Summary of Approved Research Projects

Project A-46 ***Ferry Transit Operations and Capacity Guidebook***
Research Field: **Operations**
Allocation: **$100,000**
TCRP Staff: **Dianne Schwager**

Ferry transportation services play a significant role in many municipal and regional transportation systems throughout the United States and have the potential to play an even greater role. The Bureau of Transportation Statistics' 2014 National Ferry Census identified ferry systems managed by 128 operators in 38 states carrying 115 million people and 30 million vehicles. These systems used about 500 vessels on 741 route segments, serving a combined total of 21,301 nautical miles. Of the 500, 95 percent carry passengers.

At the 441 reported terminals, two-thirds had on-site or nearby parking, one-third had local bus service, 11 percent had regional bus service, about eight percent had local rail, and 4.5 percent had intercity rail. According to APTA's *2016 Public Transportation Fact Book*, ferries serve over twice as many passenger-miles annually as the bus rapid transit and streetcar modes combined. Ferries have also served an important transportation role during emergencies. New cross-Bay ferry transit alternatives were launched following the 1989 San Francisco earthquake that closed the Bay Bridge for a month and following the 9/11 attacks in New York City, where ferries were used in the largest waterborne evacuation in history. However, growing the ferry mode requires that transportation planners have good information to work with, allowing ferry alternatives to be evaluated on a comparable basis with other transit modes.

The most recent comprehensive national research on ferry operations, *TCRP Report 152: Guidelines for Ferry Transportation Services*, addresses ferry operations in one of nine chapters and defers to the *Transit Capacity and Quality of Service Manual* (TCQSM) for information on ferry capacity.

The TCQSM needs to include more supporting research on the ferry mode. This research can be conducted as part of a larger project to document best practices in ferry operations, an effort that would benefit both existing ferry operators as well as communities considering ferries as a potential transit mode.

The objectives of this research are to

1. Identify and document best practices in ferry operations from around the world, including demand factors in the form of a guidebook.
2. Fill identified gaps in the TCQSM's ferry capacity material, including vessel, integrated vessel/dock design, route, and terminal characteristics; intermodal connections; public-

private partnership structures in various states; and capacity methods; and develop an updated ferry capacity chapter for the manual.

3. Create an annotated bibliography of national and state ferry studies from 1970 on that have become invaluable to ferry planners, and compile historical route information that can provide clues to optimal locations of piers and terminals paralleling bridges and tunnels.

Project B-48 ***Offering Alternative Services Sponsored by Transit Agencies to ADA Paratransit Customers: The Intersection of Regulation and Program Objectives***
Research Field: **Service Configuration**
Allocation: **$350,000**
TCRP Staff: **Mariela Garcia-Colberg**

With increasing frequency, transit agencies are turning to ride-sourcing services (such as Lyft and Uber), taxis, and other non-dedicated service providers in offering Alternative Services to their ADA paratransit customers. In TCRP Synthesis 135, Alternative Services are defined as:

> A transit-subsidized on-demand mobility option offered by a transit agency to ADA paratransit customers. The service must be compliant with the ADA but does not fall under the service criteria governing ADA Complementary Paratransit. This is because: (1) the decision to use the alternative service is totally up to the customer; (2) while the transit agency can offer/suggest the alternative service option, the customer may still choose to use the ADA paratransit service; (3) a customer choosing to use the Alternative Service does not impact the customer's ADA paratransit eligibility or right to continue to request trips on the ADA paratransit service; and (4) none of the vehicles used are owned, operated or controlled by the transit agency. Alternative Services are different from premium service in that premium services are provided via the same service platforms as the ADA paratransit trips, whereas Alternative Services use a different service mechanism.

Successful Alternative Services have long been favored by individuals with disabilities, as they provide immediate, on-demand service compared to the next-day service of ADA paratransit services. Moreover, transit agencies have instituted such services in part because of the opportunity the programs provide to reduce overall paratransit costs. If the savings from ADA paratransit customers using a (lower-subsidy) Alternative Service for trip(s) instead of the ADA paratransit service are more than the additional subsidies that the transit agency pays for new trips on the Alternative Service(s), then the transit agency is able to reduce cost. However, this is a challenge to prove, and so there is a need to find out the different ways in which transit agencies are calculating the savings and to develop a conclusive and common way to determine whether or not a reduction in cost has been achieved.

The most common example of an Alternative Service is a taxi-based subsidy program sponsored by a transit agency. While such programs have been made available to ADA paratransit customers for decades, the concept of "user-choice" as a pre-requisite for such services has been interpreted in a variety of different ways. For example, while the term originally meant "the customer chooses whether or not to use the service," the definition has morphed into a pre-requisite for at least two participating carriers. In some cases, this has led to the non-implementation or discontinuance of viable and needed services for ADA paratransit customers. In other cases, such single-carrier subsidy programs have been allowed to continue.

These inconsistencies have been compounded with the advent of ride-sourcing services. Several transit agencies have already implemented an Alternative Service using one or more ride-sourcing services in whole or in part. However, in several cases, the ride-sourcing services have struggled to meet the ADA requirement for service equivalency, specifically with regard to, ensuring that the response time for service will be the same for customers who are ambulatory as it is for those who require a wheelchair-accessible vehicle.

The issue of liability is also unclear. In the case of Alternative Services with provider contracts, most transit agencies have built into the provider contract a requirement for liability coverage. In cases where the contract is simply an agreement to reimburse the provider, liability coverage is uncertain. A further complication is that federal, state, and local laws and regulations are unclear on the "duty of care" and potential agency liability for data security breaches and negligent hiring.

Research is needed to more completely understand how taxis, ride-sourcing services, and other non-dedicated service providers are being used for Alternative Services so as to identify:

(1) The extent of inconsistency in the interpretation and application of pertinent federal guidelines and the extent to which these inconsistencies have limited Alternative Services.

(2) The extent of mobility benefits that Alternative Services produce, i.e., the extent to which ADA paratransit customers are using Alternative Services for new trips versus replacement trips and why; how these programs enable customers to have more freedom in when and where they make trips; and the advantages and disadvantages with using these services for customers that require a wheelchair- accessible vehicle.

(3) Whether or not transit agencies are actually successful in reducing overall paratransit costs by implementing Alternative Services and how different ADA paratransit service models change the cost equation, especially for the types of trips with the most potential savings.

(4) What data are required to be reported by providers to transit agencies and are tracked in order to measure the mobility benefits and cost savings stemming from the Alternative Services.

(5) What "best-practice" design models for Alternative Services have resulted in transit agencies achieving that goal of service equivalency and reduction in cost while also achieving regulatory compliance? Highlight how those design models or contracts can limit or apportion transit agency liability and how new technologies can support Alternative Services to ensure program success.

Project B-49 ***Design Guide for Rural Deviated Fixed Route Transit Systems***
Research Field: **Service Configuration**
Allocation: **$100,000**
TCRP Staff: **Dianne Schwager**

Traditionally, rural transit systems operate either conventional fixed route services or conventional telephone-based (dial-a-ride) demand-responsive services. In many instances, though, rural transit providers seek to implement intermediate options, often termed "deviated fixed route transit "(DFRT) systems, in which the general route and schedule are predetermined with the possibility of varied routes upon rider request.

In general, traditional fixed route service is efficient for corridors with high ridership density, while demand-responsive service is suitable for low-density areas and specialized services. DFRT addresses intermediate and mixed cases. For example, some transit systems combine fixed-route service in a central business district with DFRT in outlying low-density residential areas. Similarly, some agencies switch from daytime fixed route service to late-night DFRT.

DFRT service presents a number of policy and service planning issues. These include

- How much deviation from the standard route will be permitted and associated schedule impacts.
- How far in advance a deviation must be requested and penalties for cancellations and no-shows.
- Whether all riders are allowed to request deviations or only those passengers meeting certain criteria (e.g., a physician-certified disability).
- Whether vehicles return to the normal route after making a deviation or proceed directly to the location of the next known passenger (which could bypass non-appointment passengers waiting at intermediate stops).
- Coordination with neighboring transit systems and other travel modes.
- Target markets, fare policies, adaptation to seasonal demand fluctuations, and fare revenue.
- Eligibility and reimbursement rates for various governmental programs.
- Public communication, service marketing, and customer orientation for elderly riders and people with physical and cognitive disabilities.
- Effects of DFRT on travel time, ridership, operating costs, productivity, and customer satisfaction.

All of these issues need to be considered in the context of the size and shape of the service area, local terrain and land use patterns, and the layout of the underlying fixed routes.

Research is needed to evaluate the characteristics, benefits, drawbacks, and design considerations for rural deviated fixed route systems, including the collection of data that can help validate theoretical performance models. Additionally, the experiences of rural transit systems that have implemented DFRT service should be gathered and summarized to identify common issues and opportunities.

The objective of this project is to develop practical guidance that can assist practitioners with all aspects of rural DFRT system design, including policy setting, physical layout, service planning, and revenue forecasting. The guidebook should address methods for estimating effects on ridership, customer satisfaction, labor and equipment requirements, and operation and maintenance costs. This includes consideration of the technical requirements for stops, vehicles, software, and employee training and whether the locations of deviated stops should be pre-planned or determined in real time based on operator discretion.

The guidance should also address the use of modeling and analysis tools to develop objective methods for comparing proposed DFRT services with other service delivery methods and validating performance measure estimates against existing service plans.

Project C-25 ***Barrier Design for Bus Operator Security– The Challenges and Solutions***
Research Field: **Engineering of Vehicles and Equipment**
Allocation: **$350,000**
TCRP Staff: **Stephan Parker**

As recent operator assaults brutally demonstrate, current North American driver security barriers fail to provide protection against assaults of any form. The problems stem from bus designs that, in maximizing passenger seating, have created a conflict between front door ADA access and the space required for barriers that do not have to degrade safety to ensure security. Risks to safety come in the form of reflections and refractions off of barriers and obstructions by barriers seriously impairing vision. Risks to security include barriers with significant cut-outs for vision, which are ineffective at protecting bus operators from attack by all but the smallest of passengers. Additional problems arise from cutting off air conditioning (AC) flow (measurements of non-AC buses, in service in Seattle, showed summertime temperatures as high as 130° F due to huge windows and solar loading), a serious hazard to operators, passengers, and others near the vehicles. Reach confinement and communications problems round out the design shortfalls in current options for barrier systems.

The public transportation industry needs to explore these issues and develop practical solutions for the increasing numbers of operators being assaulted while on duty.

The objectives of this research are to

- Explore the common bus models used in current fleets, challenges for retrofits of their security barriers, and needed design elements like HVAC, etc.
- Examine currently available barrier designs and their performance in terms of preventing assaults, vision impacts, etc.
- Explore best practices for upcoming bus models designed to accommodate driver security needs. This should include the designs used in Europe and elsewhere, where original equipment designs have long provided solutions to the range of problems seen in North America due to retrofitting challenges.
- Answer the remaining issues outlined in the Transit Advisory Committee for Safety report.
- Provide a prototype for demonstration at APTA conferences, if possible, through partnering with a manufacturer, agency, and/or other funding sources. Production of a prototype could also be a follow-on project in conjunction with TCRP Project G-17, which is examining the driver's workstation.

Project D-19 ***Detecting and Mitigating Low- Level DC Fault Currents in Transit Systems Phase II of TCRP Project D-17)***
Research Field: **Engineering of Fixed Facilities**
Allocation: **$250,000**
TCRP Staff: **Stephan Parker**

Low-level electrical fault currents are a phenomenon found in DC traction systems used in public transit systems worldwide. These low-level currents are typically caused by small and sporadic failures of insulation within the electrification system, which make them difficult to locate, measure, and control. The effects of these faults go unnoticed for long periods of time because of their slow and progressive nature; however, evidence shows that if these faults go undetected, they can cause extensive damage to infrastructure of transit systems and that of adjacent private/public utilities. The main concern of private/public utilities is the significant corrosion of subsurface utilities caused by the compounding effects of low-level faults. They may also create a safety hazard to transit patrons and the general public as contact with any metallic structures, such as fences, is potentially lethal because they become energized to dangerous voltages. Furthermore, smoke generated by burning cable insulation in tunnels and confined areas creates safety hazards for transit patrons.

Under TCRP Project D-17, a lab breadboard model was developed and testing was conducted at the Greater Cleveland Regional Transit Authority (GCRTA). This research showed positive results in detecting low-level faults in DC transit systems.

Moreover, work is needed to detect low-level fault conditions. To detect these conditions, it will be necessary to conduct extensive testing.

The objective of this research is to develop a prototype system that can detect low-level faults in electrified transit systems powered by third rails.

Project F-28 ***Practitioner's Guide to Bus Operator Workforce Management***
Research Field: **Human Resources**
Allocation: **$200,000**
TCRP Staff: **Dianne Schwager**

Every sustainable organization needs a well-trained, adequate, and stable workforce. Bus operators deliver transit services and are the customer point of contact, significantly affecting consumer satisfaction ratings for most transit agencies. In tight labor markets, bus operator attrition and shortages contribute to missed trips and cancelled service. Unreliable service can start a downward spiral in ridership and, in turn, the economic sustainability of a transit agency. For transit agencies with constrained budgets, the need to improve bus operator workforce management is a timely and relevant concern.

Recent research shows that there is significant attrition of new bus operators before they complete one year of service. Furthermore, it is generally acknowledged that accidents are more likely to occur with less experienced operators. Bus operator attrition represents a significant cost to a transit agency in terms of recruiting, selecting, training, and retaining, with additional impacts on customer service, morale, and safety.

Problems at transit agencies associated with bus operator management are compounded by the difficulties encountered by large, medium, and small transit agencies across the country in attracting new bus operators. The Community Transportation Association of America finds that the single most pressing issue facing their membership is driver recruitment and retention. While transit agencies are becoming increasingly sophisticated at preparing for absences (i.e., using predictive modeling software), vehicle operator shortages can cause significant disruption to a transit system and can damage customer relations.

The objective of this study is to present a single-source, evidenced-based, comprehensive guide to the multiple issues associated with bus operators from pre-employment through their first five years of employment.

Project J-11/Task 39 ***An Evaluation of Fare-Free Public Transportation***
Research Field: **Special Projects**
Allocation: **$100,000**
TCRP Staff: **Dianne Schwager**

Public transportation exists to provide affordable mobility to diverse service areas. In fulfilling this mission, transit providers are not able to recuperate operating costs through fare collection alone. Instead, because transit benefits non-riders and enhances community development, transit funding relies on a wide range of sources, often including a local tax. An increasing number of localities are advocating for fare-free transit as a way to further fulfill the ridership, equity, and sustainability goals of public transportation agencies.

In considering a transition to fare-free transit, agencies may consider several factors:

1. What the current fare-recovery ratio is and the costs of fare collection and enforcement in relation to actual fare revenues.
2. Where additional revenue would come from to replace fare collections.
3. Specific goals associated with going fare-free, and appropriate metrics to evaluate success.

In the United States, it is common for circulator and streetcar routes not to collect fares. Systems like the Tampa TECO Streetcar and UTA Utah Valley Express BRT that have gone fare free are seeing dramatic ridership increases.[1] Less common are larger fixed route systems such as the one in Breckenridge, CO and the circulator in Washington, D.C.'s which are entirely fare free. Both systems have seen ridership growth.

The objective of this research is to provide public transportation agencies a framework for evaluating a transition to fare-free transit service. Analysis should include

- An overview of current fare collection processes and a description of associated costs.
- Recommendations for measuring the costs and benefits of a transition to fare-free transit, including benefits related to increased ridership and reduced vehicle emissions and congestion.
- A listing of funding mechanisms that could be used to meet the costs of fare-free transit.
- An overview of notable fare-free transit systems/lines in the United States and the world, along with appropriate takeaways on program structures, implementation, and results.

[1] https://www.bizjournals.com/tampabay/news/2019/04/09/streetcar-ridership-triples-will-extend-service-to.html
https://www.sltrib.com/news/politics/2019/07/05/uta-ends-year-ridership/

Project J-11/Task 40 ***The Relationship of Public Transit to Urban Homelessness Epidemic***
Research Field: **Special Projects**
Allocation: **$100,000**
TCRP Staff: **Dianne Schwager**

Many cities are not prepared to provide adequate shelter and resources to people who are homeless. As a result, public transit systems have experienced influxes of people who are homeless on buses, trains, and at stations. Although it is not part of their direct operating purpose, transit agencies must be cognizant of their region's homeless population and be prepared to take actions that mitigate negative externalities to operations and public perception.

The homelessness trend is being driven by causes out of the control of public transit agencies, who have limited resources. Rising rents, growing job skill gaps, mental health issues, drug epidemics, and limited municipal services are all factors that affect the number of people who are homeless on city streets. It is important to document not only these trends, but also how public transit agency policies and their strategic plans on homelessness are evolving and how the general public is reacting.

This research should build off of *TCRP Synthesis 121: Transit Agency Practices in Interacting with People Who Are Homeless*, released in 2016. The report surveyed agencies on effective practices, approaches, and outcomes regarding interactions with people who are homeless.

The objective of this research is to detail the relationship between urban homelessness and transit agency operations. Analysis should focus on the following areas:

- A description of the current national state of urban homelessness, including trends affecting the number and geographical presence of people who are homeless
    - What factors and policies have led to the homelessness epidemic in various geographical areas?
    - How many people experiencing homelessness does transit carry?
- The effects of urban homelessness on public transit agency budgets and operations, safety, ridership, and customer opinions.
- A description of innovative strategies, trainings, partnerships, and outreach programs that public transit agencies have developed regarding people experiencing homelessness.
- The efficacy of these programs. This includes a discussion of metrics used to monitor results and return on investment, including recidivism rates.
- Updated recommendations and policies for transit agencies to adopt regarding homelessness
    - How transit agencies can assist civic partners in helping people out of homelessness.
    - Private sector initiatives used to combat homelessness.