasted growth in operations or forecasted growth in enplanements—and a control variable, congestion. We included congestion as a control variable because we anticipated that heavily congested airports may be more likely to plan high levels of spending on capacity-related projects. While we performed our regression analysis using both linear and log-linear specifications, we based our results on the linear specifications because in some instances negative activity growth rates limited the appropriateness of the log-linear model. We also estimated the model for two groups of airports—the 421 airports classified as primary airports and, within this group, the 69 airports designated as large and medium hub airports. Time and data limitations precluded

testing more elaborate specifications, and therefore, our results should be taken as suggestive rather than conclusive evidence.

Results

We found a positive and statistically significant (at the 95-percent level) relationship between forecasted growth in aviation activity and planned capacity spending. This relationship exists using either operations or enplanements as the measure of aviation activity and for both the more inclusive set of 421 primary airports and the largest 69 airports (large and medium hubs). For all 421 primary airports, planned capacity spending is considerably more sensitive to changes in the forecasted level of enplanements than to changes in the forecasted level of operations, but when examining just the large and medium hubs, we found an equal sensitivity to each measure.

We also found a positive relationship between our congestion variable and planned capacity spending. This relationship was statistically significant at the 95-percent level in the two regressions using the 421 primary airports, and at the 90-percent level for the regression using the 69 large and medium hub airports when we used operations as the measure of aviation activity. The explanatory power of our model, as measured by the multiple correlation coefficient (R^2) statistic,[1] was greater for the regressions using the 421 primary airports. Table II.1 presents the regression coefficients and summary statistics used in our analysis.

[1]The greater the R^2, the greater the association between the set of explanatory variables and the dependent variable and, therefore, the greater the proportion of the variance in the dependent variable that can be accounted for by the explanatory variables. This statistic can range from 0 to 1.

Table II.1 Regression Coefficients and Summary Statistics

	All primary airports		Large and medium hub airports only	
	Forecasted growth in aircraft operations	Forecasted growth in enplanements	Forecasted growth in aircraft operations	Forecasted growth in enplanements
Explanatory factor coefficient	993,000 (8.2)	52,600 (9.0)	1,460,000 (3.3)	38,300 (2.1)
Elasticity of explanatory factor	.37	.74	.54	.53
Congestion coefficient	102,000,000 (6.4)	42,700,000 (2.3)	188,000,000 (1.9)	149,000,000 (1.4)
Constant	–27,400,000	–11,700,000	–96,500,000	–62,500,000
Number of observations	421	421	69	69
R^2	.25	.27	.21	.13

Note: t-statistics are in parentheses, coefficients have been rounded to 3 significant digits, elasticities have been computed at mean values, and the forecasted growth variables are measured in thousands.

Source: GAO's analysis of NPIAS data.

The regression coefficients for the explanatory factors shown in table II.1 indicate the change in planned capacity spending for each additional unit of operations or passenger enplanements, when holding the control variable constant. For example, the coefficient of 993,000 means that for each additional forecasted unit of operations at 1 of the 421 primary airports, the model indicates an additional $993,000 of planned capital spending over 5 years.

The elasticity measure in table II.1 compares the relative sensitivity of planned capital spending with respect to changes in the explanatory factors. For all 421 primary airports, we estimate that at mean values of our variables, the elasticity of planned capacity spending is about twice as great with respect to forecasted enplanement growth (.74) than with respect to the forecasted growth in operations (.37). That is, at mean values, a 1-percent increase in anticipated enplanements is associated with nearly a 0.75-percent increase in planned capacity spending, while a 1-percent increase in anticipated aircraft operations is associated with an increase in planned capacity spending only about half that large. However, for the 69 large and medium hub airports, we estimate that at mean values of our variables the elasticities are almost identical—.53 for enplanements and .54 for operations. That is, at mean values, we estimate that a 1-percent increase in either enplanements or operations is associated with slightly more than a 0.5-percent increase in planned capacity spending.

Scope and Methodology

To compare the various airport capital needs estimates and determine why they differ, we reconstructed, compared, and reconciled each of the three main estimates of needs. Appendix I describes how the three databases were compiled and our reconciliation process. While we did not verify the accuracy of the data in each of the databases, we determined the accuracy of the calculation through our process of reconstructing the estimates. In addition, we compared categories of airports and types of projects, as well as individual projects, across the databases to ascertain how complete the data sets were. We also discussed with ACI/AAAE, ATA (and its data vendor), and FAA officials the process by which their data were obtained and how they were input, maintained, and compiled. In the two instances in which our reconstructed estimates did not match the reported estimates, we discussed our results with ACI/AAAE and FAA officials to understand why they differed and to obtain agreement that our reconstructed estimate was accurate. Finally, by comparing the three databases, we were able to isolate and measure the differences among each of the three estimates. Because the projects in the databases could not be linked by a common identifier, it is not possible to measure to what extent the databases varied as a result of the differences in valuation for the same projects versus the differences in the array of projects at each airport. Therefore, these two effects were combined as a default measure.

To provide an up-to-date range of estimates for airport capital development needs over the 5 years from 1997 through 2001, we used FAA's preliminary 1997 NPIAS database, supplemented by other data sources. To obtain information on airport development needs that are not eligible for AIP grants, we relied on three data sources. We used an updated version of AMIS, the database previously used by ATA, to estimate the value of projects funded by passenger facility charges (PFC). We used the results of two different ACI/AAAE surveys to estimate the value of AIP-ineligible projects at hub airports. Finally, we used a survey conducted for us by the National Association of State Aviation Officials (NASAO) of their members to estimate the needs of airports in state system plans but not included in the NPIAS.[1] Forty-two states and Puerto Rico responded to the survey. We selected several criteria for defining need—from very narrow (safety, security, environmental, and reconstruction projects) to very broad (all projects regardless of eligibility at all airports for which data are available)—and applied them to the most current data available from FAA, ACI/AAAE, and state aviation officials. As with the first objective, we did not authenticate the accuracy of individual data elements.

[1]NASAO represents all 50 states, Guam and Puerto Rico.

To identify the key factors that affect airport development and how these will affect future capital needs, we interviewed numerous aviation industry experts and reviewed relevant studies. For FAA, we interviewed officials in headquarters and at all 31 FAA Regional Airport Division Offices and Airport District Offices. We also reviewed all NPIAS and predecessor plans for the national system published since 1947, recent aviation forecast reports, and the FAA's 1995 Aviation Capacity Enhancement Plan, the latest such plan available. For airport representatives, we held numerous discussions with officials from ACI and AAAE and interviewed 13 airport directors or commissioners. For airline representatives, we spoke with ATA officials and held a roundtable discussion with representatives from 10 passenger and cargo airlines. Finally, we held discussions with various aviation experts, including officials from six airport engineering and planning firms and two academics active in consulting for airports. All of these people were asked about the factors that have historically influenced airport development and the trends that are likely to affect future development needs. In addition, we performed a regression analysis of various predicted measures of aviation activity and future estimates of needs to better understand the relationship between predicted growth and capacity-related development. This regression analysis is more completely described in appendix II.

We performed our review from December 1996 through March 1997 in accordance with generally accepted government auditing standards.

Major Contributors to This Report

Gerald L. Dillingham
R. Jerry Aiken
Paul Aussendorf
Beverly Ann Bendekgey
Charles R. Chambers
Jay R. Cherlow
Mitchell B. Karpman
Joseph D. Kile
Mark Premo
Stanley G. Stenersen
Randall B. Williamson

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20884-6015

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000 or by using fax number (301) 258-4066, or TDD (301) 413-0006.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

PRINTED ON RECYCLED PAPER

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested