United States Government Accountability Office

Report to Congressional Committees

August 2013

INTERMODAL TRANSPORTATION

A Variety of Factors Influence Airport-Intercity Passenger Rail Connectivity

GAO-13-691

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GAO Highlights

Highlights of GAO-13-691, a report to congressional committees

Why GAO Did This Study

Increasing passenger travel has led to growing congestion in the nation's air transportation system, and projections suggest that this trend is likely to continue. The integration of air and intercity passenger rail service, which is provided in the United States by Amtrak, has been suggested by some transportation experts as a strategy to increase mobility and reduce congestion in the United States. The FAA Modernization and Reform Act of 2012 mandated that GAO review issues related to air-rail connectivity. This report discusses (1) the nature and scope of air-rail connectivity, (2) the benefits and costs of air-rail connectivity, (3) factors affecting the development and use of air-rail connectivity, and (4) potential strategies to improve air-rail connectivity.

GAO reviewed laws, strategic plans, and academic studies. GAO analyzed data to determine distances between Amtrak stations and large and medium hub airports and interviewed officials from DOT, and representatives from Amtrak, the airlines, and aviation and rail industry associations. GAO interviewed stakeholders at eight large and medium hub airports, which were selected based on geographic location and extent of connectivity with Amtrak. In addition, GAO surveyed experts from the aviation industry, rail industry, state and local governments, academia and the private sector about air-rail connectivity issues. The survey and results can be found at GAO-13-692SP.

GAO is not making recommendations in this report. DOT and Amtrak provided technical comments, which were incorporated as appropriate.

View GAO-13-691. For more information, contact Gerald Dillingham at (202) 512-2684 or dillinghamg@gao.gov.

What GAO Found

Most major U.S. airports have some degree of physical proximity to intercity passenger rail stations, though only 2 airports are currently collocated with intercity rail stations. Specifically, 42 of the nation's 60 large and medium hub airports are located within 10 miles of Amtrak stations; 21 of the 42 airports are within 5 miles of Amtrak stations. At the 2 collocated airports, passengers can access Amtrak either via an automated people mover (Newark Liberty International Airport) or by walking (Bob Hope Burbank Airport). At some airports, such as Baltimore/Washington International Thurgood Marshall Airport, passengers can take a direct shuttle between the airport and the nearby Amtrak station, while at other airports, connections to Amtrak can be made through other modes of transportation. Studies and data, while limited, suggest that relatively few passengers in the United States use intercity rail to travel to and from the airport or through more integrated travel such as code-sharing agreements, whereby airlines sell tickets for Amtrak's service. The only existing air-rail code-sharing agreement in the United States is at Newark Airport. Amtrak and states are considering projects to expand intercity rail connectivity with airports, including as part of the construction of high-speed rail in California.

Air-rail connectivity may provide a range of mobility, economic, and environmental benefits, though the financial costs of building these connections could be substantial. Specifically, based on discussions with industry stakeholders, input from surveyed experts, and a review of academic literature, GAO found a general consensus that air-rail connectivity can provide a range of mobility benefits for travelers, though less agreement existed on the importance and extent of economic and environmental benefits. However, achieving these benefits could require significant trade-offs, because the costs of expanding the existing intercity passenger rail network and constructing viable connections can be significant. Given these costs, based on GAO's work, there are currently limited locations where benefits are high enough to justify funding to improve air-rail connectivity.

Air-rail connectivity remains limited in the United States, according to experts, as a result of institutional and financial factors, among other things. In particular, the limited nature of the existing intercity passenger rail network, including the frequency of service and connectivity to other transportation modes, remains an obstacle to developing and using air-rail connections. Securing funding for air-rail projects also remains a barrier. While funds from some federal grant programs can be used to help facilitate air-rail connections, there is no single funding source for air-rail projects.

There are strategies to improve air-rail connectivity, but adopting them involves trade-offs. Experts generally focused on, among other things, leadership, funding, and infrastructure improvements, though the effectiveness of these strategies may depend on a project's local characteristics. There has been little emphasis on air-rail connectivity by either the Department of Transportation (DOT) or Amtrak. Furthermore, experts noted that some of the strategies could be particularly challenging or costly to implement, such as in locations where the rail network was developed decades before airports. For example, increasing intercity passenger rail's frequency could improve air-rail connectivity but could also be expensive.

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Abbreviations

AIP	Airport Improvement Program
Amtrak	National Railroad Passenger Corporation
BTS	Bureau of Transportation Statistics
BWI	Baltimore/Washington International Thurgood Marshall
DOT	Department of Transportation
FAA	Federal Aviation Administration
FRA	Federal Railroad Administration
HSIPR	High-Speed Intercity Passenger Rail
NextGen	Next Generation Air Transportation System
PRIIA	Passenger Rail Investment and Improvement Act of 2008
Recovery Act	American Recovery and Reinvestment Act of 2009
RITA	Research and Innovative Technology Administration
RRIF	Railroad Rehabilitation and Improvement Financing
TIFIA	Transportation Infrastructure Finance and Innovation Act of 1998
TIGER	Transportation Investment Generating Economic Recovery

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August 2, 2013

The Honorable John D. Rockefeller IV
Chairman
The Honorable John Thune
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

The Honorable Bill Shuster
Chairman
The Honorable Nick J. Rahall, II
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

Mobility—the movement of passengers and goods through the transportation system—is critical to the nation's economic vitality and the quality of life of its citizens. Mobility provides people with access to goods, services, recreation, and jobs; provides businesses with access to material, markets, and people; and promotes the movement of personnel and material to meet national defense needs. However, increasing passenger travel has led to growing congestion in the nation's transportation system, and projections of future passenger travel suggest that this trend is likely to continue. For example, the Federal Aviation Administration (FAA) estimates that the number of airplane passengers using U.S. airports is expected to grow by 23 percent from over 730 million in 2011 to nearly 900 million by 2021. At the same time, intercity passenger rail service, provided by the National Railroad Passenger Corporation, or Amtrak, has been increasingly used by passengers to travel between cities, as airlines have reduced the number of short-distance flights and airports have implemented heightened security procedures in the wake of the events of September 11, 2001. Amtrak's ridership has increased by nearly 55 percent over the last 15 years to over 31 million riders in 2012, with nearly 27 million of these passengers traveling over short distance corridors (which Amtrak defines as less than 750 miles), such as the Northeast Corridor between Washington, D.C., and Boston, Massachusetts, or the Cascades Corridor between Seattle, Washington, and Portland, Oregon.

The integration of air and intercity passenger rail service has been suggested by some transportation experts as a strategy to increase

mobility and reduce congestion in the United States based on experiences in other parts of the world. For example, European transportation policy has increasingly focused on intermodal transportation—that is, a system that connects the separate transportation modes and allows a passenger to complete a journey using more than one mode—and included improving connections between airports and intercity passenger rail, also known as air-rail connections. We reviewed intermodal connectivity at airports in 2005, and found that air-rail connections involving intercity passenger rail were limited.[1] Such integration can be challenging, in part because of the costly long-term investments that are needed to connect airports to intercity passenger rail and difficulties in developing intermodal services and ticketing options that are attractive to travelers. Furthermore, U.S. intercity passenger rail service offers limited service in many heavily traveled corridors, and its overall service has slower average speeds relative to other transportation modes, often a result of delays from sharing track with freight rail and commuter rail services.

In the FAA Modernization and Reform Act of 2012, Congress directed us to examine issues related to air-rail connectivity.[2] This report discusses (1) the nature and scope of existing air-rail connectivity in the United States; (2) the benefits and costs of developing air-rail connectivity; (3) the factors that facilitate and hinder the development and use of air-rail connectivity; and (4) potential strategies, including lessons learned from other countries, that may help inform deliberations regarding air-rail connectivity policy.

To address these objectives, we obtained and analyzed information from a variety of sources. To obtain insight on issues related to air-rail connectivity, we collaborated with the National Academy of Sciences to identify 25 experts from the aviation and rail industries, Amtrak, state and local governments, academia, and the private sector. These experts were selected based on their knowledge of one or more of the following topic areas: intermodalism, airlines and the air travel industry, airport operations, the rail industry, and passenger travel. We identified an

[1]GAO, *Intermodal Transportation: Potential Strategies Would Redefine Federal Role in Developing Airport Intermodal Capabilities*, GAO-05-727 (Washington, D.C.: July 26, 2005).

[2]Pub. L. No.112-95, § 810, 126 Stat. 11,123 (Feb. 14, 2012).

additional 17 experts in these fields through a review of academic literature, our previous work, and interviews with stakeholders. We developed and conducted a web-based survey in which we asked these 42 experts for their views on benefits of air-rail connectivity, factors that facilitate and hinder its development and use, differences between air-rail connectivity efforts in the United States and Europe, and strategies that could improve air-rail connectivity. We conducted the survey in two stages. The first round of the survey asked the experts to respond to five open-ended questions about various aspects of air and intercity passenger rail connectivity.[3] We analyzed the responses provided by the experts and developed close-ended questions for the second round of the survey where we asked each expert to rate the ideas and other information that came from the first part of the survey.[4] The information and perspectives that we obtained from the expert survey may not be generalized to all experts that have an interest or knowledge of air-rail connectivity issues. The full survey and responses are contained in an e-supplement to this report.[5]

In addition, we reviewed federal laws related to air and intercity passenger rail transportation, and strategic plans from Amtrak and the Department of Transportation (DOT). We reviewed and synthesized information from academic literature and our body of work on air-rail connectivity and air-rail "code-share" agreements in the United States and internationally. We obtained data from the Bureau of Transportation Statistics (BTS) on the location of Amtrak stations near large and medium hub airports and determined the linear distance between each airport and the nearest Amtrak station.[6] Based on the BTS data's use as a widely accepted federal statistical database, we determined these data to be generally reliable for our purpose, which was to provide context on existing air-rail connectivity. We reviewed completed, ongoing, and future

[3]We received a 95 percent (40 out of 42) response rate for the first stage of the survey.

[4]We received a 98 percent (41 out of 42) response rate for the second stage of the survey.

[5]GAO-13-692SP.

[6]FAA has established airport hub size categories based on the number of passengers boarding an aircraft (enplaned) for all operations of U.S. carriers in the United States. A large hub commercial service airport has 1 percent or more of total annual passenger boarding. A medium hub commercial service airport has at least 0.25 percent but less than 1 percent of total annual passenger boarding.

air-rail connectivity efforts at eight large and medium hub airports in the United States, and interviewed various stakeholders at each site, including airport authorities, state and local transportation agencies, local transportation-planning organizations, and air and rail industry associations.[7] These eight airports were selected to include airports that have recently planned, constructed, or completed an air-rail project and are dispersed in various regions of the country. Lastly, we interviewed officials from DOT and Amtrak, transportation experts, and representatives from U.S. airlines and industry associations to obtain their perspectives on air-rail connectivity issues.

We conducted this performance audit from August 2012 to August 2013 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Additional information on our methodology and the experts who participated in our survey are found in appendixes I and II, respectively.

Background

For the purposes of this report, an air-rail connection refers to a connection between an airport terminal and an intercity passenger rail station (in other contexts, an air-rail connection may refer to a connection between an airport terminal and an intracity rail station that serves other forms of local rail, such as commuter rail or a subway system). An air-rail connection facilitates mobility between a rail station and an airport terminal through a variety of modes and methods, such as an airport shuttle, local transit connection, automated people mover or guideway car, or by walking. Depending on the extent of the connectivity, intercity passenger rail can perform three main roles for air passengers.

[7]We reviewed air-rail connectivity efforts at Baltimore/Washington International Thurgood Marshall (BWI) Airport, Bob Hope Airport, Chicago O'Hare International Airport, Dallas/Fort Worth International Airport, Miami International Airport, General Mitchell International Airport, Norman Y. Mineta San Jose International Airport, and Newark Liberty International Airport.

- First, intercity passenger rail may serve as a short-distance connection to the nearest local airport from a metropolitan area along a more extensive intercity rail corridor.
- Second, intercity passenger rail may serve as a competitive alternative to air travel. For example, for distances less than 500 miles, our prior work has shown that intercity passenger rail, particularly high-speed rail, offers some potential advantages over air travel, including reduced times for security screening and baggage checks.[8]
- Third, intercity passenger rail can serve as part of an integrated intercity transportation solution with air travel, where the passenger travels significant distances using both modes. For these types of air-rail connections, travel may be further integrated by code-sharing, which refers to the practice of airlines applying their names and selling tickets to rail service operated by other organizations, such as Amtrak.[9]

Amtrak provides intercity passenger service to 46 states and the District of Columbia, operating over a 22,000-mile network, mainly using track owned by freight railroads. Amtrak owns about 655 miles of rail lines, primarily on the Northeast Corridor between Boston, Massachusetts, and Washington, D.C. Most of Amtrak's passengers travel within the Northeast Corridor or over relatively short-distances, though Amtrak also operates a number of long distance routes across the country. The speed of service varies across the country. For example, according to Amtrak, its Heartland Flyer service connecting Oklahoma City, Oklahoma, and Fort Worth, Texas, averages about 50 miles per hour (mph) over the 206-mile corridor while its Acela Express higher-speed service averages less than 80 mph throughout the Northeast Corridor (reaching top speeds up to 150 mph). While Amtrak's Acela Express service is currently the fastest intercity passenger rail service in the United States, California has begun

[8]GAO, *High Speed Passenger Rail: Future Development Will Depend on Addressing Financial and Other Challengers and Establishing a Clear Federal Role*, GAO-09-317 (Washington, D.C.: Mar. 19, 2009).

[9]For example, a code-sharing agreement between an airline and Amtrak would allow passengers to make reservations and purchase a ticket with the airline for both air and rail travel.

developing a 520-mile high-speed rail line designed to operate at speeds up to 220 mph.[10]

Transportation projects at airports are typically initiated and developed by local transportation agencies, including some combination of state departments of transportation, local planning bodies, and other local agencies. While roles may vary, one or more state and local transportation agency will generally take the lead in project development and implementation. Airports typically are also heavily involved with developing intermodal capabilities on airport property. This is especially true if the project involves construction of a major intermodal facility. For example, the Miami International Airport, working in cooperation with the Florida Department of Transportation, has been one of the leaders in the development of the Miami Intermodal Center, which will provide on-site access to Amtrak, multiple other rail systems, local transit services, and a rental car center through the use of an automated people mover.[11] Airlines also play a role in developing intermodal projects at airports. Use and lease agreements between airlines and airports are a major revenue source for most large airports, and because of this financial arrangement, airlines may have influence in or participate in airport decision making. The ability of airlines to participate in decision making depends on the specific airport and the structure of the lease agreements between the airport and airlines serving that airport. Amtrak generally becomes involved in the planning process at airports when a state or local government proposes a project that could potentially affect its intercity passenger rail service.

Federal laws and planning guidance have limited emphasis on air-rail connectivity, but have a broad goal of establishing a system-wide, intermodal approach to addressing transportation needs. For example, federal aviation policy encourages the development of intermodal connections on airport property and systems that serve air transportation passengers efficiently and effectively and promote economic

[10]For more information, see GAO, *California High-Speed Passenger Rail: Project Estimates Could Be Improved to Better Inform Future Decisions,* GAO-13-304 (Washington, D.C.: Mar. 28, 2013).

[11]An automated people mover is a guided transit mode with fully automated operation, featuring vehicles that operate on “guideways” with exclusive right-of-way, such as an automated monorail system.

development.[12] Additionally, FAA's 2012 reauthorization legislation directs the Secretary of Transportation to encourage airport planners to consider passenger convenience, airport ground access, and access to airport facilities during the development of intermodal connections on airport property.[13] Similarly, the Passenger Rail Investment and Improvement Act of 2008 (PRIIA) authorized development of high-speed intercity passenger rail corridors and the American Recovery and Reinvestment Act of 2009 (Recovery Act) appropriated $8 billion to fund development of these corridors and intercity passenger-rail projects.[14] In June 2009, the Federal Railroad Administration (FRA) established the High-Speed Intercity Passenger Rail (HSIPR) program that provides discretionary grants for high-speed or intercity passenger rail projects. In allocating funds, PRIIA directed FRA to give greater consideration to projects that, among other things, encourage intermodal connectivity among train stations, airports, subways, transit, and other forms of transportation.[15] However, federal policy for surface transportation, aviation, and passenger rail is established through separate legislation. For example, the planning and funding for highway and transit projects are addressed under the Moving Ahead for Progress in the 21st Century Act,[16] the planning and funding of U.S. airports is addressed under the FAA Modernization and Reform Act of 2012, and the planning and funding for intercity passenger rail is addressed under PRIIA.

While the federal government does not provide funding specifically for air-rail connections, it has established a number of other funding mechanisms that can be used to enhance elements of air-rail connectivity. (See app. III.) Most federal funding for transportation projects is provided through grant programs through the individual specific modal administration and reserved for improvements specific to that mode. For example, most direct federal financial support for airport capital projects has been provided through grants from FAA's Airport

[12]49 U.S.C. § 47101(a)(5).

[13]Pub. L. No.112-95, §131, 126 Stat. 11, 21 codified at 49 U.S.C. § 47101(g)(2)C).

[14]Pub. L. No. 110-432, div. B, title V, § 501,122 Stat. 4848, 4907, 4959 (Oct. 16, 2008); Pub. L. No. 111-5, 123 Stat. 115, 208 (Feb 17, 2009).

[15]Pub. L. No. 110-432, div. B, title V, § 501, 122 Stat. 4848, 4907, 4962.

[16]Pub. L. No. 112-141. 126 Stat. 405 (July 6, 2012).

Improvement Program (AIP).[17] While AIP grants may be used to fund intermodal projects, an airport's use of its funds is generally restricted to an airport project that is owned or operated by the airport sponsor and that is directly and substantially related to the air transportation of passengers or property.[18] Airports have funded portions of light rail and transit (such as subway or bus) using AIP funds at airports meeting these restrictions.[19] Funding for intercity passenger rail has been provided in the form of operating and capital subsidies to Amtrak, as well as the HSIPR grant program.

Federal oversight of air-rail projects is primarily divided across DOT's respective modal administrations, though DOT has established some practices to coordinate oversight of intermodal projects. For example, for an air-rail connection project, the aviation component is overseen by FAA, while the rail component is overseen by FRA. As another example, according to DOT, its Research and Innovative Technology Administration (RITA) works closely with DOT's modal administrations to improve intermodal cooperation, solve transportation challenges that cut across modal boundaries, and remove barriers to intermodal projects through a variety of research efforts.[20] In addition to these efforts, in 2012 DOT established a working group consisting of representatives from each modal administration to track intermodal initiatives and projects. The goal of the working group is to provide non-monetary resources such as recommendations of policies to promote intermodal transportation projects, including air-rail connectivity projects.

In contrast to the United States, European policy and European governments have promoted connections between passenger high-speed rail systems and airports as part of establishing high-speed rail service between cities as an alternative to air and car travel. Since 1992, the

[17]AIP grants are one of five major sources of funding for airport improvements. Airports also typically make use of four other major sources to fund capital projects: tax-exempt bonds, state and local grants, airport revenue, and passenger facility charges.

[18]49 U.S.C. §§ 47107(b)(1), 47133(a).

[19]Light rail refers to trains that may operate on exclusive tracks or on tracks in the street on the same level with pedestrians and car traffic.

[20]RITA is responsible for coordinating, facilitating, and reviewing DOT's programs and activities to identify research duplication and opportunities for joint efforts and to ensure that research, development, and technology activities are meeting intended goals.

European Commission has periodically published a common transportation policy in response to increased ground and air congestion, as well as concerns about the dependence on oil and the level of carbon emissions resulting from the current transportation system. A key component of the European Commission's transportation policy is improving the connections between air and rail, thereby transforming competition between those modes into complementary service using high-speed train connections located at European airports. The current European Commission transportation policy, adopted in 2011, aims to connect all 37 core airports to the rail network, preferably through high-speed rail, and shift a majority of medium-distance passenger transportation (which the European Commission defines as under 300 kilometers or 186 miles) to the passenger rail network by 2050.[21]

Beyond these policy differences, our prior work has also noted that differences related to population density, geography, and private automobile use have contributed to differences in the development and use of air-rail connections in Europe compared to the United States.[22] This prior work has highlighted the greater population density of European cities and that downtowns are major destination points for passengers as key differences that affect the use of intermodal systems. While some U.S. cities have population densities comparable to European cities, in general, U.S. cities are more decentralized. Furthermore, distances between many major cities in the United States are generally greater than in Europe, which can affect the ability of intercity passenger rail to be competitive with air travel, depending on price and the speed of service. In addition, private automobile use has affected air-rail connections. Specifically, the rate of car ownership is generally higher in the United States compared to Europe, while at the same time, retail gasoline prices in the United States are much lower than in Europe because of substantially lower taxes.[23] Furthermore, in the United States, surface transportation policy has primarily focused on developing and improving highways, while the transportation policy of

[21]European Commission, *Roadmap to a Single European Transport Area —Towards a Competitive and Resource Efficient Transport System,* COM (2011) 144 final (Brussels, BD: Mar. 28, 2011).

[22]GAO-05-727.

[23]As of May 30, 2013, retail gas prices in European Commission countries averaged $7.11 per gallon, while in the United States, gas prices averaged $3.66 nationwide.

European countries have placed a greater comparative emphasis on the development of intercity passenger rail and public transportation. Accordingly, people traveling to airports in the United States are more likely than in Europe to drive and park their cars at the airports, which could reduce the demand for (as well as the benefits of) intercity passenger rail connections at U.S. airports.

Beyond Europe and the United States, the integration of air travel and intercity passenger rail varies. For example, in Japan, air service and high-speed intercity passenger rail compete and do not complement each other as in Europe.[24] The uniqueness of Japan's transportation system stems from the fact that two-thirds of its population, or almost 100 million people, live in a narrow, densely populated corridor. Furthermore, Japan has nearly 5,600 miles of private tollways, which makes intercity travel by car expensive. In China, the Shanghai Railway Bureau and China Eastern Airlines commenced operations of air-rail combined services in May 2012 to and from Shanghai Hongqiao International Airport, marking China's first air-rail combined service. The service allows passengers to transfer between domestic or international air services and train operations with a single ticket.

[24]Reinhard Clever and Mark M. Hansen, "Interaction of Air and High-Speed Rail in Japan," *Transportation Research Record: Journal of the Transportation Research Board, no. 2043* (2008).

Connectivity between Major Airports and Intercity Passenger Rail Remains Limited, as Does Passenger Usage

Most Major Airports Are near Intercity Passenger Rail Stations, but Air-Rail Connectivity is Rare

Most major U.S. airports have some degree of physical proximity to intercity passenger rail stations; however, few are collocated with rail stations.[25] Specifically, our analysis found that 42 of the 60 large and medium hub airports in the contiguous United States are located within 10 miles of an Amtrak station; 21 of the 42 airports are within 5 miles of a station.[26] (See fig. 1.) Newark Liberty International Airport and Bob Hope (Burbank) Airport are the only airports where passengers can access the Amtrak stations via an automated people mover (Newark) or by walking (Burbank).[27] Airline passengers at Miami International Airport will be able to connect to Amtrak via an automated people mover upon completion of the Miami Central Station in 2014. Amtrak officials noted that, in some locations, it provides service that may operate in close proximity to an airport, but may not have an Amtrak station near that airport.[28] Passengers at the nation's other major airports have to rely on another

[25]To determine the extent that air-rail connectivity has been developed in the contiguous United States, we selected 60 airports, consisting of the 28 large hubs, and the 32 medium hub airports located in the contiguous United States based on the 2011 FAA's Air Carrier Activity Information System database for analysis. We limited our analysis to the 60 major airports in the contiguous United States because they accounted for approximately 86 percent of U.S. passenger enplanements for calendar year 2011.

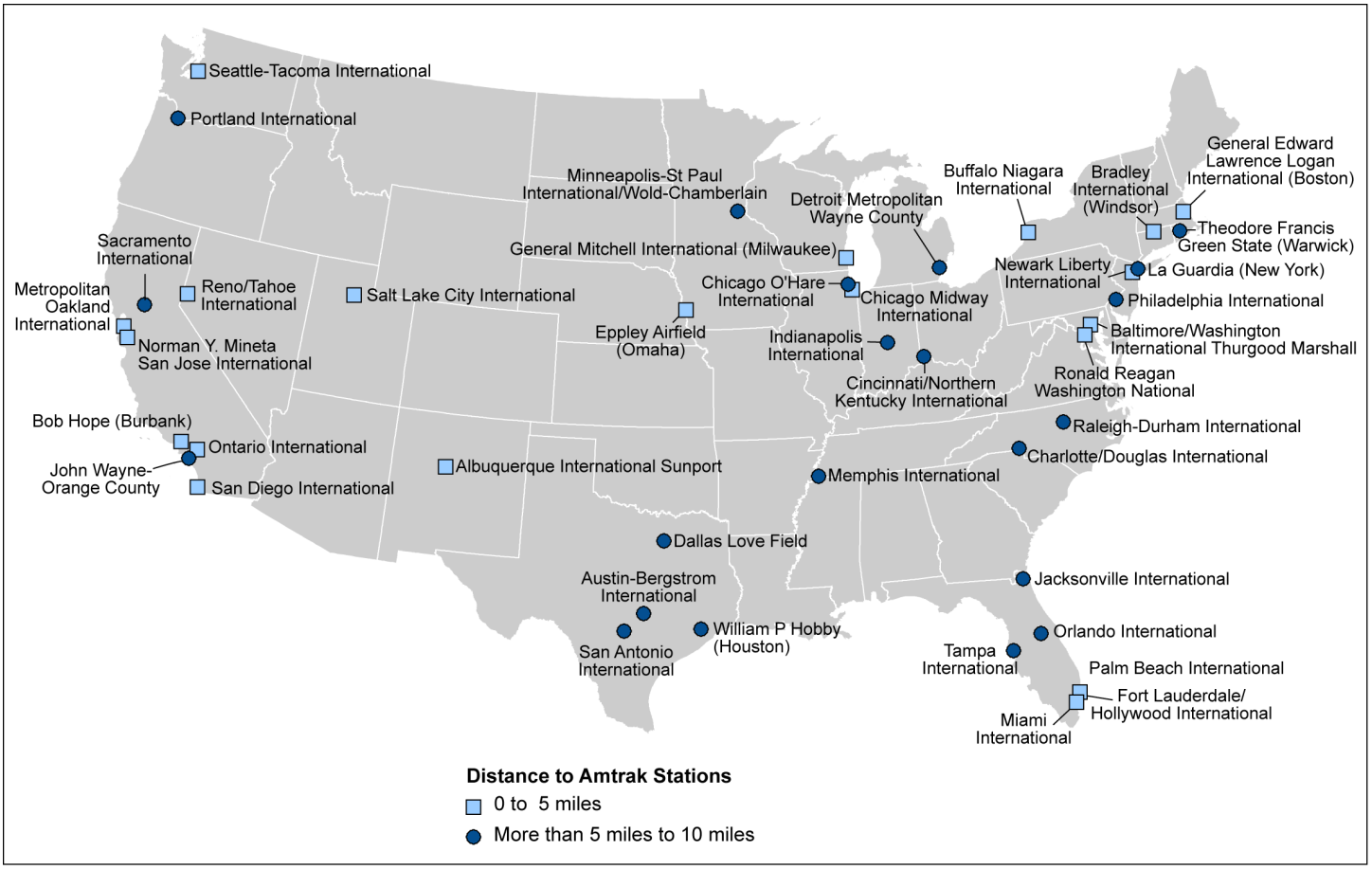
[26]We based our analysis on linear distance using latitude and longitude information for each of the 60 airports and the nearest Amtrak station; the linear distance may not reflect the actual distance that passengers experience depending on the transportation mode, local roads, or paths used. For a complete list of linear distances between large and medium hub airports and the nearest Amtrak station, see appendix IV.

[27]Bob Hope Airport also provides free shuttle services to the Amtrak station at the airport and downtown Burbank.

[28]For example, at Theodore Francis Green State Airport in Warwick, Rhode Island, Amtrak's service passes through but does not stop at a local commuter rail station located near the airport terminal.

transportation mode such as shuttle, taxi, or transit (intracity rail, subway, or bus) to connect to an Amtrak station and some passengers must make multiple connections. For example, passengers at Baltimore/Washington International Thurgood Marshall (BWI) and Milwaukee's General Mitchell International can take a free airport shuttle to and from Amtrak stations, while passengers choosing to take public transportation to access Amtrak from Norman Y. Mineta San Jose International Airport would have to take both a free shuttle and light rail. However, some officials we interviewed told us that passengers are less willing to consider intermodal travel as the number of modes needed to complete a single trip increases.

Figure 1: Large and Medium Hub Airports within 10 Miles of an Amtrak Station, May 2013



Source: GAO analysis of DOT data.

Note: The distance between each airport and the nearest Amtrak station was calculated using the linear distance between longitude and latitude coordinates of each large and medium hub airport and each Amtrak station, as identified in the National Transportation Atlas Database 2012. The distance between each airport and the nearest Amtrak station reflects the linear distance between the two

locations, and may be affected by existing buildings, roads, bridges, or other obstacles in the path of a traveler connecting between an airport and an Amtrak station. Amtrak officials noted that, in some locations, it provides service that may operate in close proximity to an airport, but may not have an Amtrak station near that airport. For detailed information on the distances between each large and medium hub airport and Amtrak stations, see appendix IV.

Stakeholders at many of the airports we visited have placed a greater emphasis on intracity connectivity (or connections within a local metropolitan region) to the airport through local rail or other transit, as opposed to connectivity through intercity passenger rail. While a local transit system may provide a connection between an airport and intercity passenger rail, such a connection is generally not the primary goal. For example, at Dallas/Fort Worth International Airport, officials are working with the Dallas Area Rapid Transit agency to provide an intracity rail connection to the airport from downtown Dallas by 2014. Officials noted that an intracity rail connection was preferable to connectivity through Amtrak because of the limited frequency of service provided by Amtrak in the region, among other factors. When the extension is completed, airport passengers would be able to connect to the Amtrak station located in downtown Dallas through the intracity rail connection. Similarly, officials at Norman Y. Mineta San Jose International Airport in California noted that policymakers should focus on connecting intracity rail to their airport, rather than intercity passenger rail, in part, because the San Jose airport is not a hub airport and most of its customers reside in the surrounding San Francisco Bay area.

Amtrak and state transportation agencies are considering projects to expand connectivity with airports. Amtrak's strategic plan states that it will increase connectivity with airports in key markets and has established a strategic goal to increase the number of air-rail connections in the Northeast Corridor from two to five by 2015.[29] However, Amtrak officials we spoke with stated that they do not believe Amtrak will achieve this goal because of limited available funding for intercity passenger rail. Some states, such as California, Illinois, and Texas, are looking at options to enhance air-rail connectivity by developing high-speed rail connections at nearby large and medium hub airports. For example, in addition to Illinois' development of high-speed rail between Chicago and St. Louis, several options for possible future opportunities for improving Amtrak

[29]Amtrak, *Amtrak Strategic Plan, FY 2011–FY 2015.*

passengers' connectivity to Chicago O'Hare International Airport have been proposed.[30]

Few Passengers Use Air-Rail Connections

Studies and data, while limited, suggest that relatively few passengers and airport employees use the limited air-rail connections available to travel to and from U.S. airports. Ground access studies have shown that intercity passenger rail is rarely used to connect to airports compared to other modes of transportation. For example, a 2012 study stated that Amtrak accounted for 3 percent of ground access mode share at Newark Liberty International; 2 percent at BWI, and less than 1 percent at Bob Hope Airport.[31] By comparison, another study observed that at some European airports with direct air-rail connections, long-distance intercity passenger rail accounts for 20 to 25 percent of the ground access mode share.[32] In general, transportation and airport officials told us that demand for public transportation options to airports is limited, as the vast majority of passengers still use personal automobiles to access the airport.

[30]The Chicago Department of Transportation's Union Station Master Plan (2012) recommends reconfiguring the station's tracks and platforms in a manner that could allow some Amtrak trains to serve Chicago O'Hare International Airport in addition to Union Station. According to the Chicago Department of Transportation, it is currently conducting a second stage of the Master Plan to estimate the amount of train and passenger capacity that the proposed improvements could add, building the case for the future federal, state, and local funding support needed to make the improvements.

[31]Benjamin R. Sperry, Shawn Larson, David Leucinger, Scott Janowiak, and Curtis A. Morgan, "Intercity Passenger Rail Access to Airports: Case Study in Milwaukee, Wisconsin," *Transportation Research Record: Journal of the Transportation Research Board*, no. 2300 (2012).

[32]Matthew A. Coogan, "Quantifying the Scale of Air/Rail Complementarity and Air/Rail Competition in Europe and the United States," (paper presented at the annual meeting of the Transportation Research Board, Washington, D.C., January 2012).

Collocated Airport Terminals and Rail Stations Allow for Code Sharing

The only current code-sharing agreement for air and rail travel in the United States is at Newark Liberty International Airport, though code-sharing has been implemented or explored at other airports.[33] The code-sharing agreement between United Airlines and Amtrak allows passengers to make reservations with United Airlines for both air and rail travel, and Amtrak provides the connecting service on its trains between Philadelphia, Pennsylvania; Wilmington, Delaware; Stamford or New Haven, Connecticut, and to anywhere United Airlines flies from Newark Liberty International Airport.[34] According to Amtrak data, about 24,000 passengers a year take Amtrak to Newark to connect to United Airlines flights, with 90 percent of those passengers originating from Philadelphia. However, United Airlines representatives pointed out that most passengers at the Newark Liberty International Airport rail station—which Amtrak estimated at over 120,000 passengers in fiscal year 2012—are not traveling through the code-share agreement. No additional code share agreements are currently planned between Amtrak and other airlines we contacted.[35] Representatives from the airlines and Amtrak told us that code-sharing agreements are generally most effective when the rail station is located at the airport and within a high-traffic rail corridor, which is the case with Newark Liberty International Airport and the Northeast Corridor. As previously noted, few rail stations are collocated with a major airport. Both airline and Amtrak officials indicate that for code-share agreements, airlines require frequent rail service with minimum passenger transfer time between modes. Amtrak officials stated that they provide that frequency of service in very few markets, generally located on Amtrak's Northeast Corridor serving highly populated metropolitan areas.

[33]For example, at BWI, Icelandair and Amtrak had put in place a code share agreement prior to Icelandair's discontinued service at BWI in 2008. Additionally, Amtrak was approached by Midwest Airlines at General Mitchell International, but both Amtrak and Midwest Airlines agreed that there was no benefit to a formal code share program. Airline officials cited operational and logistical challenges such as incompatible reservation systems, lack of reliable and frequent rail service, as well as lack of control and liability from rail delays as reasons for not pursuing code-share agreements.

[34]Amtrak and Continental Airlines began the code share agreement in 2001. With Continental's merger with United Airlines, this relationship has transitioned to one with United. The agreement also allows Amtrak to transport airline passengers between Newark Liberty International, BWI, and Philadelphia International during inclement weather or when there are disruptions to flight services.

[35]We contacted United Airlines, Delta Air Lines, U.S. Airways, and American Airlines.

Air-Rail Connectivity May Provide a Range of Benefits for Passengers and Others, but Costs Can Be Significant

Benefits

We found that air-rail connectivity has the potential to provide a range of mobility, economic, and environmental benefits. In our discussions with stakeholders, including state departments of transportation, local transportation-planning organizations, and airlines; our review of academic literature; and the expert opinions obtained from our survey, we found that a general consensus exists that air-rail connectivity can provide a range of mobility benefits for travelers; however, we found less agreement exists on the importance and extent of other types of benefits, including economic and environmental benefits. Table 1 shows the benefits most frequently cited as "very important" by the experts, five of which focus on mobility benefits.[36] However, our review suggests that the particular benefits for a given project are generally site-specific, and depend on the particular characteristics of the rail operators, the airports, and underlying regional characteristics. As a result, the benefits we identified through our work are not generalizable to all air-rail connections.

[36]Experts rated each of the potential benefits identified in the first stage as "very important," "important," "somewhat important," "not important," "not a benefit," or that they had "no opinion." For more information on our survey and results, see appendix I and GAO-13-692SP respectively.

Table 1: Benefits of Air-Rail Connectivity Most Frequently Cited as "Very Important" by Experts Surveyed

Traveler Benefits	• Increased passenger convenience • Increased reliability of travel to the airport • Increased number of travel options for passengers • Reduced travel time to and from airports • Increased passenger satisfaction
Economic Benefits	• Increased catchment area for airports • Increased catchment area for airlines • Allows short-haul flights to be replaced by intercity rail connections
Environmental Benefits[a]	• Reduced carbon emissions • Reduced energy use

Source: GAO analysis.

Note: We identified the most important benefits based on the number of respondents in the survey who rated these benefits as "very important."

[a]Experts in our survey suggested that the reduced carbon emissions and energy use could result from, among other factors, a reduction in automotive miles traveled to the airport and through the substitution of intercity passenger rail service for short-distance flights.

Air-rail connections can potentially provide mobility benefits, such as increased options for passengers connecting to the airport, and improved convenience for airport and airline customers. Specifically, over half of the experts responding to our survey agreed that increasing passenger convenience and travel options were "very important" benefits of air-rail connectivity,[37] and airport representatives cited both benefits as driving factors for intermodal projects at a number of our site visits. For example, representatives at Miami International Airport noted that in the 1980s a lack of ground transportation options, including connectivity to rail, had reduced passenger traffic at the airport. Beginning in 2001, the Florida Department of Transportation began to construct an intermodal center, which will provide passenger access to the airport through multiple ground transportation modes, including intercounty and intercity passenger rail. According to airport representatives, directly connecting Amtrak service to the airport will provide an additional option to passengers connecting to the airport and encourage passengers to be

[37]Specifically, 23 of 41 experts that responded to the survey rated increased passenger convenience as a "very important" benefit while 21 of 40 responding experts rated increased travel options as a "very important" benefit. The total number of experts who responded to each survey question slightly varied.

more willing to try other non-automotive forms of transportation. Construction of the new Amtrak terminal (Miami Central Station) began in 2011, and representatives anticipate the terminal will be completed in 2014. (See fig. 2.) Furthermore, air-rail connections can provide airport access to commuter trains in addition to intercity trains operated by Amtrak, as many of the Amtrak stations located near airports are served by both types of services. In addition, rail connectivity to airports has the potential to improve the passenger experience traveling to the airport. In particular, half of the experts (22 of 41) rated increased reliability of travel to the airport, and nearly half (18 of 40) rated reductions in the travel time to and from the airport as very important benefits of air-rail connections. Representatives from the airlines and airports we interviewed noted that their employees might also similarly benefit from an air-rail connection, specifically by providing increased options to and from the airport and improved convenience for airport and airline employees. However, representatives from one airline cautioned that the extent of any benefits would depend upon the cost of the air-rail connection and how such a connection was funded.

Figure 2: Construction of the Miami International Airport Miami Central Station, February 2013

Source: GAO.

Air-rail connections also have the potential to provide economic benefits for some transportation operators, such as an increased customer base. We found that some of the experts (16 of 40) participating in our survey and a majority of the stakeholders at six of our eight site visits highlighted the potential for intercity rail to access populations outside of the major metropolitan area served by a large or medium hub airport. Specifically, the experts and stakeholders noted that an air-rail connection may increase an airport's or airline's passenger base by attracting additional passengers from outside an airport's local market, thus potentially generating additional revenue for airports and airlines in that metropolitan area. Some studies suggest that the existence of an air-rail connection affects a passenger's choice of airport in areas where multiple options exist. In particular, a recent study of passengers using Amtrak to connect to General Mitchell International Airport in Milwaukee found that approximately one-third of passengers reported that they would have used one of the two Chicago area airports if the Amtrak-Mitchell Airport connection was not available.[38] In addition, Amtrak service can also complement existing rail connections made by commuter rail, offering additional frequencies between points served by the commuter trains. However, where transit already offers a connection between a city center and airport, stakeholders at two of our eight site visits noted that an intercity passenger rail connection to the airport may potentially compete with transit service in the same area, thus limiting any increase in airport or airline customers and benefits from enhanced connectivity.

In addition, air-rail connectivity could allow for the substitution of rail service for short-haul flights, freeing up capacity for long-haul flights and reducing airport and airspace congestion, though the importance of this benefit varies depending on the airport and the rail service's operating characteristics. Specifically, nearly half of the experts (19 of 41) in our survey and stakeholders at three of our eight site visits noted that the potential replacement of short-haul flights by rail was a "very important" potential benefit of air-rail connectivity. Our prior work has found that intercity passenger rail, particularly high-speed rail, could serve as a substitute for air service for distances of up to 500 miles.[39] Our previous

[38]Benjamin R. Sperry and Curtis A. Morgan, Texas Transportation Institute, "Intercity Passenger Rail: Implications for Urban, Regional, and National Mobility," University Transportation Center for Mobility Report 11-10-75 (College Station, TX: December 2011).

[39]GAO-09-317.

work on intercity passenger rail has found that for rail transportation to capture the market share necessary to reduce air travel congestion, the distance between cities must be short enough to make rail travel times competitive with air travel times (at comparable costs and levels of comfort).[40] In practice this has been observed to a great extent in the Northeast Corridor, where a number of major urban areas are located within close proximity and where there are significant constraints on the capacity within the air transportation system. For example, Amtrak's share of the air-rail market for trips between Washington, D.C., and New York City has increased from 37 percent to 75 percent since the introduction of the higher speed Acela Express service in 2000. However, studies of air-rail connections in other countries suggest that the complete abandonment of air service in response to the introduction of rail service serving the same markets is rare.[41] Furthermore, this benefit may be limited given that most airports in the United States are not currently capacity-constrained, though we have previously reported that FAA projects that a number of airports will be significantly capacity-constrained and thus congested within the next 15 years.[42] For example, officials from Chicago O'Hare International Airport stated that because their airport is not capacity-constrained, the benefits from a direct connection with Amtrak would be limited. Amtrak officials noted that they are exploring options to connect to Chicago O'Hare International Airport, but noted that it was premature to speculate on the benefits of such a connection, particularly given Amtrak's ongoing efforts to upgrade track speeds to major cities from Chicago.

Over one-third of the experts participating in our survey rated environmental benefits, including reduced carbon emissions (17 of 41), and reduced energy use (15 of 40), as "very important" benefits of air-rail connectivity. For the European Commission, enhancing air-rail connectivity has been embraced as part of its strategy to reduce

[40]GAO, *Intercity Passenger Rail: Issues for Consideration in Developing an Intercity Passenger Rail Policy*, GAO-03-712T (Washington, D.C.: Apr. 30, 2003).

[41]Transportation Research Board, *Innovative Approaches to Addressing Aviation Capacity Issues in Coastal Mega-Regions*, Airport Cooperative Research Program Report 31 (Washington, D.C.: 2010).

[42]GAO, *National Airspace System: Regional Airport Planning Could Help Address Congestion If Plans Were Integrated with FAA Airport Decision Making*, GAO-10-120 (Washington, D.C.: Dec. 23, 2009).

greenhouse gases, including carbon emissions, by 60 percent by 2050 while improving mobility.[43] However, academic studies vary on the extent to which environmental benefits can be achieved from increased air-rail connectivity.[44] For example, energy savings from high-speed rail connectivity may depend, in part, on the extent that passengers use rail to connect to the airport rather than other automotive transportation.[45] Studies have also suggested that the substitution of long-distance flights for short-haul flights that have been replaced by rail service could potentially increase carbon emissions.[46]

Costs

Expanding the current intercity passenger rail network and connecting it to airports would be expensive. However, the costs of facilitating connections between intercity passenger rail stations and airports could vary significantly, depending in part on the complexity and scope of the project. (See table 2.) Air-rail connectivity efforts may be as simple as providing shuttle bus service between the Amtrak station and the airport terminal or as complex as relocating the intercity passenger rail station closer to the airport and integrating it into a multimodal transportation center. For example, BWI Airport operates a free passenger shuttle between the nearby Amtrak station and the airport terminal, at a cost of $2 million per year. In addition to the shuttle service, the Maryland Transit Administration has used $9 million from the HSIPR grant program to make BWI Airport Amtrak station improvements, including planning for track and rail station upgrades. In contrast, the development of the Miami Intermodal Center—which includes construction of a rail station collocating Amtrak, commuter rail, and heavy rail transit access at Miami International Airport, a rental car facility, and an automated people

[43]European Commission, *Roadmap to a Single European Transport Area - Towards a Competitive and Resource Efficient Transport System,* COM (2011) 144 final (Brussels, BD: Mar. 28, 2011).

[44]Massimiliano Zanin, Ricardo Herranz, and Sophie Ladousse, "Environmental benefits of air–rail intermodality: The example of Madrid Barajas," *Transportation Research* Part E 48 (2012). Paul Chiambaretto, Christopher Decker, "Air-rail Intermodal Agreements: Balancing the Competition and Environmental Effects," *Journal of Air Transport Management* 23 (2012).

[45]Anthony Perl and John Calimente, "Integrating High-Speed Rail into North America's Next Mobility Transition," *Environmental Practice*, Vol 13 (2011).

[46]See for example, Wolfgang G. Grimme, "Air/Rail Passenger Intermodality Concepts in Germany," World Review of Intermodal Transportation Research, vol. 1, no. 3 (2007).

mover—is estimated to cost approximately $2 billion. Depending upon the scope of new infrastructure, project costs may include constructing stations, structures, signal systems, power systems, and maintenance facilities; relocating utilities; and obtaining rights-of-way, among other things. In addition to infrastructure costs, on-going operation and maintenance costs can be high for states and local transportation agencies. For example, airport officials estimate that the automated people mover system that connects Newark Liberty International Airport and the nearby Amtrak station costs $26 million per year to operate and maintain. Furthermore, PRIIA requires that operating and capital costs be allocated among the states and Amtrak in connection with the operation of certain Amtrak routes.[47] Absorbing such costs could be challenging for states and localities as they continue to face near-term and long-term fiscal challenges resulting from increasing gaps between revenue and expenditures.[48]

Table 2: Projected Construction Costs of Selected Ongoing Projects to Expand Air-Rail Connectivity

Description	Location	Projected cost ($ in millions)	Funding source(s)	Targeted completion
Miami Intermodal Center including construction of a rental car facility, intercity passenger rail station, automated people mover, and local transit connection to existing Metrorail system at the airport	Miami International Airport, Miami, FL	$2,023	• Federal funding (Transportation Infrastructure Finance and Innovation Act loans) • State funding (Florida Department of Transportation loans) • Local funding (Miami-Dade County contributions) • Other funding (rental car customer facility charges, toll road revenue) [a]	2014

[47]Pub. L. No. 110-432, div. B, title II, § 209, 122 Stat. 4848, 4907, 4917-4918. The routes include high-speed rail corridors designated by the Secretary of Transportation (other than the Northeast Corridor railroad line, which extends from Boston, Massachusetts, to Washington, D.C.); short-distance corridors and routes currently part of the national rail passenger transportation system that do not exceed 750 miles between their endpoints; and intercity rail routes not included in the national rail passenger transportation system that Amtrak operates on behalf of state or local entities.

[48]GAO, *State and Local Governments' Fiscal Outlook April 2013 Update*, GAO-13-546SP (Washington, D.C.: Apr. 29, 2013).

Description	Location	Projected cost ($ in millions)	Funding source(s)	Targeted completion
Regional Intermodal Transportation Center, which will connect the airport to the existing Amtrak station and include a commuter rail link	Bob Hope Airport, Burbank, CA	$112	• Federal funding (Federal Transit Administration and Federal Highway Administration grants) • Passenger facility charges • Other funding (rental car customer facility charges)	2014
Baltimore/Washington International Thurgood Marshall (BWI) Airport Amtrak station improvements, including planning for track and rail station upgrades	BWI Airport, Baltimore, MD	$9	• Federal funding (High Speed Intercity Passenger Rail grants)	2014

Source: GAO analysis of state DOT and airport data.

[a]The amount of private sector funds for this project are to be determined.

In addition to the direct financial costs of constructing, operating, and maintaining air-rail connections, economic costs may arise due to impacts on other transportation modes. For example, representatives from the Association of American Railroads noted that there is limited additional capacity on the freight rail lines shared between Amtrak and the freight railroads.[49] Accordingly, these representatives stated that any additional intercity passenger traffic initiated to enhance air-rail connectivity on existing freight rail lines could increase the cost and reduce the timeliness of freight shipped on these lines. In such an event, Amtrak and the freight railroads may have to revisit agreements over the usage of the freight rail lines, which can be a lengthy and costly process for all stakeholders. Alternatively, Amtrak or other intercity passenger rail service operators may need to acquire additional right-of-way and construct additional tracks to accommodate increased connectivity between airports and intercity passenger rail, which, as discussed previously, could increase the cost of providing air-rail connectivity. Similarly, representatives from two of the four airlines we interviewed stated that developing intercity passenger rail service that provides an alternative to air travel could affect their profitability.

[49]The Association of American Railroads is a trade association whose membership includes freight railroads that operate 82 percent of the line-haul mileage, employ 95 percent of the workers, and account for 97 percent of the freight revenue of all railroads in the United States, and passenger railroads that operate intercity passenger trains and provide commuter rail service.

As with many large capital projects, committing financial resources for air-rail projects may also impose opportunity costs as a result of delaying or deferring other projects or initiatives. Specifically, the financial cost of air-rail connectivity projects could affect the ability of governmental entities to pursue other types of transportation projects, particularly in the current fiscal environment. For example, one airline representative we interviewed noted that air travel is in direct competition for resources with other modes of transportation and suggested that any federal funds provided to enhance air-rail connectivity could come at the expense of funding for other programs, including the Next Generation Air Transportation System (NextGen) air traffic control modernization initiative.[50]

Given the high potential costs of air-rail connections, it is likely that only a limited number of places could demonstrate potential benefits high enough to justify improved air-rail connectivity investments. For example, if air passengers could access a nationwide rail network directly at an airport, some passengers might travel to that airport from other cities by train rather than on highways or short-haul flights, which might reduce highway or airport and aviation congestion. However, the demand for such service is likely to be low except in a few highly congested travel corridors, such as the Northeast Corridor, where the distances are short enough to make rail travel times competitive with air travel times. At airports that do not have substantial highway or airport congestion, such benefits would not be realized. There might still be some emission and energy benefits, but since the number of travelers likely to use these facilities at such airports is limited, these benefits will be limited as well. Amtrak officials noted that costs and benefits are relative to the scope and complexity of each air-rail connectivity option. For example, they noted that providing an air-rail connection that serves both intercity and local commuter rail, such as those provided by many of Amtrak's airport-adjacent stations, can provide benefits that might not be justified if the station was served only by intercity rail. Furthermore, Amtrak officials noted that exploring air-rail integration early during the planning and development of an airport can help reduce the overall cost of developing air-rail connectivity, while still achieving substantial mobility benefits.

[50]NextGen is FAA's initiative to transform the nation's existing ground-based air-traffic control system to an air-traffic management system using satellite-based navigation and other advanced technology. FAA estimates that NextGen improvements through 2030 may cost approximately $37 billion.

Air-Rail Connectivity Is Influenced by a Variety of Factors

Based on input from our expert survey; discussions with stakeholders, including state departments of transportation, local transportation planning organizations, airports, and airlines; and our review of academic literature, we identified five categories of factors that can greatly affect air-rail connectivity, including the degree of leadership and collaboration among stakeholders, resource availability, the extent of passenger demand for air-rail connectivity, the ease of the air-rail connection, and the passenger rail service operating characteristics.[51] (See table 3.)

Table 3: Factors Surveyed Experts Most Frequently Cited As Greatly Facilitating and Greatly Hindering Air-Rail Connectivity

Category	Factors that facilitate	Factors that hinder
Leadership/ stakeholder collaboration	• Integration of air-rail connections into an overall, multi-modal transportation plan/strategy • Communication, collaboration, and consensus across stakeholders, including, local, state, federal, and private sector entities	• Lack of integration of air-rail connections into an overall, multi-modal transportation plan or strategy • Lack of leadership for air-rail project or leadership is diffused across many stakeholders
Resource availability	• Available funding for air-rail connectivity projects	• The financial cost of air-rail connectivity projects • Lack of dedicated funding for air-rail connectivity projects • Lack of existing intercity passenger rail infrastructure, including tracks and stations • Lack of available right-of-way, land, or other physical space for air-rail projects
Passenger demand	• Sufficient passenger demand for intercity passenger rail service	• Lack of demand for intercity passenger rail service to the airport
Ease of connection	• Close proximity between airport and intercity passenger rail station • Ease of use of the airport-rail connections • Availability of information, including signage, provided to make the connection between the airport and rail service	• Lack of close proximity between airport and intercity passenger rail station

[51]In our survey, experts rated factors that were identified by other experts as either facilitating or hindering air-rail connectivity. For factors identified as facilitating air-rail connectivity, experts rated each factor as “greatly facilitates,” “facilitates,” “somewhat facilitates,” “does not facilitate,” “not a factor,” or that they had “no opinion.” Similarly, for factors that were identified by experts to hinder air-rail connectivity, experts rated each factor as “greatly hinders,” “hinders,” “somewhat hinders,” “does not hinder,” “not a factor,” or that they had “no opinion.” For more information on our survey and results, see appendix I and GAO-13-692SP, respectively.

Category	Factors that facilitate	Factors that hinder
Rail service operating characteristics	• Frequent intercity passenger rail service • Reliable intercity passenger rail service that departs and arrives on schedule • High-speed intercity passenger rail service connects to the airport	• Lack of frequent intercity passenger rail service • Lack of reliable intercity passenger rail service

Source: GAO analysis.

Note: We identified these factors based on the number of experts rating that a given factor "greatly facilitates" or "greatly hinders" the development and use of air-rail connectivity.

Leadership and Stakeholder Collaboration

The degree of leadership and the extent of stakeholder collaboration across air-rail projects can affect project development. Specifically, almost half of the experts (18 of 40) rated the lack of leadership as greatly hindering air-rail connections. Stakeholders we interviewed during our site visits told us that when there is an absence of leadership, stakeholders are unlikely to assume roles outside of their typical responsibilities and interests, a limitation that makes project development more difficult. Conversely, leadership that helps build bridges across stakeholder groups can help develop a shared vision and foster collaboration, thereby facilitating project development.

However, we found there is limited federal leadership for air-rail projects, and no modal administration has a primary responsibility to oversee air-rail projects, as responsibilities for transportation projects are segmented by mode. Furthermore, according to an academic study and stakeholders we interviewed, the United States is lacking a national policy framework and vision to guide investment in the needed infrastructure to develop air-rail connections.[52] For example, FRA's High-Speed Rail Strategic Plan does not address connectivity between airports and intercity passenger rail.[53] In addition, while DOT's 2012-2016 strategic plan broadly discusses connectivity between airports and intercity passenger rail, DOT has not established any specific goals for air-rail connectivity.[54] This is consistent with our previous work that concluded that the absence of specific

[52]Anthony Perl and John Calimente, "Integrating High-Speed Rail into North America's Next Mobility Transition," *Environmental Practice*, Vol. 13 (2011).

[53]Department of Transportation, *Vision for High-Speed Rail in America* (Washington, D.C.: April 2009).

[54]Department of Transportation, *Transportation for a New Generation:Strategic Plan for Fiscal Year 2012-16*.

national goals to develop intermodal capabilities at airports is a significant barrier to developing air-rail connections.[55] For example, half of the experts (20 of 40) rated integration of air-rail connections into an overall, multi-modal transportation plan or strategy as an approach that would greatly facilitate air-rail connectivity in the United States. In addition, officials we interviewed and over half of the experts (23 of 39) said that communication, collaboration, and consensus among stakeholders such as airlines; rail operators; airport management; and local, state, and federal government officials could greatly facilitate air-rail connectivity.

Resource Availability

Resource availability, including funding, right-of-way, and access to existing infrastructure can greatly affect the development of air-rail connectivity. As previously noted, the costs of linking existing intercity passenger rail infrastructure and airports can be significant, depending in part on the complexity and scope of the project. Slightly over half of the experts (21 of 40) rated the financial cost of a project as greatly hindering project development, while nearly three-fourths (29 of 40) rated availability of funding as greatly facilitating project development. In addition, about two-fifths of the experts (16 of 39) rated the level of funding for intercity passenger rail as a very important factor contributing to differences in air-rail connectivity development and use between the United States and Europe.

We found a number of barriers exist to securing funding for air-rail connectivity projects. For example, transportation officials and stakeholders we interviewed told us that the limitations on use of funds from federal grants and airport revenue collected from passenger facility charges are significant barriers. Furthermore, as noted previously in this report, the federal government does not provide funding dedicated to the development or operation of air-rail connections. If the trend of decreasing federal transportation funding over the past three decades continues, air-rail project sponsors may need to increasingly rely on state funds for air-rail connection projects.[56] In addition, our prior work also identified challenges of funding intercity passenger rail projects.[57] The

[55]GAO-05-727.

[56]GAO, *Grants to State and Local Governments: An Overview of Federal Funding Levels and Selected Challenges*, GAO-12-1016 (Washington, D.C.: Sept. 25, 2012).

[57]GAO, *High- Risk Series: An Update,* GAO-13-283 (Washington, D.C.: February 2013).

federal government has recently begun to pursue investment in high-speed passenger rail through the FRA's HSIPR grant program, and to date has obligated about $9.9 billion for 150 high-speed and intercity passenger rail projects from funds appropriated in fiscal years 2009 and 2010—with more than one-third of the amount obligated designated for the high-speed rail project in California. While this funding will allow many projects to begin construction, it is not sufficient to complete them. Furthermore, Congress has not appropriated any funding for the HSIPR program since fiscal year 2010.

The availability of other resources can also greatly affect the development of air-rail connectivity projects. Three-fifths of the experts (24 of 40) rated the lack of availability of land or physical space for direct air-rail projects, including the lack of existing intercity passenger rail infrastructure (e.g., tracks and stations) and rights of way, as factors that greatly influence the development of air-rail connections.

Passenger Demand

Passenger demand for air-rail connectivity has a significant role in developing and using such connections. Approximately half of the experts rated passenger volume and demand as a factor that can either greatly facilitate (if sufficient) (21 of 39) or hinder (if lacking) (20 of 40) air-rail connectivity projects. However, as mentioned previously in this report, there is limited data on the demand for intercity passenger rail. Furthermore, it is often difficult to estimate ridership demand. As we have previously reported, limited data and information, especially early in a project before specific service characteristics are known, make developing reliable ridership demand forecasts difficult.[58] Research on ridership forecasts for rail infrastructure projects around the world have shown that ridership forecasts are often overestimated.[59] Furthermore, there are no industry standard or established criteria for developing or evaluating intercity passenger and high-speed rail ridership forecasts.[60]

Ease of Connection

Over three-quarters of the experts (31 of 40) rated close proximity between the airport terminals and rail stations as greatly facilitating air-rail

[58]GAO, *High-Speed Passenger Rail: Preliminary Assessment of California's Cost Estimates and Other Challenges*, GAO-13-163T (Washington, D.C.: Dec. 6, 2012).

[59]GAO-13-304.

[60]GAO-13-304.

connectivity.[61] Connections that are easy to use and provide direct connection between the airport terminal and the rail station can greatly affect the development of air-rail connectivity. Officials we interviewed noted that air-rail connections should be designed to meet the needs of airport and intercity passenger users. Accordingly, they underscored that connections should be designed to make the experience as easy and seamless as possible for the traveler. Similarly, over half of the experts (21 of 39) rated the availability of information, including signage, about a connection as greatly facilitating air-rail connectivity. We found 20 of the 60 major airports in the contiguous United States included information about Amtrak on their respective websites, and 14 of the 20 airports provided specific instructions on how passengers could connect to or from Amtrak.[62]

Rail Service Operating Characteristics

Nearly two-thirds of the experts (26 of 40) and many of the stakeholders at our site visits cited frequency and reliability of rail service as factors that greatly influence air-rail connectivity. Stakeholders we interviewed noted that for the air-rail connection to be viable, the passenger rail operator needs to provide frequent service to multiple locations beyond the airport. The frequency of Amtrak service is highly variable across the nation. Similarly, a number of stakeholders we spoke with noted that the reliability of Amtrak service, specifically its on-time performance, affects the use of intercity passenger rail for travel, both between cities and to and from the airport. In addition, over half of the experts (25 of 40) rated the availability of high-speed intercity passenger rail service to connect to an airport as greatly facilitating an air-rail connectivity project. However, representatives from three of the four airlines we interviewed viewed high-speed rail as a potential competitor in diverting passengers away from, as opposed to feeding into, the airport.

[61]Approximately the same number of experts rated the lack of close proximity as a factor that greatly hindered air-rail project development.

[62]Based on a review of 60 major airports' ground transportation pages on their websites in April 2013.

Strategies to Improve Air-Rail Connectivity May Require Substantial Coordination and Funding

Experts participating in our survey suggested five key areas where implementing strategies could help improve air-rail connectivity: vision, coordinated planning, funding, infrastructure, and awareness and marketing of connections. We asked these experts to identify potential strategies, and then rate these strategies in terms of both their importance and their feasibility. Some of the strategies that experts rated as more important were also seen as less feasible.[63] (See table 4.) In discussing these strategies with other stakeholders and reviewing academic studies, we found that a number of strategies were inter-related. For example, some of the strategies that experts suggested to improve connectivity, such as increasing connections with other transportation modes, could be related to the implementation of other strategies, such as providing additional funding for air-rail connections.

Table 4: Experts' Rating of Importance and Feasibility of Selected Strategies to Improve Air-Rail Connectivity

	More feasible	Less feasible
More important	• Conduct additional study of air-rail policies in other countries as well as potential air-rail locations and ridership preferences in the United States • Ease restrictions on using funds collected through passenger facility charges • Include air-rail connections to the airport when intercity passenger rail service is first established in a corridor • Emphasize intermodal connectivity as a criterion for federal transportation funding	• Connect intercity passenger rail to other modes of transportation, including mass transit • Connect intercity passenger rail to city centers and urban attractions • Permit greater flexibility in using federal transportation grant funding • Provide dedicated funding for air-rail connections • Integrate existing rail service with airports, locating terminal as close to rail station as possible • Provide additional funding for intercity passenger rail • Alignment of long-term transportation plans across modes

[63]Experts in our survey identified and rated 34 strategies. When rating the importance of a potential strategy, experts were asked to rate the strategy as either "very important," "important," "somewhat important," "not important," or that they had "no opinion." Similarly, experts were asked to rate the feasibility of a strategy as "very feasible," "feasible," "somewhat feasible," "not feasible," or that they had "no opinion." For a full accounting of our results, please see GAO-13-692SP.

	More feasible	Less feasible
Less important	• Provide additional federal guidance on air-rail projects • Develop business cases to support air-rail connections • Establish national goals for air-rail connectivity • Emphasize intermodal connectivity as a core federal planning requirement • Establish a national framework for intermodal collaboration	• Align intercity passenger rail schedules with airline schedules • Establish a federal entity to work across modal administrations to champion intermodal and air-rail projects • Incentivize public-private partnerships to help fund and construct air-rail projects

Source: GAO analysis.

Note: We identified a strategy as "more important" if that strategy was within the top 10 strategies most frequently rated by experts as "very important," including ties. Similarly, we identified a strategy as "more feasible" if the strategy was within the top 10 strategies most frequently rated by experts as "very feasible," including ties. Strategies outside the top ten most frequently cited as very important and very feasible were classified as "less important" and "less feasible," respectively. This table does not list all of the strategies that were both "less important" and "less feasible." For full details on the results of our survey, see GAO-13-692SP.

Study of Preferences and Demand for National Priorities

Experts stated additional study of the demand for air-rail connectivity, as well as lessons learned in other countries, could help Amtrak and DOT clarify needs and develop priorities within their existing goals related to enhancing connectivity. Connectivity across modes has been emphasized broadly by DOT and Amtrak, though there has been limited emphasis placed by either for connectivity between airports and intercity passenger rail. For example, in its 2012-2016 strategic plan, DOT's goal of encouraging livable communities emphasizes connectivity across modes, and identifies connectivity between intercity passenger rail and transit and continued investment in the intercity passenger rail network as means to achieve that goal. DOT's strategic plan also notes that DOT will continue to work with Amtrak, states, freight railroads, airports, and other key stakeholders to ensure intercity passenger rail is effectively integrated into the national transportation system, though the department has not established any specific goals for air-rail connectivity. Similarly, DOT's most recent update to its national rail plan, published in September 2010, encourages the integration of policies and investments across modes, including air transportation, to provide convenient options for accessing the passenger rail network, but does not establish specific goals or timelines for increasing air-rail connectivity. Amtrak's strategic plan has set a goal of connecting to three additional airports in the Northeast Corridor by 2015 as part of its efforts to increase intercity passenger rail connectivity with other travel modes in key markets, but Amtrak officials we spoke with stated that they do not believe Amtrak will achieve this goal because of limited available funding for intercity passenger rail.

Should DOT, Amtrak, or Congress choose to develop a more comprehensive approach to air-rail connectivity, experts we surveyed identified further study of passenger preferences and demand as one of the most important and most feasible steps policymakers could take to improve air-rail connections. For example, half of the experts (20 of 40) rated additional study of ridership preferences across all modes as very important to informing the federal government's air-rail strategy. As previously noted, limited data on passenger preferences and demand for air-rail connectivity exists. For example, one expert emphasized that because passenger demand for air-rail connectivity varies across the country, additional study of passenger preferences at the local level could help identify approaches tailored to the specific needs of the area, noting that there is no "one size fits all" approach to air-rail connectivity. Furthermore, 24 of 40 experts rated studying lessons learned and policy responses from other countries as "very important" toward improving understanding of air-rail connectivity issues, though as previously discussed, air-rail connectivity approaches vary widely outside the United States.

Collaborative Planning

Experts in our survey and stakeholders at seven of our eight site visits highlighted the importance of coordinated transportation planning between airports and intercity passenger rail, which could help stakeholders develop multimodal solutions and facilitate problem solving. Amtrak officials noted that if airports, Amtrak, and other transportation stakeholders begin to plan for integration early, the costs of connecting air and rail transportation become part of a larger intermodal strategy and can provide benefits. Accordingly, both Amtrak officials and experts highlighted the importance of planning an intercity passenger rail connection as part of an overall ground access strategy. For example, 17 of 40 experts rated planning air-rail connections to the airport during the initial establishment of intercity passenger rail service as very important. Amtrak officials noted that planning for intercity rail connections at airports during the initial development of the airport can help minimize the incremental cost of making a connection while providing substantial benefits from air-rail connectivity. However, in many locations, particularly in the Northeast Corridor, the rail network was developed decades before the airport. In addition, such an approach may not be feasible, as federal funding and oversight is segmented by mode, a segmentation that can lead to competition, rather than collaboration for funding. Furthermore, collaboration across stakeholder groups can be a time-intensive process and may not necessarily change the willingness of stakeholders to collaborate.

Funding and Flexibility

Experts we surveyed and stakeholders at six of our eight site visits we interviewed highlighted the importance of securing funding for air-rail connectivity projects. Because of the often substantial cost of the physical infrastructure to support air-rail connections, stakeholders at four of our eight site visits noted that the federal government may have to provide most of the funding to make development possible. Over half of the experts in our survey (22 of 41) as well as other stakeholders at five of our eight site visits suggested that dedicated funding for air-rail connections could help increase the number of connections between airports and intercity passenger rail. Alternatively, nearly half (17 of 41) of the experts in our survey suggested that increased funding for intercity passenger rail is a very important strategy related to increasing Amtrak's ability to connect to airports. However, the current fiscal environment presents challenges to increasing federal funding for discretionary programs though some existing grant and loan programs—such as the HSIPR, Transportation Investment Generating Economic Recovery (TIGER), and Transportation Infrastructure Finance and Innovation Act of 1998 (TIFIA) programs—have some flexibility to fund air-rail connections if such a connection is a state or local priority.[64] As previously noted, additional funding for air-rail connections could require tradeoffs with other transportation projects. With limited existing funds available for air-rail projects, two stakeholders we interviewed suggested that the federal government should focus on a few air-rail projects of national significance, rather than a number of smaller projects throughout the entire nation. Similarly, one stakeholder suggested that the federal government provide money for a few projects to demonstrate the potential benefits of air-rail connectivity, before moving forward on a nationwide program.

Stakeholders at four of our eight site visits also suggested that providing additional flexibility in permitted expenditures among existing federal programs could help improve airport connectivity via rail. In particular, they suggested changes to the airport passenger facility charge authority as well as to the AIP grant program. Among the funding strategies evaluated in our expert survey, experts generally rated the strategy of relaxing the restrictions on passenger facility charges among the most

[64]For more information on these and other selected programs that may be used to fund and finance air-rail connectivity, see appendix III.

feasible strategies. Airport operators may currently use funds collected from air passengers through passenger facility charges to fund rail access at airports, if the project is owned by the airport, located on airport property, and used exclusively by airport passengers and employees. However, easing these restrictions on use of passenger facility charges faces obstacles. Specifically, use of passenger facility charge revenues is limited by law to airport-related projects. Such a change would require legislative action by the Congress, and changes to the passenger facility charges program have been opposed by the airline industry. For example, representatives from one airline we spoke with stated that the airline was fundamentally opposed to using funds collected through passenger facility charges to pay for airport and intercity passenger rail connections because, in their view, the federal government should not tax airline passengers to fund other transportation modes. Stakeholders at three of the eight airports we spoke with suggested that Congress could allow additional flexibility in the use of funds from transportation grant programs, including the AIP program, which is funded through a variety of aviation excise taxes. While AIP grants may currently be used to fund projects promoting air-rail connectivity on the airport property, like the passenger facility charges, program funds may only be used to fund airport-related projects. Again, however, airlines we spoke with opposed easing existing limitations on the use of AIP grants for airport projects that may benefit non-aviation passengers, and any change to the AIP program to broaden the use of these grants would require congressional action. Furthermore, as previously noted, the commitment of financial resources for air-rail projects may also impose opportunity costs as a result of canceling or delaying other projects or initiatives that could be funded by these federal programs.

Infrastructure Connectivity

Experts in our survey suggested that increasing the size and operation of the existing intercity passenger rail network could help encourage the development and use of intercity passenger rail to access airports. Specifically, 23 of 39 experts cited the size and the extent of the intercity passenger rail network as a very important factor resulting in differences between air-rail connections in the United States and Europe. Accordingly, over two-thirds of the experts in our survey (27 of 40) suggested that developing rail connections to transit and other forms of public transportation could help encourage the use of rail to the airport, and over half of the experts (22 of 40) stated that additional connections to city centers and urban attractions are very important strategies to consider. DOT has taken some steps to increase the intercity passenger rail network, most notably through the HSIPR grant program, which, FRA

officials noted, placed emphasis on using funds available for intercity passenger rail infrastructure to establish and enhance connections between major metropolitan areas. Additionally, stakeholders we interviewed at six of our eight sites noted that increasing the frequency of intercity passenger service in existing corridors could encourage greater use of rail to connect to the airport. For example, one stakeholder noted that passengers are much less likely to use rail if departure times are hours apart, as opposed to minutes. However, even in corridors that have existing intercity passenger rail service, increasing the frequency of service can be challenging due to both the cost and, as previously discussed, the shared usage of the infrastructure with the freight railroads. Furthermore, as discussed previously, stakeholders we spoke with stated that there is limited demand for public transportation options to connect to the airport, and thus it is unclear whether increasing the frequency of service will increase passenger use of intercity rail service to connect to airports.

Awareness of Air-Rail Connections

While building the infrastructure to support new air-rail connections can be expensive and time-intensive, our work identified a few low cost options that could help increase passenger awareness, and thus usage, of existing air-rail connections. For example, Amtrak station operators and airport officials could take steps to increase awareness of existing connections between the two modes, using additional or more prominently placed signage and information kiosks. For example, at the BWI Airport Amtrak Station, signs and information direct customers exiting the station platform to the bus shuttle service connecting the two modes. (See fig. 3.) Similarly, in Burbank, officials stated that the use of signage highlighting the walking path between the Burbank rail station and the airport has helped, in part, to make the connection between the two modes easier for passengers to use. These officials also noted that even with signage, an air-rail connection often required frequent and reliable service from an intercity passenger rail operator. As another option, Amtrak could highlight the connections to the airport from each station on its website, thus providing an additional source of information to travelers beyond what is available at the airport or rail station.

Figure 3: Signage and Information at the BWI Airport Amtrak Station

Source: GAO.

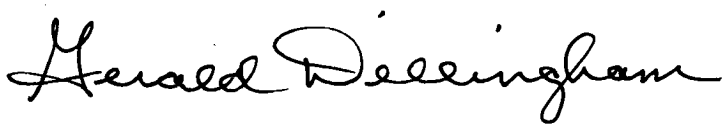
Agency Comments

We provided a draft of this product to DOT and Amtrak for comment. DOT and Amtrak provided technical comments on the draft, which we incorporated as appropriate. DOT and Amtrak did not have any comments on the e-supplement.

We are sending copies of this report to the Secretary of Transportation, the President of Amtrak, and the appropriate congressional committees. In addition, this report will be available at no charge on the GAO website at http://www.gao.gov.

If you have any questions about this report, please contact me at (202) 512-2834 or dillinghamg@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page

of this report. GAO staff who made key contributions to this report are listed in appendix V.



Gerald L. Dillingham, Ph.D
Director
Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

This report addressed the following objectives: (1) the nature and scope of existing air-rail connectivity in the United States; (2) the benefits and costs of developing air-rail connectivity; (3) the factors that facilitate and hinder the development and use of air-rail connectivity; and (4) potential strategies, including lessons learned from other countries, that may help inform deliberations regarding air-rail connectivity policy. This report focused on air-rail connections between an airport terminal and an intercity passenger rail station. In other contexts, an air-rail connection may refer to a connection between an airport terminal and an intracity rail station that serves other forms of local rail, such as commuter rail or a subway system.

To address our objectives, we obtained and analyzed information from a variety of sources. We reviewed and synthesized information from our body of work and relevant academic literature on intermodal transportation, air-rail connectivity, and air-rail code share agreements in the United States and internationally. We reviewed citations identified through a search of databases containing peer-reviewed articles, government reports, and "gray literature," including Transport Research International Documentation, Social SciSearch, and WorldCat.[1] Publications were limited to the years 2004 through 2012. After an initial review of citations, 48 articles were selected for further review. To collect information on the articles, we developed a data collection instrument to gather information on the articles' scope and purpose, methods, findings, and their limitations, and additional areas for follow-up, including a review of the bibliography to determine the completeness of our literature search. To apply this data collection instrument, one analyst reviewed each article and recorded information in the data collection instrument. A second analyst then reviewed each completed data collection instrument to verify the accuracy of the information recorded. We summarized the findings and limitations of the articles based on the completed data collection instruments, as well as areas for additional research identified in the articles. In addition, we also reviewed federal laws related to air and

[1]"Gray literature" publications may include, but are not limited to, the following types of materials: reports (pre-prints, preliminary progress and advanced reports, technical reports, statistical reports, memorandums, state-of-the art reports, market research reports, etc.), theses, conference proceedings, technical specifications and standards, non-commercial translations, bibliographies, technical and commercial documentation, and official documents not published commercially (primarily government reports and documents).

intercity passenger transportation and strategic plans from Amtrak and the Department of Transportation (DOT).

We interviewed officials from DOT and Amtrak, transportation experts, and representatives from U.S. airlines and industry associations to obtain their perspectives on air-rail connectivity issues. We reviewed completed, ongoing, and future air-rail connectivity efforts at eight airports in the United States, and interviewed a variety of stakeholders at each site, including airport authorities, state and local transportation agencies, local transportation planning organizations, and air and rail industry associations. (See table 5.) These airports were selected to include airports that have recently planned, constructed, or completed an air-rail project and are dispersed in various regions of the country. Our findings at these sites were selected as part of a judgmental, non-probability sample of air-rail connectivity efforts at airports, and cannot be generalized to all airports.

Table 5: Airports and Stakeholders Selected for GAO Review

Airport	Geographic location	Stakeholders
Baltimore/Washington International Thurgood Marshall	Glen Burnie, MD	• Maryland Aviation Administration • Maryland Department of Transportation • Maryland Transit Administration
Bob Hope	Burbank, CA	• Bob Hope Burbank Airport Authority • California Department of Transportation • Southern California Association of Governments
Chicago O'Hare International	Chicago, IL	• Chicago Department of Aviation • Illinois Department of Transportation • Chicago Department of Transportation • Chicago Metropolitan Agency for Planning • Midwest High Speed Rail Association
Dallas/Fort Worth International	Fort Worth, TX	• Dallas/ Fort Worth Airport • Texas Department of Transportation • North Central Texas Council of Governments • Dallas Area Rapid Transit
Miami International	Miami, FL	• Miami-Dade Aviation Department • Florida Department of Transportation • Miami-Dade County Municipal Planning Organization • Miami-Dade Transit

Airport	Geographic location	Stakeholders
General Mitchell International	Milwaukee, WI	• Milwaukee General Mitchell International Airport • Wisconsin Department of Transportation • Southeastern Wisconsin Regional Planning Commission • Airport Gateway Business Association/Gateway to Milwaukee
Norman Y. Mineta San Jose International	San Jose, CA	• San Jose International Airport • City of San Jose Department of Transportation • Metropolitan Transportation Commission
Newark Liberty International	Newark, NJ	• The Port Authority of New York and New Jersey • Regional Plan Association • New Jersey Transit

Source: GAO.

We also analyzed Amtrak's distance and connectivity to the 28 large and 32 medium hub airports located in the contiguous United States based on the 2011 Federal Aviation Administration's Air Carrier Activity Information System database.[2] We limited our analysis to these 60 airports because they accounted for approximately 86 percent of U.S. passenger enplanements for calendar year 2011. We determined the linear distance for each of the 60 airports and the nearest Amtrak station based on information from the Bureau of Transportation Statistics and the National Transportation Atlas Database for 2012. Based on the use of both as widely accepted federal statistical data sources, we determined these data to be generally reliable for our purpose, which was to provide context on existing air-rail connectivity. Linear distance is the distance measured between two points using their latitude and longitude. This may understate the distance a passenger may have to travel because it does not account for actual travel routes (e.g., a route that crosses a bridge or avoids buildings or other obstacles along the passenger's route). The actual distance that a passenger may travel also depends on the selected transportation mode, local roads, or route selected. We used the linear distance calculations to determine the number of airports with an Amtrak station within 5, 10, 20, and over 20 miles. (See app. IV.) To determine the modal connectivity between airport and Amtrak stations, we

[2]Airport hub size categories are based on the number of passengers boarding an aircraft (enplaned) for all operations of U.S. carriers in the United States. A large hub commercial service airport has 1 percent or more of total annual passenger boarding. A medium hub commercial service airport has at least 0.25 percent but less than 1 percent of total annual passenger boarding.

systematically reviewed the airport websites' ground transportation page and Amtrak System Timetable for Winter/Spring 2013 for information on how passengers can access Amtrak to and from the airports.

To obtain additional insight on issues related to air-rail connectivity, we collaborated with the National Academy of Sciences to identify 25 experts from the aviation and rail industries, Amtrak, state and local governments, academia, and the private sector. These experts were selected based on their knowledge of one or more of the following topic areas: intermodalism, airlines and the air travel industry, airport operations, the rail industry, and passenger travel. We identified 17 additional experts in these fields through a review of academic literature, our previous work, and interviews with stakeholders. (See app. II for a list of these experts.) We conducted a web-based survey in which we asked these 42 experts for their views on the benefits of air-rail connectivity, factors that facilitate and hinder the development and use of air-rail connectivity, differences between air-rail connectivity in the United States and Europe, and strategies that could improve air-rail connectivity. We employed a modified version of the Delphi method to organize and gather these experts' opinions.[3] Experts were sent an email invitation to complete the survey on a GAO web server using a unique username and password. The survey was conducted in two stages. The first stage of the survey—which ran from January 16, 2013, to February 19, 2013—asked the experts to respond to five open-ended questions about various aspects of air-rail connectivity based on our study objectives. To encourage participation by our experts, we stated that responses would not be individually identifiable and that results would generally be provided in summary form. We received a 95 percent (40 of 42) response rate for the first stage of the survey. After the experts completed the open-ended questions, we performed a content analysis of the responses to identify the most important issues raised by our experts. Two members of our team independently categorized experts' responses to each of the questions. Any disagreements were discussed until consensus was reached. We analyzed the responses provided by the experts and developed close-ended questions for the second stage of the survey where we asked each expert to evaluate the ideas and other information that came from the first part of the survey. Because this was not a sample

[3]The Delphi method, developed by the RAND Corporation in the 1950s, is most commonly applied in a group-discussion forum. We modified the approach to have the group discussion take place in the form of a web-based forum.

survey, it had no sampling errors. However, the practical difficulties of conducting any survey can introduce non-sampling errors, such as difficulties interpreting a particular question, which can introduce unwanted variability into the survey results. We took steps to minimize non-sampling errors by pre-testing the questionnaire with 5 experts. We conducted pretests to help ensure that the questions were clear and unbiased, and that the questionnaire did not place an undue burden on respondents. An independent reviewer within GAO also reviewed a draft of the questionnaire prior to its administration. We made appropriate revisions to the content and format of the second survey questionnaire based on the pretests and independent review. The second stage of the survey was administered on the Internet from March 25, 2013, to May 15, 2013. To increase the response rate, we followed up with emails and personal phone calls to the experts to encourage participation in our survey. We received responses from 41 of 42 experts, resulting in a 98 percent response rate. The information and perspectives that we obtained from the expert survey may not be generalized to all experts that have an interest or knowledge of air-rail connectivity issues. The full survey and responses are available at GAO-13-692SP.

We provided a draft of this report to Matthew A. Coogan, director of the New England Transportation Institute for review and comment, based on his expertise on air-rail connectivity issues similar to those in our report. Mr. Coogan was selected based on his extensive past and on-going research on similar topics related to air-rail connectivity issues in the United States. He provided technical comments, which we incorporated as appropriate. We conducted this performance audit from August 2012 to August 2013 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Experts Participating in GAO's Survey on Air-Rail Connectivity

Name	Title	Affiliation
Thomas Adler	President	Resource Systems Group, Inc.
Ruth Bagley	Project Lead	Chief Executive of Slough Borough Council
John Bennett	Former Assistant Vice President, Policy, Standards and Business Integration	Amtrak
Mohamed Bhanji	Director, Marketing Technologies	VIA Rail Canada
David Classey	Director, Planning and Programmes	Travelport
Patty Clark	Senior Advisor for Aviation Policy	The Port Authority of New York & New Jersey
John Conlow	Senior Director of Corridor Planning	Amtrak
Matthew A. Coogan	Director	New England Transportation Institute
Linda Culp	Principal Planner - Rail	San Diego Association of Governments
Crystal DuPont	Project Manager for Passenger Rail Planning Management	Wisconsin Department of Transportation
Dan Feger	Executive Director	Bob Hope Airport
Geoff Gosling	Principal	Aviation System Consulting
Mark Hansen	Professor	University of California, Berkeley
John Hansman	Professor of Aeronautics and Astronautics	Massachusetts Institute of Technology
Tim Hoeffner	Director	Michigan Department of Transportation Office of Rail
Roger Hooson	Senior Planner, Landside Operations	San Francisco International Airport
Hanan Kivett	Vice President and Senior Project Manager, Transportation	AECOM
Joerg Last	Managing Partner	STRATA GmbH
Paul LeBlond	President	International Air Rail Organisation
Bob Longworth	Owner	Bob Longworth Consulting
William Mallett	Specialist in Transportation Policy	Congressional Research Service
Michael Mallonee[a]	Principal Transportation Planner	North Central Texas Council of Governments
Philip Martin	Head of Marketing	Amadeus Rail

Name	Title	Affiliation
Jennifer Moczygemba	Rail System Section Head	Texas Department of Transportation
Gary Molyneaux	Airport Planning Manager	King County International Airport/Boeing Field
Curtis Morgan	Program Manager	Texas A&M Transportation Institute
Mike Muller	Head Interline and Intermodal Policy	International Air Transport Association
Christopher Nash	Research Professor	Institute of Transport Studies, University of Leeds
Paul Neal	Principal	Parsons Brinckerhoff
Peter Pfragner	Commissioner for Intermodality	Frankfurt Airport
Richard Roberts	Chief Planner	New Jersey Transit Corporation
Megan Smirti Ryerson	Assistant Professor	University of Pennsylvania
John Schalliol	Executive Director, Retired	St. Joseph County Airport Authority
Joshua Schank	President and CEO	ENO Center for Transportation
George Schoener	Executive Director	I-95 Corridor Coalition
Andrew Sharp	Policy Adviser	International Air Rail Organisation
Stephen Van Beek	Executive Director, Policy and Strategy	LeighFisher, Inc.
Mark Walbrun	Market Leader, Transit and Rail, East Region	CH2M Hill
Mike Welch	Corporate Director of JFK Operations	Delta Air Lines
Joan Zatopek	Senior Aviation Project Manager	Port of Oakland

Source: GAO.

Note: In addition to the 40 experts listed above, one official from a U.S. airline participated on the panel. An additional expert was selected to participate in the survey but did not provide a response in either round of the survey.

[a]Chad Edwards and Kevin Feldt, program managers with the North Central Texas Council of Governments, provided input as part of this response.

Appendix III: Examples of Potential Federal Financing and Funding Sources for Air-Rail Projects

Source	Description	Example of use for air-rail projects
Airport Improvement Program	Provides grants to airports for planning and developing projects through the Federal Aviation Administration (FAA). The program is funded, in part, by aviation user excise taxes, which are deposited into the Airport and Airway Trust Fund. In terms of promoting air-rail connections, these funds may be used for projects that are on airport property or right-of-way owned or controlled by the airport, airport owned, and exclusively serves airport traffic. In fiscal year 2013, this program was funded at $3.1 billion.[a]	GAO found no example of its use for air-rail projects.
High Speed Intercity Passenger Rail grants	Provides competitively awarded grants to states, interstate compacts, and other public agencies, for high-speed and intercity passenger rail projects through the Federal Railroad Administration (FRA). Eligible projects include acquiring, constructing, improving, or inspecting equipment, track, and track structures, or a facility for use in or for the primary benefit of high-speed and intercity passenger rail service. Congress appropriated $8 billion for high-speed rail and intercity passenger rail in the American Recovery and Reinvestment Act of 2009 and $2.5 billion in the fiscal year 2010 Department of Transportation (DOT) Appropriations Act.[b] For fiscal year 2011, $400 million in unobligated funds were rescinded.[c]	Baltimore/Washington International Thurgood Marshall Airport Amtrak station improvements, including planning for track and rail station upgrades
Passenger Facility Charge program	Authorizes commercial service airports to charge airline passengers a boarding charge of up to $4.50 to be collected by the airlines, after obtaining FAA approval. The fees are used by the airports to fund FAA approved projects that are on airport property, airport-owned, and exclusively serve airport traffic. These projects must enhance the safety, security, or capacity of air travel; reduce the impact of aviation noise; or increase air carrier competition. In calendar year 2012, $2.8 billion in fees were collected under this program.	AirTrain automated people mover at Newark's Liberty International Airport
Railroad Rehabilitation and Improvement Financing program	Provides direct loans and loan guarantees to railroads, state and local governments and Amtrak, among other entities, to finance the development of railroad infrastructure, including the development of new intermodal or railroad facilities. The program, administered by FRA, is authorized to provide up to $35 billion in loans or loan guarantees for eligible projects.	GAO found no example of its use for air-rail projects.
Transportation Investment Generating Economic Recovery grants	Provides discretionary grants through DOT, awarded on a competitive basis, to fund merit-based transportation projects expected to have a significant impact on the nation, a metropolitan area, or a region. Each project is multi-modal, multi-jurisdictional, or otherwise challenging to fund through existing programs. Eligible projects include capital investments in roads, highways, bridges, or transit; passenger and freight rail; and port infrastructure; as well as bicycle and pedestrian-related improvements. In fiscal year 2013, this program was funded at $474 million.	GAO found no example of its use for air-rail projects.

Source	Description	Example of use for air-rail projects
Transportation Infrastructure Finance and Innovation Act of 1998, as amended[d]	Provides federal credit assistance for surface transportation projects jointly through the Federal Highway Administration, Federal Transit Administration, and FRA. Project sponsors may include public, private, state, or local entities. Projects eligible for credit assistance include intercity passenger rail facilities and vehicles, such as those owned by Amtrak, as well as projects otherwise eligible for federal assistance through existing surface transportation programs. In fiscal year 2013, this program was funded at $750 million.	Miami Intermodal Center at Miami International Airport[e]

Source: GAO analysis.

[a]In fiscal year 2013, approximately $3.4 billion was made available for obligation for the AIP program. On May 1, 2013, the Reducing Flight Delays Act of 2013 was enacted. It authorized the Secretary of Transportation to transfer an amount, not to exceed $253 million, from the AIP program to the FAA operations account that the Secretary of Transportation determines to be necessary to prevent reduced operations and staffing of the FAA during fiscal year 2013. Pub. L. No. 113-9, 127 Stat. 443.

[b] Pub. L. No. 111-5, div. A., title XII, 123 Stat. 115, 208 (Feb. 17, 2009); Pub. L. No. 111-117, div. A, title I, 123 Stat. 3034, 3056 (Dec. 16, 2009).

[c] Pub. L. No. 112-10, div. B, title II, § 2222, 125 Stat. 28, 193 (Apr. 15, 2011).

[d]23 U.S.C. §§ 601-609.

[e]In addition to these funds, the Miami Intermodal Center will also use state and local funding, as well as funds generated from rental car facility charges and toll road revenue to complete the project. The amount of private funding for this project has yet to be determined.

Appendix IV: Distances between Large and Medium Hub Airport Terminals and Amtrak Stations in the Contiguous United States

Distance between airport and nearest Amtrak station[a]	Airport name	Airport location
0 to 5 miles (21 airports)	Albuquerque International Sunport	Albuquerque, New Mexico
	Baltimore/Washington International Thurgood Marshall	Glen Burnie, Maryland
	Bob Hope	Burbank, California
	Bradley International	Windsor Locks, Connecticut
	Buffalo Niagara International	Buffalo, New York
	Chicago Midway International	Chicago, Illinois
	Eppley Airfield	Omaha, Nebraska
	Fort Lauderdale/Hollywood International	Fort Lauderdale, Florida
	General Edward Lawrence Logan International	Boston, Massachusetts
	General Mitchell International	Milwaukee, Wisconsin
	Metropolitan Oakland International	Oakland, California
	Miami International	Miami, Florida
	Newark Liberty International	Newark, New Jersey
	Norman Y. Mineta San Jose International	San Jose, California
	Ontario International	Ontario, California
	Palm Beach International	West Palm Beach, Florida
	Reno/Tahoe International	Reno, Nevada
	Ronald Reagan Washington National	Arlington, Virginia
	Salt Lake City International	Salt Lake City, Utah
	San Diego International	San Diego, California
	Seattle-Tacoma International	Seattle, Washington
More than 5 miles to 10 miles (21 airports)	Austin-Bergstrom International	Austin, Texas
	Charlotte/Douglas International	Charlotte, North Carolina
	Chicago O'Hare International	Chicago, Illinois
	Cincinnati/Northern Kentucky International	Greater Cincinnati, Kentucky
	Dallas Love Field	Dallas, Texas
	Detroit Metropolitan Wayne County	Detroit, Michigan
	Indianapolis International	Indianapolis, Indiana
	Jacksonville International	Jacksonville, Florida
	John Wayne Airport-Orange County	Santa Ana, California
	La Guardia	New York, New York
	Memphis International	Memphis, Tennessee
	Minneapolis-St. Paul International/Wold-Chamberlain	Minneapolis, Minnesota
	Orlando International	Orlando, Florida
	Philadelphia International	Philadelphia, Pennsylvania

Distance between airport and nearest Amtrak station[a]	Airport name	Airport location
	Portland International	Portland, Oregon
	Raleigh-Durham International	Raleigh, North Carolina
	Sacramento International	Sacramento, California
	San Antonio International	San Antonio, Texas
	Tampa International	Tampa, Florida
	Theodore Francis Green State	Providence, Rhode Island
	William P. Hobby	Houston, Texas
More than 10 miles to 20 miles (13 airports)	Cleveland-Hopkins International	Cleveland, Ohio
	Dallas/Fort Worth International	Fort Worth, Texas
	Denver International	Denver, Colorado
	George Bush Intercontinental/Houston	Houston, Texas
	Hartsfield-Jackson Atlanta International	Atlanta, Georgia
	John F. Kennedy International	New York, New York
	Kansas City International	Kansas City, Missouri
	Lambert-St. Louis International	St. Louis, Missouri
	Los Angeles International	Los Angeles, California
	Louis Armstrong New Orleans International	New Orleans, Louisiana
	Pittsburgh International	Pittsburgh, Pennsylvania
	San Francisco International	San Francisco, California
	Washington Dulles International	Dulles, Virginia
More than 20 miles (5 airports)	McCarran International	Las Vegas, Nevada
	Nashville International	Nashville, Tennessee
	Phoenix Sky Harbor International	Phoenix, Arizona
	Port Columbus International	Columbus, Ohio
	Southwest Florida International	Fort Myers, Florida

Source: GAO analysis of National Transportation Atlas Database.

Note: This analysis does not include large and medium hub airports located outside of the contiguous United States. Specifically, this analysis does not include Honolulu International Airport in Honolulu, Hawaii; Kahului Airport in Kahului, Hawaii; Luis Munoz Marin International Airport in San Juan, Puerto Rico; and Ted Stevens Anchorage International Airport in Anchorage, Alaska.

[a]The distance between each airport and the nearest Amtrak station was calculated using linear distance between the longitude and latitude coordinate of each airport and Amtrak stations, as identified in the National Transportation Atlas Database for 2012. The distance between each airport and the nearest Amtrak station reflects the linear distance between the two locations, and may be affected by existing buildings, roads, bridges, or other obstacles in the path of a traveler connecting between an airport and an Amtrak station. Amtrak officials noted that, in some locations, it provides service that may operate in close proximity to an airport, but may not have an Amtrak station near that airport.

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

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Acknowledgments

In addition to the contact listed above, Teresa Spisak (Assistant Director), Matt Voit, Rosa Leung, Paul Aussendorf, Leia Dickerson, Patrick Dudley, Lorraine Ettaro, Jessica Evans, Kathleen Gilhooly, Delwen Jones, Richard Jorgenson, Jill Lacey, John Mingus, and Josh Ormond made major contributions to this product.