Quantifying Passenger Rail Access Mode Shift

Requested by
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Executive Summary

Background

A major goal of the California High-Speed Rail (HSR) Project is to reduce automobile travel and greenhouse gas emissions, relieving roadway congestion and improving air quality and public health. Current forecasts, based on data from existing California commuter and intercity stations, suggest that a majority of riders at most stations will access HSR by either driving and parking near stations, or by being dropped off or picked up in automobiles. Caltrans is interested in the factors that determine the access and egress behavior of rail riders and how particular investments in facilities and programs can impact this behavior. Of particular interest are quantifiable methods for determining the expected impact of rail station access investments.

To assist with this information-gathering effort, CTC & Associates reviewed domestic and international published and in-process research that examines how rail rider behavior is impacted and measured when agencies implement strategies to shift rider access and egress modes. The review considered both HSR and non-HSR passenger facilities, and examined potential factors not directly associated with the rail station that may determine access and egress behavior. International practices were also included in the review.

Summary of Findings

Through a literature search, we identified publications that address the access and egress behavior of transit riders and how investments in facilities and programs can impact this behavior. Below is a summary of the publications that are described in detail in the body of this report.

Station Access Planning Models and Tools

National Models and Tools

Perhaps the most significant resource among the national resources identified in this Preliminary Investigation is the 2012 Transit Cooperative Research Program (TCRP) publication TCRP Report 153, which provides guidelines and an Excel spreadsheet-based tool that allows the user to conduct trade-off analyses among various station access modes. A literature search conducted for the project provides information about other models that can be used to “estimate access mode shares under proposed development or improvement scenarios.” Another TCRP report, a 2013 revision to the Transit Capacity and Quality of Service Manual, provides tools to assess the quality of transit facilities from the passenger perspective.

Agency Models and Tools

In a California-based study, researchers assess the adequacy of station mode access rating system metrics to plan for nonmotorized station access. Bicycle plans and models from Bay Area Rapid Transit (BART) and Los Angeles County Metropolitan Transportation Authority seek to quantify investments that encourage bicycle access trips to transit stations.

Using a hierarchical choice model, researchers studying one of the first U.S. suburb-to-suburb commuter railroads, Westside Express in the Portland, OR, metropolitan area, identified significant substitution effects between bike and walk modes. A Sound Transit tool based on the tool presented in TCRP Report 153 is examined in a study that identifies “how much shift away from single-occupancy vehicles could occur by 2030 if capital investments are made to improve

access via alternative modes." (Sound Transit serves the urban areas of King, Pierce and Snohomish counties in Washington.)

Two publications highlight tools used in conjunction with the regional transit agency in the greater Toronto and Hamilton area. The authors of a 2016 conference paper used empirical models to explore the relationship between characteristics of transit-oriented development and passenger transit demand with walk access and egress. A 2014 journal article describes ways to balance park-and-ride with other modes through application of the process outlined in TCRP Report 153. The authors identified several ways in which the TCRP Report 153 process could be improved.

Station Access Plans and Studies

A 2015 BART access policy update and report of best practices includes lessons learned from a review of other agency practices with regard to access modes. Among the practices highlighted in this report are efforts to improve access through investments off of station property to enhance pedestrian and bicycle networks and innovations in parking management.

A peer review in connection with an access alternatives study conducted for Metrorail in the Washington, D.C., area identified recurring access strategies, none of which the authors described as "truly cutting-edge station access strategies." Among the common themes identified in the peer review are the use of remote satellite parking lots and targeted reverse commute shuttles. An improvements study provides recommendations to increase the percentage of people walking and bicycling to and from Metrorail stations.

In an October 2014 system access issue paper prepared for Sound Transit in Washington, the authors recommend changes to various modes, including park-and-ride lots, paratransit bays and pick-up and drop-off space, bus service, and pedestrian and bicycle access.

An access plan developed for GO Transit of Ontario, Canada, recommends a series of pilot projects and programs to vary access mode share. Among the programs are a green parking zone and the use of transit shuttles.

Station Access Investments

A sampling of publications that highlight station-related investments to encourage access mode shifts begins with a case study described in a 2013 journal article. The authors use the case study to argue that on-site bicycle improvements will increase the mode share of bicycle access trips to rail stations. In another publication that also takes a more anecdotal approach to the topic of access mode shift, a 2005 TCRP report considers the integration of bicycles and bicycle parking with transit.

Researchers examined pedestrian station access in a research study conducted for Caltrans. While not focused on increasing the mode share for pedestrian access, the report does identify ways to improve the efficiency of pedestrian movements within the station that could encourage a mode shift to pedestrian access.

In a 2012 Transportation Research Record article, researchers present a spreadsheet-based framework to examine the implications of choosing transit-oriented development over parking, and the Smart Parking Value Pricing Pilot Project on the COASTER commuter rail line in San Diego is examined in a 2009 conference paper. This pilot project sought to optimize parking resources with the use of advanced parking technology and management measures.

Policy and Program Investments

Investments that encourage access mode shifts away from single-passenger vehicles can extend beyond the rail or transit station itself. The impact of various biking alternatives as well as investments in bike sharing programs and bicycle-friendly policies on rider access are examined in three recent publications and a project in process in California. With the focus on pedestrians, an analysis conducted by TriMet, the transit agency covering most of Portland, OR, provides a way to objectively assess the need for program investments that provide better pedestrian access to transit stops. In other pedestrian-related publications, researchers examine walkability measures, pedestrian intersection safety indices, and the environmental factors that affect a pedestrian's route choice.

An examination of intermodal connections between public transportation and public trails in Florida resulted in recommendations for making the connections stronger. An evaluation of the Safe Routes to Transit program in San Francisco's Bay Area, which funded enhancements to increase walking and cycling to regional transit stations, concluded that the program "positively affected the decision to walk and bicycle to access transit." While not focused on a specific program or policy, the Pedestrian and Bicycle Information Center provides resources that address the linkage of pedestrian and bicycle facilities to transit.

Connectivity to transit facilities is the subject of a project in process and reports produced for Caltrans and the Florida Department of Transportation (DOT). In two reports prepared for Caltrans, recommendations are offered to enhance the spatial and operational connectivity of HSR with other modes in a blended transportation system, and lessons learned are offered from an examination of the interconnectivity of HSR facilities in France, Spain, Japan and China. In Florida, connectivity studies were produced to "identify any additional pedestrian and bicycle infrastructure projects critical to enhancing multi-modal connectivity" around the agency's SunRail commuter rail stations.

International Practices

International researchers' examination of access mode shifts mirrors the types of research conducted domestically. A limited sampling of international research includes an examination of land use policies and other factors in a Canadian study; a Chinese study examines the behaviors and preferences of seven intermodal travel groups (travel groups are classified as bike-metro-transit, bike-metro-walk, transit-metro-walk and transit-metro-transit and others). In a Shanghai case study, researchers identified promising approaches to improve bicycle-rail connectivity. Austrian researchers used four scenarios to consider how trip speeds affect access and egress, and an Australian study provides a checklist of station principles associated with each access mode. Finally, results of a Netherlands study suggest that "paid bicycle parking is a feasible solution by which to distribute scarce parking capacity at major railway stations."

Gaps in Findings

While this review uncovered tools and models that assess the impact of transportation improvements on access and egress trips—principally, a spreadsheet-based tool developed in conjunction with a 2012 TCRP project—a good deal of the research associated with this topic, particularly with regard to the expected impact of access investments, tends to be more qualitative in nature. While the use of quantitative methods may be limited, research associated with this topic can provide practical recommendations for improving and increasing nonautomobile access to rail and transit stations.

Documentation associated with agency use of the tool developed for the 2012 TCRP project is available, though limited. Given the recency of this project, it is possible that further work with this tool will be conducted in the future.

The scope of this Preliminary Investigation did not permit an analysis that compares and contrasts the various station investments or policy and program changes that are intended to encourage a shift in access mode.

Next Steps

Moving forward, Caltrans could consider:

- Reviewing in detail the spreadsheet tool presented in TCRP Report 153 and the agency-specific experiences with this tool (Sound Transit in Washington and GO Transit in Ontario).
- Examining the mode-specific tools available, including:
    - The BART Bicycle Investment Tool used to investigate investments to double the bicycle trips used as an access mode to BART stations.
    - Los Angeles County Metropolitan Transportation Authority's Metro Bicycle Investment Scenario Analysis Model.
    - The empirical regression model used by GO Transit to predict transit ridership with walk access and egress as a function of specific land-use and station-level attributes.
- Consulting with transit agencies proposing station improvements to address access and egress issues to determine the impact of completed investments. These agencies include BART in California; Metrorail in Washington, D.C.; Sound Transit in Washington; and GO Transit in Ontario.
- Comparing and contrasting the impacts described in the literature cited in this Preliminary Investigation for different types of station investments, programs or policy changes.
- Checking in with Los Angeles County Metropolitan Transportation Authority in the next six months to learn about progress on development of a new tool that will provide an assessment of pedestrian-related investments similar to the analysis provided by the Metro Bicycle Investment Scenario Analysis Model.

Detailed Findings

Station Access Planning Models and Tools

National Models and Tools

TCRP Report 153: Guidelines for Providing Access to Public Transportation Stations, Transit Cooperative Research Program, 2012.
http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_153.pdf
As the foreword indicates, "TCRP Report 153 addresses planning and design for access to high capacity transit stations, including guidelines for arranging and integrating various station design elements." Among the issues addressed in the report:

- Station arrangement and design, and broad objectives and considerations for improving station access.
- Guidelines for enhancing pedestrian access to, from and within station areas.
- Guidance relating to bicycle access and parking.
- Guidance for improving the efficiency and effectiveness of feeder transit access.
- Park-and-ride locations and arrangements to stations.
- Transit-oriented development and its relation to station access and parking.

The print report is accompanied by a CD that "includes the station access planning spreadsheet tool that allows trade-off analyses among the various access modes (automobile, transit, bicycle, pedestrian, and transit-oriented development) for different station types." See Related Resources below for a link to an online version of the tool. The following report appendices are available at http://www.trb.org/Publications/Blurbs/166516.aspx:

- Appendix A: Summary of Stakeholder Survey and Literature Review.
- Appendix B: Overview of Existing Analysis and Evaluation Tools.
- Appendix C: Spreadsheet-Based Access Tool and Instructions.
- Appendix D: Detailed Station-Level Access Data.
- Appendix E: Detailed Station Access Case Studies.

Related Resources:

TCRP B-38 Station Access Planning Tool, Transit Cooperative Research Program, 2012.
http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_153.xlsx
This is the Excel-based tool developed for the project.

TCRP Web-Only Document 44: Literature Review for Providing Access to Public Transportation Stations, Transit Cooperative Research Program, March 2009.
http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_webdoc_44.pdf
A discussion of evaluation tools begins on page 25 of the report (page 30 of the PDF) and includes the following:

> There is considerable research on access mode choice, which shows that individual characteristics as well as built environment characteristics are important. Both aggregate and disaggregate models have been developed, based on data availability. Transit agencies may use these models to estimate access mode shares under proposed development or improvement scenarios.

Each tool addressed in TCRP Report 153 is summarized in detail in this supplementary document.

TCRP Report 165: Transit Capacity and Quality of Service Manual, Third Edition, Transit Cooperative Research Program, 2013.
Report components available at http://www.trb.org/Main/Blurbs/169437.aspx
The Transit Capacity and Quality of Service Manual provides tools to assess the quality of transit facilities from the passenger perspective. The manual includes the latest research results on estimating and assessing the capacity, speed, reliability and quality of service influencing transit services, facilities and systems; methods for performing these estimates and assessments; and computational examples illustrating the application of the manual's methods.

Agency Models and Tools

California

"Comparison of Station Access Quality Ratings and Travel Behavior: An Examination of Commuter Rail Access Station Mode Access," Ruben Dario Salas, *TRB 94th Annual Meeting Compendium of Papers*, Paper #15-5546, 2015.
Citation at https://trid.trb.org/view/2015/C/1339302
From the abstract:

> This paper examines rail station mode access rating system metrics for commuter rail and it assesses the adequacy of those metrics to plan for non-motorized station access. This research identifies and compares non-motorized access ratings based on qualitative and quantitative rating systems, with a particular focus on Orange County, California Metrolink Stations. Data from these two studies is compared [:] 1) measured station access modes to Orange County commuter rail stations, 2) non-motorized access quality ratings using a set of variables that were considered to be vital to non-motorized station access. The comparison shows that simply providing bike-lanes and completed sidewalks, even when these are clean, landscaped, well lit, and with good way-finding information, is not enough to ensure use. To better support non-motorized rail station access, it is recommended that additional variables be incorporated. Non-motorized quality rating systems should not be cookie-cutter systems that rate metropolitan, suburban, and rural areas the in the same manner; rather, these should consider mix of land-uses, population density, demographic information, ridership and utilization data tracking, links between transportation projects and public health, connectivity to bike and pedestrian ways, quality of facilities maintenance, and policies directly or indirectly impacting non-motorized transportation projects. A more comprehensive and sensitive access quality rating system will help assess where the most effective investments in non-motorized transportation infrastructure can be made.

Metro Bicycle Investment Scenario Analysis Model: Methodology, Technical Memo, Los Angeles County Metropolitan Transportation Authority, May 2013.
http://www.downtownsdmobility.com/files/managed/Document/159/Appendix%20J%20%E2%80%93%20Metro%20Bicycle%20Investment%20Scenario%20Analysis%20Model%20Methodology.pdf
The Bicycle Investment Scenario Analysis Model "provide[s] LA County jurisdictions with an accessible, web-based application that enables the estimation of potential benefits associated with certain bicycle investments." This document describes the general methodology employed by the tool.

The model can analyze bikeways, including off-road paths, separate cycle tracks, bike lanes and bike boulevards; the model also analyzes transit station bicycle parking and bike sharing programs. Based on an estimated increase in bike trips, the model forecasts benefits across four categories:

- Mobility (new bike trips, new bicycle miles traveled and congestion reduction).
- Environmental (greenhouse gas reduction, household energy consumption reduction and air pollution damage savings).
- Economic (household operating cost savings).
- Public health (reduction in health care and mortality costs).

The Mitigation Fee Planner, cited in Related Resources below, is the web-based application of the model. The Bicycle Investment Scenario Analysis Model generates inputs that can be used in the agency's travel demand model.

Related Resources:

Mitigation Fee Planner, Cambridge Systematics, Inc.
www.mitigationfeeplanner.org
This web site offers access to the Bicycle Investment Scenario Analysis Model (described above) through the site's "Bike" drop-down menu. The web site offers this description of Mitigation Fee Planner:

> The Mitigation Fee Planner enables authorized employees of Los Angeles County's 88 jurisdictions, eight subregional metropolitan planning organizations, and the Los Angeles Metropolitan Transportation Authority to enter project information, adjust growth forecasts, and calculate transportation impact fees and approximate revenue streams for future development in Los Angeles County.

Supplementary Information

Contact: Ying Zhu, Transportation Planning Manager IV, Los Angeles County Metropolitan Transportation Authority, 213-922-2817, zhuy@metro.net.

We contacted Ying Zhu, Transportation Planning Manager IV for Los Angeles County Metropolitan Transportation Authority, to learn more about the next steps for the Metro Bicycle Investment Scenario Analysis Model. Zhu indicated that work on Phase II, a travel demand model (see the citation below), will be completed soon—perhaps three to six months. Further documentation associated with the Phase II project is in development. Work on a pedestrian investment-related model has begun and is expected to conclude in a year.

Phase II, Model Description: Los Angeles County Metropolitan Transportation Authority Bicycle Travel Demand Model, Staff Working Paper, Los Angeles County Metropolitan Transportation Authority, March 2014.
http://www.scag.ca.gov/committees/CommitteeDocLibrary/mtf032614_BicycleModelPaper.pdf
This working paper describes the travel demand model, including external inputs, computational modules, internal data files and output files. Next steps for the project are identified on page 39 of the report and include:

- Refining the specifications in the existing mode choice model so that the mode choice step is sensitive to the bicycle travel demand model.
- Establishing a new module for recreational trip purposes.
- Establishing a comprehensive data collection program. The resulting database will provide a solid foundation for model parameter verifications and model validations.

BART Bicycle Plan: Modeling Access to Transit, Bay Area Rapid Transit, July 2012.
https://www.bart.gov/sites/default/files/docs/BART_Bike_Plan_Final_083012.pdf
This plan outlines strategies to encourage passengers to bike to and park at BART stations. The project also created the Bicycle Investment Tool that BART staff and other transit agencies can use to select improvements that will result in the largest increases in bicycle access trips.

A list of the agency's recommended strategies to expand bicycle parking and improve onboard access begins on page v of the report (page 9 of the PDF). The strategies are organized in the following five categories:

- Cyclist circulation.
- Plentiful parking.
- Beyond BART boundaries.
- Bikes on BART.
- Persuasive programs.

The BART Bicycle Investment Tool (available at http://www.bart.gov/guide/bikes/investment) will be used to investigate BART's investments to double the bicycle trips used as an access mode to BART stations.

Oregon

"Modeling Access Mode Choice for Inter-Suburban Commuter Rail," Asa Bergman, John Gliebe and James Strathman, *Journal of Public Transportation*, Vol. 14, No. 4, pages 23-42, December 2011.
http://www.nctr.usf.edu/wp-content/uploads/2011/12/Bergman.pdf
From the abstract:

> This paper presents an analysis of access mode choice by riders of one of the first U.S. suburb-to-suburb commuter railroads, the Westside Express (WES), in the Portland, Oregon metropolitan area. The study uses on-board survey data collected by the region's transit agency, Tri-Met, during WES's first year of operation. The data include observed access mode choices, historical mode usage, and subjective assessment of WES attributes. A hierarchical choice model was estimated, using attributes of the access trip, station areas and rider characteristics. The estimation results revealed pre-WES-mode inertia effects in choosing drive access, pro-sustainability attitudes in choosing bike access, the importance of comfort to light rail and auto users, and strongly positive station-area effects of feeder bus lines and parking provision. The hierarchical choice model revealed significant substitution effects between drive and light rail modes and between bike and walk modes. This study provides potentially valuable insights to agencies for the purposes of station-area planning and targeted marketing efforts.

Washington

Sounder Stations Access Study, Sound Transit, September 2012.
http://www.soundtransit.org/sites/default/files/documents/pdf/projects/sounder/StationAccess/Sounder_Stations_Access_Study_Report.pdf
Sound Transit plans, builds and operates express bus, light rail and commuter train services in the urban areas of Washington's King, Pierce and Snohomish counties. The agency conducted this access study in response to public concerns about station access given the plans for expanded service. From the report introduction:

> As a response to these concerns and inquiries, Sound Transit has advanced the concept of station access solutions. This Sounder Stations Access Study implements this approach by addressing how much demand can be accommodated by modes other than by autos parking at the stations. This report will determine how much shift away from single-occupancy vehicles could occur by 2030 if capital investments are made to improve access via alternative modes, such as walking or bicycling, while acknowledging stations needing additional parking.

Related Resource:

> **Appendices to Sounder Stations Access Study**, Sound Transit, September 2012.
> http://www.soundtransit.org/sites/default/files/documents/pdf/projects/sounder/StationAccess/Sounder_Stations_Access_Study_Report_-_Appendices.pdf
> This document includes Appendix E, Sound Transit Access Tool (see page 121 of the PDF), which is based on the spreadsheet tool developed for TCRP Report 153. Appendix F, Sound Transit Station Connectivity Tool, begins on page 125 of the PDF.

Canada

"Empirical Models of Transit Demand with Walk Access/Egress for Planning Transit Oriented Developments around Commuter Rail Stations in the Greater Toronto and Hamilton Area," Saidal Akbari, Mohamed Salah Mahmoud, Amer Shalaby and Khandker Nurul Habib, *TRB 95th Annual Meeting Compendium of Papers*, Paper #16-6349, 2016.
Citation at https://trid.trb.org/view/2016/C/1394380
From the abstract:

> This paper explores the relationship between characteristics of Transit Oriented Development (TOD) and passenger transit demand with walk access/egress. Two separate Log-linear Cobb-Douglas regression models are estimated for predicting transit ridership with walk access/egress as a function of specific land-use and station-level attributes around commuter rail stations in the Greater Toronto and Hamilton Area (GTHA). The empirical models are estimated using passenger survey data collected by the regional transit authority in the GTHA. The regional transit system considered in this research is GO Transit which has stations distributed across the GTHA. The first estimated model is a trip production model that predicts the number of daily trips produced per GO Transit station with walk as the access mode to the station. A trip attraction model is also estimated for predicting the daily trips attracted to a GO Transit station with walk as the egress mode from the station. The empirical models reveal that the station-level trip production via walk access is significantly associated with population density and walkability in the vicinity of the station, as well as the station's frequency of trains, number of bus feeder lines and utilization of parking spaces. Trip attraction by rail via walk egress at a GO Transit station is shown to be highly related to employment density, frequency of trains, and the relative network distance from the station to the central business district. A noteworthy finding with policy implications is that the frequency and number of bus feeder lines to a station is negatively associated with trip production via walk access.

"Strategic Station Access Planning for Commuter Rail: Balancing Park-and-Ride with Other Modes," Joshua Engel-Yan, Malvika Rudra, Christopher Livett and Rebecca Nagorsky, *Transportation Research Record 2419*, pages 82-91, 2014.
Citation at http://dx.doi.org/10.3141/2419-08
From the abstract:

> The recently released TCRP Report 153: Guidelines for Providing Access to Public Transportation Stations outlines a process to identify multimodal access priorities at high-capacity transit stations, and to weigh the benefits and trade-offs. This paper presents a case study analysis of how this station access planning process could be adapted and applied to a commuter rail network. The analysis considered the GO Transit rail system, which at the time of the study operated more than 65,000 park-and-ride spaces across 62 stations in the Greater Toronto and Hamilton area of Ontario, Canada. In general, the TCRP process provided an effective approach to develop a strategic station access plan. However, several ways in which the process could be improved were identified. The paper recommends policy scenario analysis as a consultative and analytical approach to prepare a systemwide station access policy. The paper also presents a decision-making framework to assess parking needs at the individual station level and provides an example of how this framework was used to make trade-offs during the station access planning process, with balanced investment in park-and-ride and other access modes.

Station Access Plans and Studies

California

BART Station Access Policy Update: Policy Context and Best Practices Review, BART Planning, Development, and Construction, October 2015.
https://www.bart.gov/sites/default/files/docs/BART%20Access%20Policy%20Update%20-%20Policy%20Context%20and%20Best%20Practices%20Review_1.pdf
A summary of lessons learned from case studies of other transit agencies begins on page 36 of this report. Among the most promising approaches:

- **Recognize multimodal access strategies as a tool for system demand management.** As the authors note, "systems like TransLink's Skytrain that have more diverse land uses around stations and access patterns dominated by pedestrian, bicycle, and transit access tend to have more of their ridership in off-peak periods and greater reverse-commute travel."
- **Recognize pedestrian and bicycle networks in station areas as vital to station access.** As the report notes, "TransLink, TriMet, and WMATA case studies illustrate successful efforts to improve access through investments off of station property."
- **Continue to innovate in parking management.** Among the practices highlighted:
    - Several Bay Area communities, including San Francisco, Berkeley, Redwood City and Union City, demonstrate that market prices can be used to ensure that parking is available at all times of day.
    - Sharing parking with surrounding land uses.
    - Development of parking benefit districts that could help encourage neighboring communities to make on-street parking available to BART riders.
- **Study opportunities for integrating with shared-use mobility services.** For example, LA Metro will soon be deploying "Shared Mobility Hubs," a strategy that will offer access to several app-based shared mobility as well as more traditional last-mile services at the same location.

Washington, D.C.

Metrorail Station Access Alternatives Study, National Capitol Region Transportation Planning Board, July 2012.
https://www.mwcog.org/uploads/pub-documents/pF5dW1s20120927111358.pdf
Metrorail provides transit service throughout the Washington, D.C., area. A peer review conducted for the transit agency identified recurring access strategies, none of which the authors described as "truly cutting-edge station access strategies." These strategies include:

- Single-occupancy vehicle access is the lowest priority in most cases.
- Remote satellite parking lots can work.
- Increased facilities for bicycle access are popular.
- Few systems have ridesharing accommodations.
- Feeder bus connections and frequency are critical to attracting riders.

- Targeted reverse commute shuttles are feasible.
- Land use policies are often seen as a solution for improving station access.

Among this report's recommendations, which begin on page 54 of the report (page 59 of the PDF), are a set of individual strategies identified for each of the Metrorail station types. As the report indicates, a "benefit-cost analysis showed that the anticipated quantifiable benefits exceed the anticipated costs for each scenario." The strategies include:

- Real-time parking information.
- Shared satellite parking.
- Improved connections from satellite parking.
- Improved pedestrian links.
- Kiss-and-ride redesign.

Metrorail Bicycle & Pedestrian Access Improvements Study, Metrorail, Washington Metropolitan Area Transit Authority, October 2010.
http://planitmetro.com/wp-content/uploads/2010/12/Metrorail-Bicycle-Pedestrian-Access-Improvements-Study-_Final.pdf
From Chapter 4, Recommendations, beginning on page 31 of the report (page 49 of the PDF):

> This chapter provides a broad range of system-wide recommendations to increase the percentage of people walking and bicycling to and from Metrorail Stations. The recommendations are intended to improve safety, access, and mobility for all users, helping Metro achieve the goals highlighted in Chapter 1.

Washington

System Access Issue Paper (Draft), Regional Transit Long-Range Plan Update, Sound Transit, October 2014.
http://m.soundtransit.org/sites/default/files/documents/pdf/projects/LRPupdate/201410_SystemAccessIssuePaper.pdf
The table on page 18 of the report (page 24 of the PDF) summarizes the approaches to station access that are taken from case studies in TCRP Report 153 and additional follow-up. The authors consider ways to address access, from planning through operations (see page 28 of the report, page 34 of the PDF).

When addressing system planning, the authors note that "[t]he system plan could address and prioritize modes of access in order to shift access investments to the lower-impact modes of access such as walking, bicycling and transit." The authors recommend changes to various modes, including park-and-ride lots, paratransit bays and pickup and drop-off space, bus service, and pedestrian and bicycle access.

Canada

GO Transit Rail Parking and Station Access Plan, Metrolinx, Government of Ontario, Canada, June 2013.
http://www.metrolinx.com/en/regionalplanning/projectevaluation/studies/GO_Transit_Rail_Parking_and_Station_Access_Plan_EN.pdf
GO Transit is the regional public transit system in Southern Ontario, Canada. Metrolinx is an agency of the Government of Ontario "created to improve the coordination and integration of all modes of transportation in the Greater Toronto and Hamilton Area."

A discussion of pilots and projects begins on page 63 of the report (page 79 of the PDF):

> Testing new approaches, or investing in additional research, to achieve mode shift can help to understand the impacts before rolling out initiatives system-wide. The following programs and projects have been proposed to test innovative options for varying station access mode share, as well as further developing the analysis for station access planning[:]
>
> - **GO Transit Shuttle Pilot (in progress):** Planning and delivery of pilot shuttle services to support station access and egress at both ends of a rail journey, providing end-to-end connectivity to improve accessibility, and support increased rail ridership.
> - **GO Transit Website Station Pages (in progress):** Updated external GO Transit website station pages will provide customers with information about all transportation modes available to them, demonstrating sustainable modes as attractive and viable means of transport for both existing and future GO Transit customers.
> - **Station Travel Plans:** Development of station-level plans to integrate and direct the delivery of active transportation access improvements, transit priority initiatives, and promotion of active transportation, transit and carpooling.
> - **Further Station Catchment Analysis - Travel Times and Customer Profiling:** Enhancing the analysis to inform decision making for investment in other modes of station access.
> - **Green Parking Zone:** A priority zone providing preferential space for more sustainable, low carbon station access including carpooling, car sharing, and ultra-low carbon vehicles and charging points.

Station Access Investments

Publications in the following three categories provide a sampling of the types of investments in station access that are made to encourage access mode shifts:

- Bicycle facilities.
- Pedestrian facilities.
- Parking.

Bicycle Facilities

"Bike-and-Ride: Build It and They Will Come," Roberto Cervero, Benjamin Caldwell and Jesus Cuellar, *Journal of Public Transportation*, Vol. 16, No. 4, pages 83-105, 2013.
http://www.nctr.usf.edu/wp-content/uploads/2013/12/jpt16.4_Cervero.pdf
From the abstract:

> This paper adopts a case-study approach to probe factors that have had a hand in not only cycling grabbing a larger market share of access trips to rail stops, but also in the enlargement of bike access-sheds over time. Both on-site factors, such as increases in the number of secure and protected bicycle parking racks, as well as off-site factors, such as increases in the lineal miles of separated bike-paths and bike boulevards, appear to explain growing use of bicycles for accessing rail stations. The adage "build it and they will come," we argue, holds for bicycle improvements every bit as much as other forms of urban transportation infrastructure. Pro-active partnerships between transit agencies, local municipalities, and bicycle advocacy organizations are critical to ensuring such improvements are made.

TCRP Synthesis 62: Integration of Bicycles and Transit, Transit Cooperative Research Program, 2005.
http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_62.pdf
This report provides a synthesis of practices for integrating bicycles and transit gathered from a survey of 56 North American transit agencies. This report provided no methods for calculating the impact of these investments. Of particular note:

- Chapter 4, Integration of Bicycles with Rail Transit Services, which begins on page 25 of the report (page 33 of the PDF).
- Chapter 6, Integration of Bicycle Parking and Transit, which begins on page 34 of the report (page 42 of the PDF).

Pedestrian Facilities

Passenger Flows in Underground Railway Stations and Platforms, Anastasia Loukaitou-Sideris, Brian Taylor and Carole Turley Voulgaris, Caltrans and U.S. Department of Transportation University Transportation Centers Program, May 2015.
http://transweb.sjsu.edu/PDFs/research/1230-passenger-flows-in-underground-railways-stations-platform.pdf
This study examines the planning and analysis of station passenger queuing and flows to offer guidance on how to best accommodate and manage rail passengers. Rather than focusing on passenger access and egress or how to increase pedestrian station access mode share, this

report examines ways to improve the efficiency of passenger movements within the stations, which may improve the rider experience and ridership.

Parking

"Station Parking and Transit-Oriented Design: Transit Perspective," Peter C. Martin and William E. Hurrell, *Transportation Research Record 2276*, pages 110-115, 2012.
Citation at http://trid.trb.org/view/2012/C/1129359
From the abstract:

> A simple spreadsheet analysis framework is presented to help transit agencies and local communities make informed decisions regarding parking and TOD [transit-oriented development]. This suggested analysis framework focuses on the rail transit ridership implications of parking versus TOD and on the cost of station parking.

"Smart Parking Value Pricing Pilot on COASTER Commuter Rail Line in San Diego, California," Tagan Blake, Caroline Jane Rodier and Susan A. Shaheen, *TRB 88th Annual Meeting Compendium of Papers DVD*, Paper #09-3554, 2009.
Citation at https://trid.trb.org/view/2009/C/882343
From the abstract:

> This paper reports on the Smart Parking Value Pricing Pilot Project on the COASTER commuter rail line in San Diego (CA, USA), which builds on transit-based smart parking field test research conducted at the Rockridge San Francisco Bay Area Rapid Transit station. This paper begins with a comprehensive review of the literature on the options and applications of advanced parking technology and management measures available to optimize parking resources at both transit and non-transit facilities. Next, the results of an initial feasibility study for the pilot are described, which include an evaluation of the parking challenges at all six COASTER stations based on an analysis of ridership trends, observed station parking demand, and focus groups with COASTER commuters. Finally, the phased smart parking implementation plan, carefully tailored to address key transit-related parking problems at the station and corridor levels, is described along with the pilot project's evaluation criteria.

Policy and Program Investments

Investments to encourage a shift in rail or transit access modes away from single-passenger vehicles can extend beyond investments made in the rail or transit station and take the form of policies or programs that impact riders' decisions about access mode. The citations in this section are organized in four categories:

- Bicycle facilities and programs.
- Pedestrian facilities and programs.
- Multimodal facilities and programs.
- Connectivity to transit facilities.

Bicycle Facilities and Programs

Research in Progress: Transit Access and Egress via Bicycle Sharing, Caltrans, expected completion date: unknown.
Abstract at http://trid.trb.org/view/2012/P/1239193
From the abstract:

> The work will explore the benefits of designing bicycle-sharing programs to serve public mass transit. Given that bicycle speeds exceed those of walking, a transit system's ridership can increase by promoting bicycle travel to and from its stations. And bicycle sharing may reduce transit costs, especially if the bike-sharing and transit systems can be designed in joint fashion.

"Bicycle Sharing and Public Transit: Does Capital Bikeshare Affect Metrorail Ridership in Washington, D.C.?," Ting Ma, Chao Liu and Sevgi Erdogan, *Transportation Research Record 2534*, pages 1-9, 2015.
Citation at http://trid.trb.org/view/1339357
From the abstract:

> This study examined the impact of the Capital Bikeshare (CaBi) program on Metrorail's ridership in Washington, D.C. When CaBi trips were mapped, it was observed that Metrorail stations had been important origins and destinations for CaBi trips. Six of seven CaBi stations producing more than 500 trips were located close to Metrorail stations. This study conducted a regression analysis and found that public transit ridership was positively associated with CaBi ridership at the station level. A 10% increase in annual CaBi ridership contributed to a 2.8% increase in average daily Metrorail ridership.

Perceptions of Bicycle-Friendly Policy Impacts on Accessibility to Transit Services: The First and Last Mile Bridge, Bradley Flamm and Charles Rivasplata, Caltrans and Research and Innovative Technology Administration, January 2014.
http://transweb.sjsu.edu/PDFs/research/1104-bicycle-policy-transit-accessibility-first-last-mile.pdf
From the abstract:

> This research project was designed to assess the distances travelled on bicycle by cycle-transit users (CTUs), both those who use bicycles as a means of access to transit stops and stations and those who bicycle to and travel on transit with their bicycles. A mixed-methods approach was employed, using a literature review, a survey of cyclist-transit users in

Philadelphia and San Francisco, and telephone interviews with a subset of survey respondents. Responses provided by CTUs in the two cities allow us to define their characteristics and behaviors in detail. What is more, they highlight two intriguing conclusions: that transit catchment areas can be much larger for cycle-transit users than for traditional transit users who access transit buses and rail on foot, and that the very concept of a cycle-transit catchment area is quite complex because of the variety of travel opportunities that cycle-transit coordination policies present transit riders. CTUs take advantage of larger catchment areas to reduce their travel costs, and they use those catchment areas in curious, less predictable and more varied ways.

Bicycling Access and Egress to Transit: Informing the Possibilities, Kevin J. Krizek, Eric Stonebraker and Seth Tribbey, Caltrans and Research and Innovative Technology Administration, April 2011.
http://transweb.sjsu.edu/PDFs/research/2825_bicycling_access.pdf.
From the abstract:

> A CTU index provides an initial attempt to understand transit stops that have a higher likelihood to attract CTUs. The Analytic Hierarchy Process ranked cyclists' preferences for four bicycle and transit integration strategies in order of preference: (1) "Bike ON transit" (transporting the owner's bicycle aboard(inside or outside) the transit vehicle) (0.471), (2) "Bike TO transit" (using and parking the owner's bicycle at a transit access location) (0.185), (3) "Shared bike" (sharing a bicycle, which would be based at either the transit access or egress point) (0.185), and (4) "Two bike" (using an owner's two bicycles at the access and egress location) (0.159). Results of the cost effectiveness assessment suggest that "Bike ON transit" ranked most cost effective overall, followed by "Bike to transit," "Two bike," and "Shared bike" strategies.

Pedestrian Facilities and Programs

Pedestrian Network Analysis: A Safer, Easier, More Comfortable Walk to Transit, TriMet, undated.
http://trimet.org/pdfs/pednetwork/trimet-pedestrian-network-analysis-report.pdf
TriMet is the transit agency covering most of Portland, OR. An excerpt from the executive summary describes this project, which can serve as a template for other agencies to follow:

> The Pedestrian Network Analysis Project provides TriMet and its partners a way to objectively assess areas of its service district for needs and opportunities, communicate priorities, and eventually work with partners to program investments that provide better pedestrian access to transit stops.
>
> Specifically, the pedestrian network analysis objectives are fivefold:
>
> - Address the needs of seniors, people with disabilities, the economically disadvantaged, and school children;
> - make existing transit customers walking trips safer, more direct, and comfortable;
> - improve pedestrian safety and comfort through design and operations;
> - attract new transit and walking trips;
> - leverage other public and private investments.

Links to other project-related documents are available at
http://trimet.org/projects/pednetwork/index.htm (scroll down to the bottom of the web page).

"To Walk or Not to Walk: Testing the Effect of Path Walkability on Transit Users' Access Mode Choices to the Station," Sungjin Park, Keechoo Choi and Jae Seung Lee, *International Journal of Sustainable Transportatio*n, Vol. 9, No. 8, pages 529-541, November 2015.
Citation at http://trid.trb.org/view/2015/C/1346955
From the abstract:

> Using a path walkability measurement instrument developed for this research, 38 path walkability indicators are extracted from each of the 249 walking routes. The 38 walkability indicators are grouped by using factor analysis yielding four path walkability factors: "sidewalk amenities," "traffic impacts," "street scale and enclosure," and "landscaping elements." The four factors are utilized as new walkability variables for modeling access mode choices. With 150 walkers and 99 habitual auto users/occasional walkers, two access mode choice models are estimated. … The model result suggests that micro-level walkability influences access mode choices in a statistically significant way and having more walking-conducive walkability available for access trips increases the chance of choosing walking over driving. This research shows that improving micro-level walkability could be a cost-beneficial incentive for more walking to the station.

"Application of Pedestrian Intersection Safety Index in Planning Access to New Rail Stations," Daniel Nabors, Dalia Leven and Frank Spielberg, *Transportation Research Record 2112*, pages 1-7, 2009.
Citation at https://trid.trb.org/view/2009/C/881241
From the abstract:

> In the next decade, a new Metrorail line connecting downtown Washington, D.C., to Dulles International Airport and Loudoun County, Virginia, will open. This extension will pass through the suburban community of Reston, Virginia, where two stops will be located. … The pedestrian intersection safety index, recently developed for FHWA, was used to determine the suitability and safety for pedestrians of intersections surrounding proposed stations. These measures use readily available data to produce a quantitative rating of the safety of intersections. Recommendations for physical improvements were developed for 38 intersections within 1 mi of the station entrances. These projects were then prioritized for implementation on the basis of several factors, including safety measures. This process discovered some benefits and constraints associated with the implementation of the model.

Related Resource:

> **Pedestrian and Bicyclist Intersection Safety Indices: User Guide**, Federal Highway Administration, April 2007.
> http://www.fhwa.dot.gov/publications/research/safety/pedbike/06130/06130.pdf
> The objective of this study was to develop safety indices to allow practitioners to prioritize intersection crosswalks and approaches with respect to pedestrian and bicycle safety. These safety indices can be used to improve not just the safety of intersections nearby transit stations but to increase the pedestrian and bicycle access mode share of those transit stations.

How Far, By Which Route, and Why? A Spatial Analysis of Pedestrian Preference, Marc Schlossberg, Asha Weinstein Agrawal, Katja Irvin and Vanessa Louise Bekkouche, Caltrans and Research and Innovative Technology Administration, June 2007.
http://transweb.sjsu.edu/MTIportal/research/publications/documents/06-06/MTI-06-06.pdf
The objectives of this study were to determine:

- How far do pedestrians walk to rail transit stations?
- What environmental factors influence their route choice?

Among the project's findings:

- Pedestrians walk considerably farther (close to one-half mile) to access rail stations than commonly assumed.
- Pedestrians believe that their primary consideration in choosing a route is minimizing time and distance.
- Secondary factors influencing route choice are safety and, to a lesser extent, attractiveness of the route, sidewalk quality and absence of long waits at traffic lights.

Multimodal Facilities and Programs

Methodology for Linking Greenways and Trails with Public Transportation in Florida, Sara Hendricks and Martin Catalá, Florida Department of Transportation and Research and Innovative Technology Administration, February 2016.
http://www.dot.state.fl.us/research-center/Completed_Proj/Summary_PTO/FDOT-BDV26-977-03-rpt.pdf
From the abstract:

> The purpose of this research was to provide a methodology to evaluate how intermodal connections between public transportation and public trails can improve livability in Florida communities. This research explored other available methodologies for evaluating intermodal connectivity, developed three case studies of communities outside Florida to compare different approaches, and developed an alternative methodology as applied to the trails and transit systems of Pinellas County and Hillsborough County, Florida. … Recommendations were developed for improvements for each of these transit/trail junctures to make the connections stronger so that someone using nonmotorized transportation could use both public transit and a public trail to complete a multimodal trip to the destination.

"Evaluation of the Safe Routes to Transit Program in California," David Weinzimmer, Rebecca L. Sanders, Heidi Dittrich and Jill F. Cooper, *Transportation Research Record 2534*, pages 92-100, 2015.
Citation at http://trid.trb.org/view/1336853
From the abstract:

> This paper elaborates on findings from an evaluation of the San Francisco Bay Area's Safe Routes to Transit (SR2T) program in California. This program funded enhancements to increase walking and cycling to regional transit stations. To understand how the program influenced travel choices, behavior, and perceptions of safety and local air quality, the study surveyed transit users and observed driver, pedestrian, and bicyclist behavior in the periods before and after the enhancements were made at multiple transit stations. … In particular, the results showed that walking and bicycling increased by 3% at treatment sites compared with control sites. Bicycling also increased at control sites; this factor indicated a general

societal shift. Furthermore, driving decreased 2.5% at treatment sites. Perceived air quality, in general, improved in the posttime period. When asked about perceived traffic risk, bicyclists more than pedestrians reported feeling safer on the road, with 10% of the bicyclists, on average, feeling safer after the improvements. There were also economic benefits from this project—pedestrians and bicyclists were overrepresented in those who stopped en route to transit for food and drink. The evidence suggested that the SR2T program positively affected the decision to walk and bicycle to access transit. The program is recommended for expansion to additional sites.

"Factors That Influence Walking and Biking to the Station: Modeling Commuter Rail User's Access Mode Choice," Sungjin Park and Junhee Kang, *TRB 87th Annual Meeting Compendium of Papers DVD*, Paper #08-1939, 2008.
Citation at https://trid.trb.org/view/2008/C/848283
From the abstract:

> The major goal of this research is to help create more walking- and biking-friendly policies by finding factors that influence walking and biking to transit stations. In 2005, a station user survey was conducted in Mountain View, California. Based on the survey result, this paper developed mode choice models of commuter rail user's access trips to the station. To find statistically significant variables that influence the probability of choosing walking and biking over driving, a pair of binominal logit analyses were performed with 40 travel, socio-economic, and built environment variables. The research tested 277 walkers and auto travelers living within 1.5 miles of the station and 280 bikers and auto travelers living within 2 miles of the station. This research found six predictors for the walking vs. driving model: trip distance, trip purpose, car availability, race, intersection density, and proximity to driving-friendly streets, and found five predictors for the biking vs. driving model: trip distance, trip purpose, car availability, race, gender, and proximity to driving-friendly streets. A similar set of variables entered both models, but the explanatory power of the bike model was much lower, suggesting that the factors influencing biking may be different from the traditional variables used by existing research. The influence of the built environment, which is probably more policy-relevant than travel and socio-economic variables, seems relatively low for both models, suggesting that future research needs to look at finer-grained micro-level pedestrian and biker environment.

Pedestrian and Bicycle Information Center, University of North Carolina Highway Safety Research Center and Federal Highway Administration, undated.
http://www.pedbikeinfo.org/
The Pedestrian and Bicycle Information Center (PBIC) maintains a substantial amount of information related to pedestrian and bicycle facilities and programs, including resources for linking to transit. According to PBIC, transit riders will typically walk one-fourth to one-half mile (about 5 to 10 minutes) to and from transit. A bicycle-to-transit trip usually extends the catchment area of a bus stop or transit station to two or three miles. This information is important when considering bicycle and pedestrian facility improvements in the areas near the transit station.

Related Resource:

> **Transit Solutions for Bikes**, Pedestrian and Bicycle Information Center, University of North Carolina Highway Safety Research Center and Federal Highway Administration, undated.
> http://www.pedbikeinfo.org/planning/transit_bikes.cfm
> This web site provides case studies about getting bikes on buses and trains, and real-world examples of bicycle parking programs at transit stations.

Connectivity to Transit Facilities

Research in Progress: Pedestrian and Bicyclist Connectivity in the High-Speed Rail Alternatives Analysis, Research and Innovative Technology Administration, expected completion date: unknown.
Project description at
http://nitc.trec.pdx.edu/research/project/719/Pedestrian_and_Bicyclist_Connectivity_in_the_High-Speed_Rail_Alternatives_Analysis
The project description gives a completion date of June 2014 and a project status of in progress. A final report is not available on the research organization's web site. From the project description:

> This research presents a methodology for quantifying the connectivity of proposed rail alignments to pedestrian and bicyclist networks and demonstrates how this information can be considered in the alternatives analysis process for selecting a preferred rail alignment.

Promoting Intermodal Connectivity at California's High-Speed Rail Stations, Anastasia Loukaitou-Sideris, Deike Peters and Wenbin Wei, Caltrans and U.S. Department of Transportation University Transportation Centers Program, July 2015.
http://transweb.sjsu.edu/PDFs/research/1209-promoting-intermodal-connectivity-at-calif-high-speed-rail-stations.pdf
This study considers the integration of HSR with existing conventional rail in a blended system in which HSR shares the same tracks with conventional passenger or freight rail. Researchers offer recommendations on how to enhance both the spatial and the operational connectivity of HSR in a blended system. Among the recommendations:

- **Station scale.** Provide lounges, information kiosks and way-finding signage.
- **Station neighborhood level.** Consider the placement of station entrances and their relationship to the surrounding existing land use and infrastructure.
- **Operational considerations.** Include integrated ticketing options, transfer of luggage services from one mode to the other, clear and frequent way-finding signs, and advanced information systems detailing connections with other modes.

DeBary SunRail Station Area Bicycle and Pedestrian Connectivity Study, Florida Department of Transportation, April 2014.
http://sites.kittelson.com/SunRailConnectivity/Downloads/Download/27728
From the introduction:

> The FDOT recognizes there is a need to look more closely at immediate and short term infrastructure requirements to seamlessly connect pedestrians and cyclists to the stations. Some of these needs are already being identified and planned for as part of the FDOT's SunRail station development work, as well as by each municipality's individual planning initiatives.
>
> FDOT has initiated this Connectivity Study to help coordinate all of these individual efforts, as well as to identify any additional pedestrian and bicycle infrastructure projects critical to enhancing multi-modal connectivity around the SunRail stations.

Links to other reports produced for the connectivity study are available at http://sites.kittelson.com/SunRailConnectivity/Downloads.

Supplementary Information

Contact: Marianne Gurnee, Program Manager, SunRail, Florida Department of Transportation, 407-492-0836, marianne.gurnee@dot.state.fl.us.

We spoke with Marianne Gurnee, SunRail's program manager, to learn more about the transit agency's activities. Gurnee reported that a previous Florida DOT effort provided a foundation for the connectivity study cited above. The agency conducted walkability studies that included a detailed assessment of each SunRail station's 10-minute walk area based on a range of characteristics. Gurnee noted that Florida DOT has not performed a thorough analysis of access and egress related to the agency's commuter rail stations.

Developing Seamless Connections in the Urban Transit Network: A Look Toward High-Speed Rail Interconnectivity, Harry Teng, Tarik Toughrai, Tingting Yu, Russell Ozawa and Bingyi Hu, Research and Innovative Technology Administration, July 2014.
http://transweb.sjsu.edu/PDFs/research/1148-high-speed-rail-urban-transit-interconnectivity.pdf
From the abstract:

> The objective of this study was to quantify multimodal connectivity of HSR [high-speed rail] stations and its impact on ridership in four countries where HSR has been established, setting the basis for future rail interconnectivity. In this study, multimodal connectivity is measured by the number of different modes of transportation connected to HSR stations, the number of installed arrival and departure facilities for each mode, the transfer time from connecting modes to boarding platforms at HSR stations, and the arrival time intervals of public transportation modes. To achieve this objective, data were collected from HSR systems of France, Spain, Japan and China.

Implications of the research findings with regard to California HSR are addressed on page 80 of the report (page 94 of the PDF). Among them:

- Special attention should be given to bicycle and pedestrian accommodations.
- Transforming an existing transit station into an HSR station will cause some connections to have excessively long transfer times.
- A more convenient fare payment system should be used to facilitate transfer between HSR and other modes of transportation.
- Coordinating the arrivals and departures of different modes of transportation at HSR stations is very important.

Enhancing the Connectivity of High Speed Rail in the Orlando-Tampa Corridor with Local Public Transportation Systems: Issues and Opportunities, Rob Gregg and Justin Begley, Florida Department of Transportation and Research and Innovative Technology Administration, January 2011.
http://www.nctr.usf.edu/wp-content/uploads/2011/05/77928.pdf
From the abstract:

> This project looks at local public transportation systems that have opportunities to connect to HSR stations planned for the Orlando-Tampa corridor. How will the availability of HSR affect the existing transit services? What approach are local agencies taking to re-align services to

benefit both local and regional travelers? The creation and authority of the Florida Rail Enterprise High Speed Rail project is a catalyst for local agencies to reassess their existing and planned public transportation development activities.

International Practices

The publications below highlight international practices in Australia, Austria, Canada, China and the Netherlands.

Bicycle Facilities

"Bicycle Parking Demand at Railway Stations: Capturing Price-Walking Trade Offs," Eric Molin and Kees Maat, *Research in Transportation Economics*, Vol. 53, pages 3-12, November 2015.
Citation at http://trid.trb.org/view/2015/C/1377014
From the abstract:

> Due to the increasing use of bicycles as an access and egress mode for train travel in the Netherlands, bicycle parking facilities at many inner city railway stations are having trouble accommodating parking demand while scare space near train platforms precludes the expansion of such facilities. A potential solution for this problem is to offer paid, high-quality parking facilities close to the train platforms and free but lower-quality parking further away. … The estimated model was used to predict choice behaviour under various implementations of the new pricing policy. The results indicate that only a small proportion of the train travellers will stop cycling to and from the station. Of these, the vast majority would rather walk and a fair share would use public transport. Only a very small number would travel to the station by car. The results suggest that paid bicycle parking is a feasible solution by which to distribute scarce parking capacity at major railway stations.

"Intermodal Transfer Between Bicycles and Rail Transit in Shanghai, China," Haixiao Pan, Qing Shen and Song Xue, *Transportation Research Record 2144*, pages 181-188, 2010.
Citation at https://trid.trb.org/view/2010/C/910218
From the abstract:

> This research examines the challenges and opportunities for improving the bicycle–rail connection by using Shanghai as a case study. On the basis of two questionnaire surveys of rail transit riders, the research analyzes the existing mode shares of rail station access and egress trips, the underlying mechanisms for choosing among alternative modes, and the comparative advantages of the bicycle for trips that have certain distance and location characteristics. Empirical results suggest that the potential for travel improvement for rail transit riders lies primarily in the collection and distribution phases. Results point to several promising approaches to improving the bicycle–rail connection and utilizing the bicycle more fully as an efficient supplement mode for the rapidly expanding urban rail transportation in China.

Policy or Program Investments

"Analysis of Metro Commuters' Satisfaction in Multi-Type Access and Egress Transferring Groups," Min Yang, Jingyao Zhao, Wei Wang, Zhiyuan Liu and Zhibin Li, *TRB 93rd Annual Meeting Compendium of Papers*, Paper #14-0522, 2014.
Citation at http://trid.trb.org/view/2014/C/1287367
From the abstract:

> This paper takes the access and egress stages together as a whole process to analyze travelers' satisfaction level on the metro-commuting journey. Based on the survey in Nanjing, China, 7 intermodal travel groups are taken as the targets for this analysis. … The results show that access and egress stages play important but different roles in the 7 groups. And facility services qualities in two stages are key factors that affect the overall satisfaction. The groups with same access or egress modes have very different core factors. Accessing by bike, bike-metro-transit users care much about bike parking safety while bike-metro-walk users value parking space near metro. With two bus-metro transfers, transit-metro-transit users identify that the weak point in access stage is the crowded spaces on bus. However, transit-metro-walk users value access bus frequency, which is the common weak point in groups with one bus-metro transfer. When egress by walk, commuters using motorized mode to access are found to concern about egress walking environment while those using non-motorized access modes care more about egress walking spaces.

"Analyzing Commuter Train User Behavior: A Decision Framework for Access Mode and Station Choice," Vincent Chakour and Naveen Eluru, *Transportation*, Vol. 41, No. 1, pages 211-228, January 2014.
Citation at https://trid.trb.org/view/2014/C/1286836
From the abstract:

> This article presents a decision framework to understand commuter train users' access mode and station choice behavior. In contrast to the hierarchical choice model that is typically used to frame access mode and station choice, this study proposes a latent segmentation-based approach. Two segments of station and access mode choice behavior are considered, one that considers station first and access mode second and one that considers access mode first and station mode second. Using survey data from an on-board survey of commuter train users in Montreal, Canada, the latent segment model investigates the role of sociodemographic variables, level of service (LOS) parameters, trip characteristics, land-use and built environment factors and station characteristics on commuter train user behavior. Among the findings are that individuals are more likely to select a station first as the distance from the station by active transportation increases. The results also show that young people, females, car owners and individuals leaving before 7:30 am are more likely to drive to the commuter train station. Travel time is also shown to have a negative impact on station choice according to the station model, and the presence of parking and increased train frequency is found to lead to greater use of stations.

"Railway Trip Speeds and Areal Coverage. The Emperor's New Clothes of Effectivity?" Tadej Bezina and Hermann Knoflacher, *Journal of Transport Geography*, Vol. 39, pages 121-130, July 2014.
Citation at http://trid.trb.org/view/2014/C/1322678
From the abstract:

> The authors embrace a passenger's point of view and utilize a generalized overview model for illustrating the trade-offs between trip speeds of complete trip chains, access/egress legs and mainline trip lengths. In order to estimate input parameters, an overview of railway

network and settlement structure of Austria is empirically derived. In four scenarios, we vary these input parameters to study the impact of timetable integration, speed upgrades on mainlines and access/egress modes on trip speed in the Austrian case. The results show that travel speed advantages of mainline speed increases are quickly countervailed by access/egress improvements or timetable integration improvements.

"Employing Best Practice in Station Access to Bridge the Door-to-Door Divide," Phil Charles and Ronald John Galiza, *Australasian Transport Research Forum 2013 Proceedings,* October 2013.
Citation at http://trid.trb.org/view/2013/C/1285375
From the abstract:

> Station access bridges the gap between origin (destination) and transit stations making rail service more comparable to door-to-door car travel. … A checklist of station principles associated with each access mode is provided to assess existing station access conditions from case studies in Brisbane, Perth, and Sydney. Results of the analysis identify opportunities for improvement in order to meet future access demands. This paper presents a new perspective for Australian rail agencies, including access in the overall design process and provides a best practice approach, building on developments in Europe and North America.

"Rail Station Access: An Assessment of Options," Conor Semler and Chris Hale, *33rd Australasian Transport Research Forum Conference*, October 2010.
http://www.worldtransitresearch.info/cgi/viewcontent.cgi?article=5066&context=research
From the abstract:

> The paper summarises findings from a review of literature exploring station-area access planning, and the emerging field of non-auto transport evaluation methods. We find that encouraging walking, cycling, and riding public transport to rail stations can increase ridership without the need to provide additional car parking facilities, which clearly tend to be expensive, land-intensive, and which generate localised congestion. Instead, station-area land can be used more productively, through residential, office, and retail transit-oriented development (TOD) which provides economic value to the community and ridership for the rail agency.

Contacts

CTC contacted the individuals below to gather information for this investigation.

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