# Intercity Rail Passenger Systems Update

No. 23 Spring 2015

## Current Research and Development in Intercity Rail Passenger Systems

***Intercity Rail Passenger Systems Update*** is published exclusively on the Internet. The table of contents offers links directly to each article, or you can scroll down to read the entire newsletter. Please keep your bookmark at www.trb.org/Publications/PubsStandingCommitteeNewsletters.aspx for upcoming editions.

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### Contents



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## Also in This Issue



## FROM THE CHAIR

### Education as Catalyst

*A Note from the Chairman*

Most of those reading this page are firmly committed to improved rail travel in North America. It may come from a nostalgic attachment to trains, an aversion to flying, or a yearning for a more commodious, relaxed travel medium that can enrich the experience of getting from one city to another. For many of us, it is a desire to recapture productive time that otherwise is lost standing in airport lines or with eyes glued to boring, seemingly endless repetitive lane markers on modern Interstate highways.

What role can the Standing Committee on Intercity Passenger Rail (AR010) play in transforming our visions into reality? As extensions of the National Academies, Transportation Research Board (TRB) committees are, at their best, centers of excellence that attract the finest in new thinking, research, and technical debate for transportation modes. Our recent TRB Annual Meeting sessions and workshops featured lively and engaging discussions in topics from exploring track segregation to examining international development models for passenger rail.

Solid technical research, both in the United States and abroad, creates a foundation for development that is particularly critical for rail. Research also provides a base of information for public agency officials, many of whom have had little exposure to rail development issues. Over the past 50 years, the United States mostly has been an observer to the process as other developed nations have built modern rail infrastructure systems.

With the recent groundbreaking of the California High-Speed Rail project and a solid, privately funded proposal in Texas to connect Houston and Dallas with high-speed rail, there is ample reason for optimism. The bar for our committee will be raised once again as we help define best practices in engineering, policy, and development models for our corner of the planet. My thanks to all who contributed so generously of their time in making this year's Annual Meeting agenda an unqualified success for Intercity Passenger Rail!

*–David Simpson, Chair*
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## Also in This Issue



# EDITOR'S INTRODUCTION

This is the first issue of 2015, so Happy New Year! I hope 2015 will prove to be a good and productive year for all.

Late 2014 and early 2015 introduced rail-related developments that the new 114th Congress is expected to address this year. In February, the U.S. House of Representatives Transportation and Infrastructure Committee passed its intercity passenger rail reauthorization legislation, the Passenger Rail Reform and Investment Act (PRIIA 2015), which included Amtrak funding authorization from 2015 through 2018. The committee passed a version of the same bill in the previous Congress in September 2014. In a late-night, last-minute action on December 14, 2014, the U.S. Senate also approved a fiscal year 2015 spending package that included $1.39 billion in Amtrak funding, thus maintaining the current allocation through September 30, 2015. President Barack Obama signed the $1.1 trillion federal spending bill on December 16, 2014.

Passenger and freight railroads also will continue their work this year to install positive train control (PTC) systems as mandated by the Rail Safety and Improvement Act of 2008 (RSIA), which established a deadline of December 31, 2015, for Class I railroad carriers and intercity and commuter rail operators to install PTC. The law requires PTC installation on any main line with regular intercity passenger or commuter rail service, any line over which toxic-by-inhalation hazardous materials are transported, and any other routes prescribed by the U.S. Secretary of Transportation.[1] Discussion continues, however, as to whether railroads—Amtrak, commuter railroads, and freight carriers that host passenger trains or carry toxic-by-inhalation materials—realistically will be able to meet the December 2015 deadline.

All intercity passenger rail stakeholders also await the U.S. Supreme Court's ruling in the case *Department of Transportation v. Association of American Railroads*. Representing the freight railroads that host Amtrak trains, the Association of American Railroads (AAR) sued the U.S. Department of Transportation (DOT), claiming that Amtrak trains' on-time performance metrics and standards, which the Federal Railroad Administration (FRA) and Amtrak cowrote pursuant to Section 207 of the Passenger Rail Investment and Improvement Act of 2008 (PRIIA 2008), violate constitutional principles by delegating regulatory authority to Amtrak. According to AAR's complaint, Amtrak is a private company that competes with freight carriers for valuable space on their lines. Other arguments state that Amtrak should be considered akin to a government agency because it was created by Congress to carry out a public mission and receives a great deal of direction from the federal government. Depending on its breadth, the ruling could have wide-ranging impacts on the legal and working relationships between the federal government, host railroads, Amtrak, and the other operators that provide passenger service over those railroads. The Supreme Court heard oral arguments in December 2014 and a ruling is expected in May or June of this year.

The beginning of 2015 also brought many new developments to the TRB Annual Meeting, which was held January 10–14, 2015. Attendees experienced the new meeting venues—the Walter E. Washington Convention Center and Marriott Marquis Hotel—and stayed at many new overflow hotels. As always, the hundreds of research and panel presentations facilitated a useful information exchange between researchers

[1] Rail Safety Improvement Act of 2008, Pub. L. No. 110-432, Division A, 122 Stat. 4848 (2008).

## Also in This Issue



**Emeritus member John Tone participates in the AR010 meeting at the 2015 TRB Annual Meeting. (Photo: Risdon Photography)**

and practicing transportation professionals. The Intercity Passenger Rail Committee sponsored a half-day workshop—Segregating Freight and Passenger Rail Service in Congested Urban Corridors—as well as a poster session comprising 10 studies, a lectern session on demand forecasting, and a lectern session presenting the four best practice-ready papers in the following topics:

- High-Speed Rail New Lines and In-the-Market Competition: Short-Term Effects on Services and Demand in the Italian Case;
- High-Speed Rail and Urban Decentralization in China;
- Analyzing the Financial Relationship Between Railway Industry Players in a Vertically Separated Environment: The Train Operator's Perspective; and
- Estimating the Accessibility Impacts of High-Speed Rail in Portugal.

The AR010 Committee meeting also featured three presentations:

- Building the Virtual Automobile;
- Getting Up to Speed: Assessing the Usable Knowledge; and
- America's Jet-Powered Train: The NYC M-497.

The next issue of *Intercity Rail Passenger Systems Update* will provide more details about the Annual Meeting events sponsored by this committee.

Articles in this newsletter pertain to recently completed or ongoing research and programs related to intercity and high-speed rail. The first article, authored by Camille Tsao of CDM Smith and Josh Callen of LTK Engineering, reflects on the requirements for and progress made by California commuter rail operator Caltrain in meeting the federal mandate for PTC installation by the end of 2015.

The second article, by Larry Goldstein, Senior Program Officer, TRB Cooperative Research Programs, discusses current projects with the $5 million received in FY 2011 to create a Cooperative Rail Research Program.

The third article, "Capacity Pricing and Allocation in Shared Railway Systems" by Maite Pena-Alcaraz of the Massachusetts Institute of Technology, presents a brief analysis of the relatively new opportunity for capacity pricing and allocation in which infrastructure ownership and rail operation are managed by separate entities.

## Also in This Issue



Back to page 1

I appreciate the assistance I received in preparing this newsletter and thank all of the authors: Camile Tsao, Josh Callen, Larry Goldstein, and Maite Pena-Alcaraz. Also, special thanks to my editorial assistants, Joseph Glowitz and Malcolm Kenton—their rail industry knowledge and review of the submitted articles helped significantly in the production of this issue.

I hope you find these articles informative and useful. As always, I am happy to receive suggestions for informative articles on your research or programs for future issues. Feel free to contact me with these suggestions.

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## Also in This Issue



Back to page 1

# PTC PROGRESS IN CALIFORNIA

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*Editor's note*: As previously mentioned, both Class 1 freight and passenger railroads are required through RSIA to install PTC for monitoring and controlling train movements to enhance safety. The railroads are in various stages of implementation, although several have encountered delays. In the report *PTC Implementation*: *The Railroad Industry Cannot Install PTC on the Entire Nationwide Network by the 2015 Deadline*, released in 2012 and updated in March 2014, AAR described several accomplishments but also several remaining challenges. The railroads continue with this effort, and the following article illustrates the progress made by Caltrain, a passenger operator that provides commuter rail service in California.

Caltrain is owned and operated by the Peninsula Corridor Joint Powers Board. It provides commuter rail service between San Francisco and San Jose, California, with limited service farther south to Gilroy (see map). Caltrain ridership has increased steadily over four consecutive years and, as of October 2014, had reached 61,000 passengers per weekday. The Caltrain Modernization Program, which includes PTC, will increase throughput and system capacity to help meet growing demand.


**Caltrain System Map**

Caltrain owns and dispatches the 52-mile corridor from San Francisco to Control Point (CP) Lick in San Jose. Union Pacific (UPRR) dispatches along the right-of-way it owns south of CP Lick. Caltrain operates 92 San Francisco–San Jose trains per day, and six peak-period trains from San Francisco to Gilroy on weekdays. Caltrain hosts other passenger rail operators and UPRR freight trains on its right-of-way.

Caltrain utilizes Centralized Traffic Control (CTC), a wayside signaling system with CPs. There are no cab signals and no positive stop or speed enforcement. Two-, three-, and four-track configurations along the right-of-way are signaled for moves in both directions. The new Rail Operations Control System deploys computer-based dispatching that communicates to the CPs via radio links and phone lines. This system will be integrated with the new PTC system so that dispatchers can access new system information and functions.

There are 27 stations, 42 highway grade crossings, and 12 pedestrian-only crossings within the 52-mile corridor. These crossings utilize track circuit-based constant warning time devices to trigger the crossing gates and flashing light signals. Since many of these crossings are located at stations, crossing gates frequently will lower when a train is stopped at the adjacent station. This results in prolonged gate downtimes that frustrate automobile drivers who do not see a train advance through the crossing.

In August 2014, FRA granted Caltrain permission to install and test its PTC system. System testing is estimated to be complete by October—in time to meet the federal mandate to install PTC by the end of 2015. Caltrain will be the first passenger railroad in the United States to utilize Interoperable Incremental Train Control System (I-ITCS) technology. This technology was selected for its ability to address the unique challenges of providing reliable commuter rail service, which has different requirements than freight operations; for instance, train characteristics in I-ITCS are better suited for commuter applications. I-ITCS also provides a solution for enforcing scheduled station stops—a prerequisite for the crossing-inhibit function described above and below.

In addition to installing PTC, Caltrain is electrifying its right-of-way and replacing a majority of its push–pull diesel-powered fleet with electric multiple units by 2020 or 2021. With this program in place, Caltrain plans to increase peak-period service to six trains per hour per direction, and will be able to accommodate future high-speed train service as part of the blended system.

Caltrain's PTC system consists of an overlay of I-ITCS—an enhanced version of the Amtrak Michigan Line Central Division ITCS—and of the existing speed and route wayside signaling system. I-ITCS will be installed on rolling stock, wayside, communications, and office subsystems. The architecture consists of a locomotive-centric intelligent subsystem that requests and receives the status of wayside elements and includes an onboard database with information on the railroad alignment and the location of critical features. When initialized, the system verifies that the locomotive subsystem has current databases and uploads mandatory directives that also are sent to the locomotive in real time. The onboard portion calculates a speed–distance profile to ensure target points associated with the status of critical features are not exceeded.[1] The onboard system makes sure that the speed–distance profile is enforced and that the mandated PTC requirements are met reliably and functionally.

[1] Speed–distance profile also can be referred to as a braking curve. The curve shows what speed a train should be going as it progresses to a target (e.g., a stop signal or a station). If the train exceeds the speed associated with the braking curve at a given point, then the train automatically will put the brakes on. This brake initiation ensures that the train does not travel beyond the target.

Back to page 1

The federally mandated requirements for PTC are to prevent

- Train-to-train collisions,
- Over-speed derailments,
- Incursions into established work zone limits, and
- Movement of a train through a main-line switch left in the improper position.

Each CP, intermediate signal, crossing, and base station location will be equipped with a wayside unit to monitor signal status, verify switch point positions, and interface with existing crossing warning systems. This interface will allow I-ITCS–equipped Caltrain trains to activate or inhibit crossing warning systems wirelessly. Wireless activation will ensure that crossing warning systems are activated within the necessary warning time, enabling a future maximum allowable speed increase for electrified trains. The crossing-inhibit function will eliminate the occurrences of prolonged gate downtimes at crossings that are just beyond station stops. This function will enforce a stop at the station platform, keeping the crossing gate up until the train is ready to depart the station and enter the crossing.

Caltrain I-ITCS is being modified from the version of ITCS installed on Amtrak's Michigan Line to meet Caltrain's specific operational needs and PTC requirements and, as required, also will be compatible with host and tenant trains utilizing the Interoperable Electronic Train Management System (I-ETMS). I-ITCS incorporates major features of I-ETMS and is interoperable by using incremental train control (ITC)–compliant wayside, back office, and communication subsystems and an onboard subsystem that can receive wayside status, mandatory directive, and database information in the ITC protocol. Caltrain has developed an interoperability coordination plan with tenant railroads and participates in interoperability technical working groups.

When PTC is fully operable, Caltrain riders can expect several benefits, particularly increased safety. By predicting location and speed, PTC can enforce and correct for human error in complying with speed limits and stop targets, thus providing an additional level of safety. Moreover, since Caltrain also is electrifying its right-of-way as part of the Caltrain Modernization Program, passengers also can expect increased performance and reliability on the current system and a corridor ready to host future high-speed rail service in California.

# NATIONAL COOPERATIVE RAIL RESEARCH PROGRAM: AN INTRODUCTION

**Larry Goldstein**
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*Goldstein is a Senior Program Officer in Cooperative Research Programs at TRB.*

The National Cooperative Rail Research Program (NCRRP) is the newest of the Cooperative Research Programs at TRB; however, with funding limited to only one year, it may be one of the most short-lived. The program was set up to address critical research problems affecting the interaction between passenger rail and freight systems in a multiuse environment, with the importance of the issues demonstrated by the broad range of substantive projects selected for study. Research studies address alternative financing and funding strategies, energy consumption and greenhouse gas emission comparisons among different travel modes along corridors, consumer choice modeling that incorporates the effect of demographic factors on travel demand forecasting by mode, legal issues that affect passenger operations along freight rail rights-of-way, and complex institutional issues faced by multiple jurisdictions planning and developing expanded rail passenger service.

NCRRP was authorized as part of PRIIA 2008.[1] In September 2010, FRA executed a contract with the National Academies, acting through TRB, to serve as manager of the NCRRP. Program oversight and governance are provided by representatives of rail operating agencies, state DOTs, and others. Five years of funding at $5.0 million per year were authorized, but only one year has been appropriated.

Nine projects selected for research were originally selected:

- 02-01, Comparison of Passenger Rail Energy Consumption with Competing Modes [Contractor: TranSys Research, Ltd.; Principal Investigator (PI): Gordon English; the comparative model and the draft guidelines have been completed and now are under review]
- 03-01, Intercity Passenger Rail Service and Development Guide (Contractor: Texas A&M Transportation Institute; PI: Curtis Morgan)
- 03-02, Intercity Passenger Rail in the Context of Dynamic Travel Markets (Contractor: Resource Systems Group, Inc.; PI: Matthew Coogan)
- 06-01, Building and Retaining Workforce Capacity for the Railroad Industry (Contractor: QinetiQ North America Technology Solutions Group; PI: Amanda DiFiore)
- 07-01, Alternative Financing Approaches for Passenger and Freight Rail Projects (Contractor: CPCS Transcom Limited; PI: Marc-André Roy; complete and about to be published)
- 07-02, Developing Multistate Institutions to Implement Intercity Passenger Rail Programs (Contractor: Parsons Brinckerhoff, Inc.; PI: Michael Meyer)
- 07-03, Inventory of State Passenger and Freight Rail Programs (Contractor: Prime Focus LLP; PI: Libby Ogard)

[1] Passenger Rail Investment and Improvement Act of 2008, Pub. L. No. 100-432, Division B, 122 Stat. 4848 (2008).

- 12-01, Legal Aspects of Rail Programs
  - Topic 1: Compilation, Review, and Summary of Railroad Law Resources (Contractor: The Thomas Law Firm; PI: Lawrence Thomas; complete and under review)
  - Topic 2: Issues that Emerge when Public Entities Acquire a Real Property Interest in Rail Lines (Contractor: Kaplan Kirsch Rockwell, LLP; PI: Allison Fultz and Charles Spitulnik)
  - Topic 3: Buy America Requirements (Contractor: Conner Gwyn Schenk PLLC; PI: Timothy Wyatt; published as NCRRP Legal Research Digest 1, *Buy America Requirements for Federally Funded Rail Projects*)
- 12-02, Strategic Plan–Research Agenda (Contractor: Transportation Center at Northwestern University; PIs: Joseph L. Schofer, Breton L. Johnson, Norman Carlson, and Kit Ho (Derek) Cheah; published as NCRRP Research Results Digest 1, *A Potential Strategic Plan and Research Agenda for the National Cooperative Rail Research Program*)

As indicated, several projects have been completed or are nearing completion. NCRRP Project 12-02 is complete and has been published as Research Results Digest No. 1. Final documents for NCRRP Project 07-01 now are being readied for publication; one legal study has been completed and published and a second currently is being finalized for publication. The two completed studies are described below.

### A Potential Strategic Plan and Research Agenda for the National Cooperative Rail Research Program, NCRRP Project 12-02

A critical early task was to develop a strategic plan and research agenda for the program. Generating that plan included a review of recent rail research and relied primarily on a series of interviews with more than 60 railroad stakeholders, who were asked to identify key opportunities and problems facing the industry.

The resulting plan identifies eight areas where rail research is needed and expected to produce cost-effective results:

- Assuring safe and efficient management of railroad capacity, particularly in the case of shared rights-of-way;
- Facilitating and accelerating railroad project delivery;
- Developing the railroad workforce;
- Promoting innovation in funding and financing rail projects and operations;
- Growing ridership on regional and commuter passenger services;
- Promoting and facilitating freight rail services to reduce highway congestion, save energy, and reduce environmental impacts;
- Developing and deploying strategies and technologies for enhancing safety; and
- Developing and deploying advanced methods—faster, cheaper, and better methods—and materials for railroad design, rehabilitation, and maintenance.

The full document describes each of these research areas in detail and presents several specific topics under each area. These topics reflect problems and opportunities raised by stakeholders, as well as building on and expanding current work.

*Prepared by the Transportation Center at Northwestern University: Joseph L. Schofer, Breton L. Johnson, Norman Carlson, and Derek Cheah.*

## Also in This Issue



Back to page 1

### Alternative Funding and Financing Mechanisms for Passenger and Freight Rail Projects, NCRRP Project 07-01

The guidebook produced as a result of this project identifies and describes the importance of many alternative funding and financing mechanisms that can be combined for passenger and freight rail projects and services where traditional funding sources are insufficient. This guidebook also identifies other opportunities and strategies for completing rail projects and services that have funding gaps.

As pointed out in the guide, the terms "funding" and "financing" often are confused but address very different things. "Funding" refers to the sources of revenue that can be used to pay for a project or service. Sources of funding include, but are not limited to, current or future revenue streams from the delivery of freight or passenger rail transportation services; ancillary revenues or non-repayable capital grants; and operating subsidies funded from various forms of taxes, fees, or user charges. "Financing" refers to financial mechanisms or tools to access money for a project or service, generally before the project generates the necessary revenue to pay for the investments. Financing mechanisms include various forms of debt, equity, capital leases, and more, and typically are used when the time profile of a project's revenues does not correspond to its cash needs. Unlike with funding, the use of financing mechanisms generally creates a future financial obligation to the entity providing the financing.

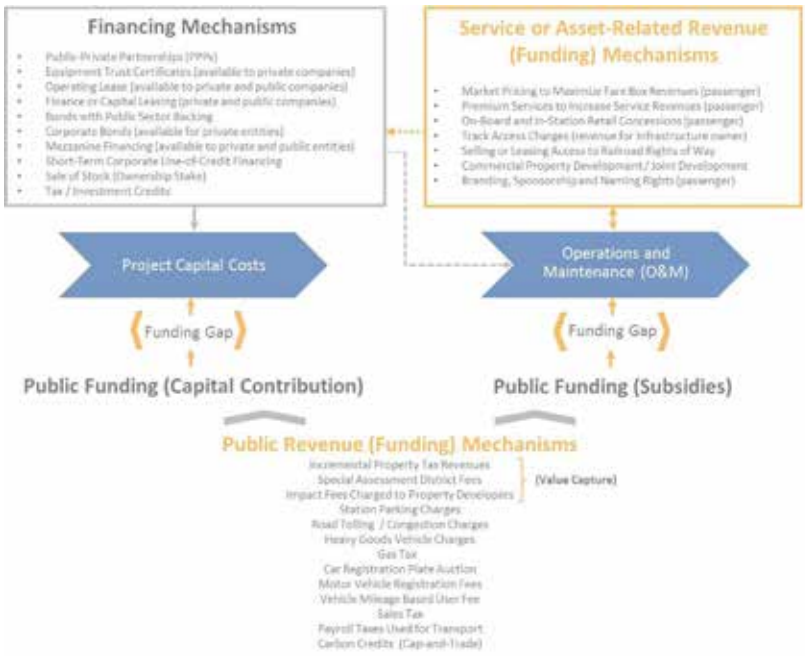


**FIGURE 1 Funding and financing. Source: CPCS**

To illustrate how alternative financing and revenue mechanisms could be used in practice, the research team assessed these alternative mechanisms using five real-world case studies for U.S. rail projects in planning or early development stages. Each of the following cases would potentially address a funding gap:

- California High-Speed Rail (high-speed rail);
- Amtrak, Virginia, I-81–US-29 Corridor (intercity passenger rail);

- Virginia Rail Express (commuter service);
- Chicago CREATE (shared corridor); and
- New Orleans Rail Gateway (shared corridor).

For each of these cases, the research team gathered publicly available information from online sources and industry publications. They identified, at a preliminary level, potential funding gaps and solutions and contacted stakeholders involved in each project (e.g., project sponsors, key government departments, and prospective funding partners) to obtain additional detailed information.

The approach to selecting the case study test applications first was based on a need to include at least one project per rail sector: commuter, regular intercity, high-speed intercity, and freight or shared corridor. Projects with funding gaps and with publicly available information then were selected. The NCRRP Project 07-01 panel also vetted the case study selections.

*CPCS Transcom Limited is responsible for this project.*

### Research in Progress

As other projects near completion, additional information will describe the challenging research that is under way and how it can contribute to an understanding of the major issues facing intercity rail passenger and freight operations in the United States.

# CAPACITY PRICING AND ALLOCATION IN SHARED RAILWAY SYSTEMS

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Governments recently have started promoting shared railway systems as a way to take advantage of existing, capital-intensive railway infrastructure. Until 1988, all major railways were vertically integrated, managing both their infrastructure and operations. By contrast, multiple train operators use the same infrastructure on shared railway systems, meaning that there is some vertical separation between infrastructure management and train operations.

Examples of shared railway systems include the Northeast Corridor in the United States and the railway system in Italy. Such systems can achieve high utilization, but also require coordination between the infrastructure manager and the train operators *(1)*. Such coordination in turn requires capacity-planning mechanisms to determine which trains can access the infrastructure at what time as well as to allocate capacity and establish the price operators need to pay for this capacity. This article presents literature studies that analyze the performance of shared railway systems under alternative capacity pricing and allocation mechanisms.

The need to establish capacity pricing and allocation mechanisms in the railway system is relatively new (*2*). Under traditional, vertically integrated railway systems, there was no need to pay for access or to allocate capacity. The literature in this area is nascent as a result and understanding of the trade-offs and the comparative performance of alternative capacity pricing and allocation mechanisms is limited. Most of this literature builds on existing literature in other network industries such as power systems, telecommunication systems, and air transportation systems (*1*, *3*–*6*).

There are two main types of capacity pricing and allocation mechanisms: negotiation-based and market-based mechanisms. Negotiation and bilateral contracts between railway companies led to capacity planning agreements in shared railway systems in the United States (*7*). The main drawback of negotiation-based mechanisms is that negotiations can be very complex and time-consuming (*8*). These mechanisms usually also result in nontransparent bilateral contracts that prevent adaptation to future needs or create barriers to new operators. As a result, FRA advocates for the implementation of market-based capacity planning regulation in the United States, according to PRIIA 2008.

Market-based capacity pricing and allocation mechanisms can be classified further depending on whether they are price-based or capacity-based (*9*). In price-based mechanisms, the infrastructure manager determines the infrastructure access charges and the operators decide how many trains they want to operate (*2*, *7*, *10*). In capacity-based mechanisms such as auctions, the operators reveal the prices they are willing to pay to use the infrastructure and the infrastructure manager determines which trains can be scheduled taking into account infrastructure capacity (*11*–*13*). Market-based capacity planning regulation has been implemented in Europe, defined by each country's national network statements (*14*).

Also in This Issue

From the Chair

Editor's Introduction

PTC Progress in California

National Cooperative Rail Research Program: An Introduction

Capacity Pricing and Allocation in Shared Railway Systems

Back to page 1

In theory, the implementation of alternative capacity pricing and allocation mechanisms in different countries could help compare them. Two factors complicate a comparison, however: first, implementation details have heavy impacts on the performance of the system; second, each system is designed with different objectives and therefore is evaluated using different performance measures (*15*, *16*). Although some countries place a priority on recovering infrastructure costs, other countries emphasize the promotion of downstream competition or the maximization of the social value of railway services.

Finally, operational and managerial considerations that affect the performance of shared railway systems also complicate the design and assessment of capacity pricing and allocation (*17*). From an operational standpoint, railway capacity depends heavily on the schedule of trains, which in turn depends on the capacity pricing and allocation mechanism and is subjected to engineering constraints (*18–22*). From a managerial standpoint, the capacity pricing and allocation mechanisms—together with the competitive environment—affect the scheduling preferences and the incentives of train operators (*9*, *15*). As a result, integrated approaches that consider the regulatory, operational, and managerial aspects of shared railway systems would best identify and clarify the trade-offs and implications involved in the choice between alternative capacity pricing and allocation mechanisms.

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We look forward to your feedback on the format and the content of this publication. Comments on this newsletter, and most especially, continued contributions by committee members, friends of the committee, and others can be sent to the editor:

**Penny Eickemeyer**
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The Transportation Research Board's Committee on Intercity Passenger Rail (AR010) is concerned with research that will lead to better planning and implementation of intercity rail passenger systems, with particular emphasis on the full range of high-speed systems including new technology. This research will include demand analysis, financial considerations, economic impacts (including consideration of user and social benefits), and institutional arrangements including public–private partnerships. The research should also address impacts on other rail operations, coordination with other modes, rail–highway interfaces, corridor versus system concerns, technology assessment, environmental impacts, and implementation strategies.