

## INTRODUCTION

# Expanding the Benefits of Aviation

## ANSWERING KEY CHALLENGES

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Aviation with fixed-wing aircraft—a technology proved more than 100 years ago—amazingly remains the newest and most revolutionary mode of transportation in the 21st century world of digital communications, satellite navigation, and economic globalization. Civil aviation has grown to connect the world in ways that automobiles, trains, or ships never have, and has served as the mode of transportation that most has enabled the world to develop technologically and economically.

Although aviation is new as a mode, more than 150 papers, publications, symposia, and other products of aviation-related research emanate annually from Transportation Research Board (TRB) activities. This special issue of *TR News* highlights several of the most important issues facing the aviation industry.

### A Complex System

Civil aviation is a complex system of aircraft, airports, and air traffic infrastructure. Aircraft range in shape, size, and purpose—from 700-passenger commercial superjumbo jets to general aviation aircraft seating one or two persons. Similarly, nearly 20,000 public- and private-use airports, heliports, and other landing areas of varying sizes and purposes operate in the United States, including nearly 500 commercial service airports, more than 5,000 public-use general aviation airports, and thousands more privately owned facilities.

All of the airports and aircraft in the aviation system are supported by publicly operated air traffic management infrastructure, including command centers, control towers, radar facilities, navigational aids, communications systems, and a defined network of federal airways not unlike the Interstate

The world's first airliner specifically designed for commercial aviation was the F.K. 26, produced by British Aerial Transport in 1919. Although modern aircraft accommodate significantly more passengers and often use new technologies such as satellite navigation or biofuel power, the fixed-wing design remains constant.



Photo: KooHoven Aeroplanes Foundation, www.koohoven.com



PHOTO: AIR NEW ZEALAND

The Boeing 747-400 jet airliner combines a four-engine wide-body layout with an efficient airframe. First introduced in the late 1980s, a 747-400 can hold more than 500 passengers.

The complex infrastructure system supporting commercial aviation includes public- and private-use airports, heliports, landing areas, air traffic management, and multimodal transportation to and from airports.

Highway System. Unlike vehicles on the roads, however, aircraft are under constant management—for routes, speeds, and altitudes—from the departure gate or parking position until arrival at the destination gate or parking position. Airports function as true multimodal centers in the nation's transportation infrastructure—all are served by automobiles, and most commercial airports are served by taxis and buses; many are served by rail—or soon will be; and some are integrated with marine terminals.

For each pilot flying an aircraft, no fewer than 10 full-time professional staff are working behind the scenes to make the flight successful, including airline flight planners and dispatchers, aircraft maintenance and repair personnel, airport operations and management professionals, and air traffic controllers. In addition, dozens of ancillary positions contribute to the success of the system, including aircraft and parts manufacturers, caterers,

customer service personnel, emergency services, policy makers, and—of course—researchers.

## Meeting Mobility Needs

The U.S. civil aviation sector—including air transportation, aircraft manufacturing, and air-based travel and tourism—collectively generated more than \$1.3 trillion in economic activity in 2007, accounting for 11.5 million jobs and \$396 billion in payroll expenditures.<sup>1</sup> U.S. civil aviation provides an enormous contribution to the national and global economies. A recent study by the Federal Aviation Administration (FAA) reported that

- ◆ The revenue ton-miles for freight transported through U.S. airspace exceed 67 billion<sup>1</sup>;
- ◆ Regularly scheduled nonstop air service connects the United States to more than 140 international cities<sup>2</sup>; and
- ◆ More than 700 million passengers board a commercial aircraft in the United States annually,<sup>1</sup> and more than 4 billion passengers board flights worldwide.

Aviation is key to meeting the world's mobility needs. The timely movement of people and goods around the world depends on a smoothly functioning aviation system. In the United States, people assume that shipments will arrive overnight and that they can travel anywhere in the world in less than 24 hours. A reliable air transportation system is vital to many industries—such as the manufacturers of personal electronics, computers, and computer parts and the wholesalers of flowers and fresh foods.

## Key Challenges

Authors of articles in this special edition of *TR News* examine several key challenges facing civil aviation, including the implementation of the Next Generation Air Transportation System (NextGen); the sustainability of the aviation system; developing and testing alternative fuels; effective approaches to aviation security; and meeting the economic needs of the industry.

### NextGen

NextGen represents one of the greatest challenges to the long-term future of the aviation system, requiring the accommodation of a major technological upgrade for managing air traffic. NextGen is expected to improve national airspace capacity, as

<sup>1</sup> [www.faa.gov/air\\_traffic/publications/media/FAA\\_Economic\\_Impact\\_Rpt\\_2009.pdf](http://www.faa.gov/air_traffic/publications/media/FAA_Economic_Impact_Rpt_2009.pdf).

<sup>2</sup> [www.bts.gov/xml/air\\_traffic/src/index.xml#TwelveMonthsSystem](http://www.bts.gov/xml/air_traffic/src/index.xml#TwelveMonthsSystem).



PHOTO: COLORADO SPRINGS AIRPORT



Successful aircraft flights depend not just on the pilot but also on communications and navigation professionals such as flight planners and dispatchers and air traffic controllers.

well as contribute to safety and efficiency and reduce impacts on the environment. The successful transition of a mature system built on a more than 100-year foundation will require a vast amount of dedicated resources for years to come.

***Sustainability and Alternative Fuels***

In delivering many positive economic benefits, the aviation industry and system consume increasingly scarce resources. To manage the available resources—particularly fossil fuels—in a sustainable way while providing for the movement of people and goods, the aviation industry is reviewing opportunities across the entire system to ensure that future needs can be met.

The development of commercially viable alternative fuels offers an important opportunity. Research is under way and is starting to yield promising results that will determine if alternative fuels can be used

safely, can reduce U.S. dependence on foreign imports significantly, can provide an economically viable alternative to increasingly expensive fossil fuels, and can reduce the environmental impacts from the use of fossil fuels.

***Maintaining a Secure System***

Perhaps the most significant changes affecting the aviation industry and those it serves have occurred in the past 10 years as a result of terrorist attacks involving aircraft and airports. These changes address the design and operation of airports, aircraft, and supporting services. Although a necessity, the changes to enhance aviation security have increased the time required to travel through U.S. airport terminals and have decreased somewhat the level of comfort and convenience aviation offers.

Preserving the efficacy of the aviation system while ensuring its security continues to challenge all



An airplane fuels up at Seattle-Tacoma International Airport. Research into environmentally friendly, commercially viable alternative jet fuels has gained traction as oil prices rise.



PHOTO: DAVID BERENICK

The scope and intensity of airport security measures have grown significantly since the September 11, 2001, terrorist attacks, posing a challenge to the aviation industry in balancing efficiency and thoroughness.

The Oversight Committee for the Airport Cooperative Research Program meets at the National Academies' Keck Center in Washington, D.C., January 2011. Since 2005, ACRP has initiated more than 200 research projects and released more than 70 practice-oriented publications.

who are working at the task, including government officials, aircraft and airport operators, first responders, university and research organizations, security consultants, and technology providers.

#### Meeting Economic Needs

A key difference between the U.S. aviation system and its road and transit system is that aviation is virtually self-supporting. The civil aviation system relies principally on user charges—for example, surcharges on the costs of tickets and of aviation fuel—to fund operations and capital development.

In the United States, federal laws and regulations require major commercial service airports to be financially self-sustaining. U.S. airports rely on grants from these federally imposed user charges, as well as on revenues from fees collected directly from aircraft operations—such as landing fees, fuel fees, gate leases, and hangar rentals—and from passengers and visitors who purchase such services as food, retail goods, and public parking at the airport.

Assuring an adequate and continuing source of funding is a key challenge for the entire aviation industry. The radar and communication technologies supporting the U.S. air traffic control system are quickly becoming obsolete and are to be replaced with satellite-based navigation and digital communication systems. The new systems require the concurrent replacement of ground-based technologies and the installation of compatible technologies in commercial aircraft. Funding these replacement technologies will be difficult.

### TRB's Involvement

The nine standing committees in TRB's Aviation Group promote and share the results of research addressing each of the operational, environmental, economic, and security challenges presented in this issue, along with issues associated with intergovernmental relations, system planning, airport terminals and ground access, aircraft–airport compatibility, and light commercial and general aviation aircraft. In 2011, the Aviation Group sponsored and cosponsored more than 150 presentations and posters in more than 50 sessions, workshops, and events on these topics at the TRB Annual Meeting; the committees peer-reviewed 18 papers published in August in *Transportation Research Record: Journal of the Transportation Research Board*, No. 2214. In addition, the Aviation Group and its committees routinely sponsor meetings, webinars, and symposia around the country.<sup>3</sup>

Members of the Aviation Group committees actively participate in TRB's Airport Cooperative Research Program (ACRP) as researchers, as members of panels overseeing the research, or by identifying research needs. Established in 2005 in the FAA's Vision 100 Reauthorization Act, ACRP has initiated more than 200 research projects benefiting the aviation industry and has released more than 70 publications.<sup>4</sup>

The articles in this issue should provide readers with a greater appreciation of the aviation industry and the challenges it faces. Readers are welcome to become involved in one or more of TRB's Aviation Group committees and in the ever-promising future of the world's newest mode of transportation.

### Acknowledgment

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<sup>3</sup> For more information about the activities of the Aviation Group committees, see [www.TRB.org/Aviation1/TRBCommittees.aspx](http://www.TRB.org/Aviation1/TRBCommittees.aspx).

<sup>4</sup> For more information about ACRP publications and research, see [www.TRB.org/ACRP](http://www.TRB.org/ACRP).

