



New England
University Transportation Center

New England University Transportation Center
77 Massachusetts Avenue, E40-279
Cambridge, MA 02139
617.253.0753
utc.mit.edu

Year 24 Final Report

Grant Number: DTRT12-G-UTC01

Project Title:

Determining Performance Measures to Evaluate the Effect of High Speed Rail on Communities' Livability

Project Number:

Project End Date:

Submission Date:

MITR24-11

12/21/2015

12/21/2015

Principal Investigator:

Joseph M. Sussman

Co-Principal Investigator:

Title:

JR East Professor

Title:

University:

MIT

University:

Email:

sussman@mit.edu

Email:

Phone:

617.253.4430

Phone:

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the information presented herein. This document is disseminated under the sponsorship of the Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or the use thereof.

The New England University Transportation Center is a consortium of 5 universities funded by the U.S. Department of Transportation, University Transportation Centers Program. Members of the consortium are MIT, the University of Connecticut, the University of Maine, the University of Massachusetts, and Harvard University. MIT is the lead university.

Determining Performance Measures to Evaluate the Effect of High-Speed Rail On Communities Livability

Principal Investigator: Professor Joseph Sussman, MIT

This project takes a broad look at the concept of livability – broadly defined -- and the role of intercity passenger rail systems in creating viable sustainable communities. The geographic venues we have considered include California and the Northeast Corridor of the United States. The research considers many issues. These include: the use of shared infrastructure to create a viable and affordable rail network; the effective measurement of performance (e.g. schedule adherence) and its role in creating demand for intercity high-speed rail systems; the concept of capacity pricing and allocation in creating an economically balanced rail network; the multi-scale considerations in developing intercity rail systems that effectively interface with regional and urban transportation systems. This research, taken collectively, includes methodological advances. This includes adding modules to the CLIOS Process (to study Complex Large-Scale Integrated Open Sociotechnical Systems) to consider such concepts as advanced stakeholder analysis, multi-criteria, multi-stakeholder decision making under uncertainty, and creating strategy vectors that properly weigh different performance criteria.

Our group was professionally active beyond the specific conduct of this research. We participated in a number of public meetings on the Northeast Corridor and provided written comments on the plans put forward by NEC FUTURE. We contributed through presentations and papers in the Transportation Research Board (TRB), the Transportation Research Forum (TRF), the Council of University Transportation Centers (CUTC) and the Council of Engineering Systems Universities (CESUN). And we note with particular pride the award of the CUTC Wootan Prize in 2015 for best thesis in policy and planning at *both* the SM and PhD level to Sam Levy and Maite Pena Alcaraz respectively. The Region/ High-Speed Rail Research Group at MIT takes this opportunity to thank the USDOT's University Transportation Center's program for providing support that allowed us to conduct this research in a vital area in the transportation field. Our research contributes to the substantive area of sustainability and livability in transportation, the creation of new methodologies for studying such systems and the education of young professionals who can contribute to the field of transportation for decades to come. Also, our group is fortunate to have support from, in addition to the Region 1 UTC based at MIT, the MIT-Portugal Program, the East Japan Railway Company and NURail, a rail-centered UTC housed at UIUC. Our research performed with Region 1 UTC is enriched by cross-fertilization with these other sponsors, whose support we also acknowledge. For a comprehensive treatment of the work of the Regions/ High-Speed Rail group, please see: <http://web.mit.edu/hsr-group/index.html>

The remainder of this report discusses the particulars of our research.

Capacity Challenges on the California High-Speed Rail Shared Corridors: How Local Decisions Have Statewide Impacts

http://web.mit.edu/hsr-group/documents/Sam%20Levy_MST%20Thesis.pdf

Research Assistant: Sam Levy

In 2012, as a cost-control measure and in response to local opposition in the San Francisco Bay Area, the California High-Speed Rail Authority (CHSRA) adopted a "blended system" at the north and south bookends of the planned first phase of its high-speed rail line. In this blended operation, the high-speed rail line will share track and other infrastructure with commuter rail, intercity rail, and freight on the 50-mile Peninsula Corridor in Northern California and on 50 miles of right-of-way between Burbank, Los Angeles, and Anaheim in Southern California. The change to a blended system was a dramatic change of direction for the CHSRA; as a result, a new paradigm is needed for implementation of the system over the next 15 years. The decisions made on the local blended corridor level will affect both the financial viability of the overall project and the quality of service experienced by customers across the entire California rail system. The blended system of shared corridors will put high demands on the existing infrastructure. Commuter rail or freight delays can propagate to the HSR system. As the ratio of service volume to capacity tends towards 1, the system loses stability and on-time performance suffers. With degraded on-time performance and uncertainty regarding arrival times, schedule padding becomes necessary and makes rail as a mode less attractive to time-sensitive consumers. The blended system dictates that the CHSRA will operate on a multi-owner network, in many ways like Amtrak does today. Instead of having sole control of its infrastructure, the CHSRA will have to work with the TJPA, PCJPB, SCRRA, and BNSF Railway to ensure smooth operation. As a result, the CHSRA will face many of the issues Amtrak faces today regarding train priority. The ability for the CHSRA to operate in a reliable fashion will depend on the priority rules that the CHSRA can negotiate with its host railroads on the blended corridors. Optimizing locally constrains the overall system optimal solution; and as agencies make decisions regarding vehicle fleets and track investments, we can see that the local optimizing has already begun. Decisions made on the Peninsula Corridor can create capacity bottlenecks affecting HSR trains inter-regionally. The Peninsula Corridor, therefore, is an important proving ground for whether or not blended operations can work. Integrated operations have a potential to bring HSR a revenue source; like regional airlines feed into international hubs, so too can commuter rail services feed into interregional high-speed rail services. To that end, service planning should drive infrastructure decisions; in an era where infrastructure such as new HSR stations or electrification are expensive and the public is leery of megaprojects, California can set an example with a well-conceived (i.e. well service-planned), integrated rail system.

The Impact of Amtrak Performance in the Northeast Corridor

http://web.mit.edu/hsr-group/documents/OGUNBEKUN,%20Tolu_Thesis.pdf

Research Assistant: Tolu Ogunbekun

The performance of Amtrak's Acela and Regional services in the Northeast Corridor (NEC) is a topic that, while frequently discussed as substandard by some travelers, has received minimal attention in the compendium of open source research literature. This research focuses on Amtrak's Acela and Regional travel time performance in the last ten years (2005 to 2014).

Amtrak is a vital transportation provider on the Northeast Corridor serving travelers between Boston, MA and Washington, DC, including major cities such as Providence, RI; New Haven, CT; New York, NY; Philadelphia, PA; and Baltimore, MD. In Fiscal Year 2014 (FY 2014), Amtrak had a record high of 11.6 million passengers on the Acela and Regional services combined. However, only 3.9 million passengers arrived at their destination at the scheduled arrival time; that is, 7.4 million passengers experienced delays for a myriad of reasons. This research evaluates different factors that led to variability in service performance, as well as the impact of service performance on ridership. The authors hopes that this research will inform the ongoing discussion on measures needed to strengthen intercity passenger rail in the Northeast Corridor

The findings from the research were used to recommend active steps for Amtrak regarding monitoring and improving service performance in the Northeast Corridor.

Refine Data Records; Refine Timetables; Educate and Reinforce On-Time Culture, Management Policies and Programs.

Analysis of Capacity Pricing and Allocation Mechanisms in Shared Railway Systems: Lessons for the Northeast Corridor

http://web.mit.edu/hsr-group/documents/PenaAlcaraz_Maite_Thesis.pdf

Research Assistant: Maite Pena Alcaraz

In the last 15 years, the use of rail infrastructure by different train operating companies (shared railway system) has been proposed as a way to improve infrastructure utilization and to increase efficiency in the railway industry. Shared use requires coordination between the infrastructure manager and multiple train operators. Such coordination requires capacity planning mechanisms that determine which trains can access the infrastructure at each time, capacity allocation, and the access charges they have to pay, capacity pricing.

This research contributes to the field of shared railway systems coordination by 1) developing a framework to analyze the performance of shared railway systems under alternative capacity pricing and allocation mechanisms, and 2) using this framework to understand the implications of representative capacity pricing and allocation mechanisms in the Northeast Corridor in the US, one of the busiest shared railway systems worldwide.

The implications of capacity pricing and allocation mechanisms for shared railway systems are still unclear. While this research tries to offer clarity in this area, there is still much work to be done. Any progress in research that contributes to a better understanding of the implications of alternative mechanisms to price and allocate capacity could immensely help practitioners and policy makers. This is germane since several countries are currently restructuring their railway sector to allow shared use.

Sharing railway infrastructure capacity is not straightforward. In the railway industry, as compared to other network industries, there are very strong interactions between capacity planning and infrastructure operations. The implementation of adequate capacity pricing and

allocation mechanisms can mitigate the coordination problems of shared railway systems while maintaining the benefits of shared infrastructure use in the railway industry. We argue that the improved understanding of the system performance gained with the framework proposed in this research enables stakeholders to design adequate capacity pricing and allocation mechanisms.

Impact of Hub Station Governance on Regional Transportation Systems and Economies

<https://www.dropbox.com/s/9sb0ofl064b6w5v/Impact%20Of%20Hub%20Station%20Governance%20On%20Regional%20Transportation%20Systems%20And%20Economies.pdf..pdf?dl=0>

Research Assistant: Rebecca Heywood

Hub stations are a physical manifestation of the need for intermodal transport and connections. They present possible network constraints due to network governance, the location of intermodal transfers, and overall station design and layout. However, they can also serve as network enablers by bringing together a multitude of services and information in one space, and improve the ability of passengers to transfer between multiple services, thus expanding the perceived network size. This research aims to understand how profound changes in station and system characteristics affect regional economic development, and how hub stations interact with transportation networks. Changes in the transportation, economic and social landscapes are taking place not only over a multi-scale environment (urban, metropolitan and mega-regional), but also over a multitude of timescales. Hub stations lie at the center of these changes, and can have a profound effect on the ability to realize larger network changes and adaptations.

New York City's Penn Station is an example of a major hub station at the heart of not only a regional rail network, but also of a mega-regional network, the Northeast Corridor, that may soon expand to include high-speed rail service. It is home to three main rail operators in addition to the local urban transit provider. Nested complexity, the presence and recognition of the physical system embedded within, and interacting with, a complex institutional and policy sphere, as well as predictive coalition building, are used to evaluate Penn Station. By looking at its history and current state, it is possible to better understand the role of Penn Station, and other hub stations, in their regional economies, and evaluate possible changes to the institutional landscape. The future of regional rail transport in the New York Metropolitan Area stands to not only impact the economy of New York City and its surrounding areas, but also the broader Northeast economy. High-speed rail may provide enormous economic benefit by bringing four major metropolitan areas within commuting distance of New York City, and enable a new perception of distance. However, the success of high-speed rail in the NEC is hindered by the lack of cooperation and integration among rail operators and services at Penn Station, at the heart of the system.