

Transit Cooperative Research Program

TCRP

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November 7, 2012

TO: DISTRIBUTION

FROM: Christopher W. Jenks
Director, Cooperative Research Programs

SUBJECT: Project Panel Nominations for the FY 2013 Transit Cooperative Research Program
Immediate Action Requested

The purpose of this memorandum is to solicit nominations to serve on project oversight panels for FY 2013 Transit Cooperative Research Program (TCRP) research projects.

The TCRP is an applied research program that provides solutions to practical problems faced by transit operators. The primary participants in the TCRP are an independent governing board organized by the Transit Development Corporation and designated the TCRP Oversight and Project Selection (TOPS) Committee; the Transportation Research Board (TRB) as program manager and secretariat for the TOPS Committee; the American Public Transportation Association (APTA) as a vital link to the transit community; and the Federal Transit Administration (FTA) as program sponsor.

The TOPS Committee met on October 25, 2012, and approved new research projects for Fiscal Year 2013. Descriptions of the new research projects are attached. The purpose of this memorandum is to solicit your nominations for new project panels. We are asking you to nominate individuals with expertise directly relevant to the research proposed, and we would particularly welcome your help in identifying women and minority candidates. Your nominations would be appreciated as soon as possible, **but no later than January 18, 2013**, so that we may move the program forward in a timely manner. We will begin the panel formation process shortly thereafter. **Nominations received after January 18th will not be guaranteed full consideration in the panel formation process.**

To ensure proper consideration of your panel nominations, we need information on each nominee's affiliation, title, address, approximate age, and, most importantly, professional qualifications related to the particular project. Contacts to determine an individual's interest in serving will be made from this office after we have matched available expertise with that required by the nature of the project. A panel nomination form is attached for your use if a resume is not available. We also encourage submittals via e-mail, which can be sent to ablackwell@nas.edu.

The TCRP is sponsored by the Federal Transit Administration; research projects are selected by the Transit Development Corporation, and the Program is managed by the Transportation Research Board.

Panels for the new research projects are scheduled to meet during March/April 2013. Panel members are prohibited from submitting or participating in preparation of proposals on projects under their jurisdiction. They serve on the panels without compensation, but are reimbursed for travel and subsistence expenses. Travel insurance is provided at no cost to the members. In many cases, only two meetings are held in the life of a project, and these normally occur in Washington, D.C. The first meeting is to develop a project statement that is used to solicit proposals; the second meeting is to select a research organization from among those submitting proposals. Other meetings may be dictated by project circumstances; however, they are few and usually at least a year apart. Membership for each panel will number approximately eight. Panels operate under the guidance of a permanent chair, and there is liaison representation from the FTA, APTA, and TRB; the TCRP staff serves as the secretariat.

We are grateful for your ongoing support of the TCRP in providing nominees. Typically, nominees for panels in the Cooperative Research Programs outnumber the available positions by about four to one. As a result, we have been able to establish panels truly outstanding in their ability to play a fundamental role in the accomplishment of successful research.

Attachments: New FY 2013 Research Project Descriptions
TCRP Panel Nomination Form

DISTRIBUTION: Chair and Members, TCRP Oversight and Project Selection Committee; Executive Director, TDC; Associate Administrator for Budget and Policy, FTA; Associate Administrator for Research, Demonstration, and Innovation, FTA; Director, Office of Research Management, FTA; Liaison Representatives, FTA; APTA Committees; Directors, U.S. DOT University Transportation Centers; Chair and Members, AASHTO Standing Committee on Public Transportation; Board of Directors and State Delegates, Community Transportation Assoc. of America; Executive Secretary, Women's Transportation Seminar; Representatives, Historically Black Colleges; Executive Director, Conference of Minority Transportation Officials; Executive Director, National Transportation Consortium of Minority Colleges & Universities; Executive Director, National Association of Black Engineers; Executive Director, Society of Hispanic Professional Engineers; Executive Director, National Forum for Black Public Administrators; Executive Director, National Association of Minority Contractors; CEO and President, National Urban League; President, National Council of Negro Women; Chair and Members, TRB Executive Committee; Chair, TRB Group Councils and Sections; Chair, TRB Committees (Transit); TRB State Representatives; TRB University Representatives; TRB Transit Representatives; TRB Sustaining Associates; Chair, Subcommittee on NRC Oversight; TRB Staff (Selected)

**Transit Cooperative Research Program
Panel Nomination Form**

Use this form only when a resume is not submitted. The resume is preferred.

Nomination for TCRP Project Number: _____

NOMINEE: _____

First

Middle

Last

Employer: _____

Current Job Title: _____

Address: _____

Phone #: _____ Fax #: _____ Email: _____

Years at Current Position: _____ Years of Experience Relevant to this TCRP Project: _____

Education:

Name of Institution

Degree

Year

Professional Licenses: _____

Fields of Special Knowledge or Interest (e.g., operations, planning, vehicle engineering):

Comments: _____

TCRP Panel Nomination Form

Optional Information on Nominee

Please check one: Male Female Date of Birth: _____

Ethnicity (*please check one*):

_____ (A) American Indian or Alaskan Native; origin in any of the original peoples of North America.

_____ (B) Black; origin in any of the black racial groups.

_____ (H) Hispanic, Mexican, Puerto Rican, Central or South American, or other Spanish culture or origin, regardless of race.

_____ (P) Asian or Pacific Islander; origin in any of the original peoples of the Far East, Southeast Asia, or the Pacific Islands. Includes China, Japan, Korea, the Philippine Islands, Samoa, and the Indian subcontinent.

_____ (W) White; origin in any of the original peoples of Europe, North Africa, or the Middle East.

_____ (2) Two or more races (not Hispanic or Latino); all persons who identify with more than one of the above five races

Name of Nominator: _____

Address: _____

Please return to:

Christopher W. Jenks, Director
Cooperative Research Programs
Transportation Research Board
500 Fifth Street, NW
Washington, D.C. 20001
or
FAX 202/334-2006

**Transit Cooperative Research Program
Projects in the Fiscal Year 2013 Program**

**Transit Cooperative Research Program
Projects in the Fiscal Year 2013 Program**

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Summary of Approved Research Projects

■ Project A-40

Platform/Train Interface Standards, Accident Prevention Measures and Technologies Study

Research Field: Operations
Allocation: \$275,000
TCRP Staff: Dianne Schwager

Transit operators have experienced injuries and sometimes fatal accident scenarios at platforms. Fatalities usually are related with the “inter-car” gap. However, platform/train gap related incidents are much more common and frequently result in injury. The focus of this research is to look at existing research studies and available standards and technologies to prevent platform/train interface accidents or minimize their consequences.

There are number of existing measures including platform edge doors, platform/train-deployed gap fillers, warning announcements, warning signs, CCTV monitoring fitted on trains/platforms, convex mirrors, different methods of dispatch, and measures to reduce the platform edge gap. However, there are no studies that analyze the effectiveness of those measures (relative to the cost) and comprehensive strategies to retrofit platforms or build new platforms.

The objective of this research is to review existing standards, best practices, available technologies, and measures to prevent and minimize platform/train interface accidents.

This research will provide mass transit operators with a best practice manual to prevent platform/train interface accidents or minimize their consequence.

■ Project B-44

Impact of the Trend Toward Separate Statewide Medicaid Transportation Brokerages on Human Services Transportation Coordination

Research Field: Service Configuration
Allocation: \$300,000
TCRP Staff: Dianne Schwager

The Medicaid program is the federal government's largest provider of human services transportation (HST), spending between \$2 and \$3 billion annually on non-emergency medical transportation (NEMT). The successful coordination of federally funded human services transportation services is highly dependent upon the extent to which these resources coordinate with and complement other specialized transit and human service transportation options. Because the Medicaid program is administered by states, which are able to set their own rules and regulations within the Centers for Medicare and Medicaid Services (CMS) framework, coordination of NEMT with transit and other human services transportation is highly dependent on state Medicaid agencies' policies and priorities.

Over the past decade, many states have made significant progress coordinating NEMT with other federally-funded transportation services, most often by allowing local or regional organizations to broker NEMT trips along with numerous other trip types. This approach results in transportation resources and costs being shared across multiple programs and providers.

In recent years, numerous state Medicaid programs have separated their transportation services out of local or regionally coordinated systems in order to create a statewide brokerage for all NEMT trips. This is often justified in terms of cost savings, fraud deterrence, and/or administrative expedience.

Transportation coordination and mobility management professionals have lamented this trend saying that it leads to less coordination, more service duplication, loss of local revenue for transportation providers, and headaches for transportation disadvantaged populations who are suddenly required to book trips in varying ways through multiple systems depending on their type of trip. Transit agencies complain of “trip shedding” in which NEMT brokerages place Medicaid customers on costly Americans with Disabilities Act (ADA) complementary paratransit services while only paying the heavily subsidized individual fare.

Most research conducted on NEMT brokerages have focused on the narrow impacts on the specific Medicaid program and agency. Meanwhile, the broader fiscal, coordination, and customer service effects of statewide Medicaid NEMT brokerages have never been fully studied. As more states consider the statewide brokerage option in times of fiscal austerity, it is necessary to determine what the larger outcomes are for human services transportation, what motivates states to establish separate brokerages and what the actual costs and benefits are.

The objective of this research project is to answer several questions:

- What is the state of the NEMT program in each state? Which are operating with statewide brokerages and which allow local or regionally coordinated provision of service?
- In states that have begun operating statewide brokerages in the past few years:
 - What motivated the change?
 - What has been the fiscal impact on the state's NEMT program? Positive, negative, or neutral?
 - What have been the major impacts on state, regional, and local HST coordination efforts?
 - What have been customer experience impacts in terms of simplicity of getting ADA, HST, and NEMT rides?

- Are Medicaid brokers truly “shedding” paratransit-eligible Medicaid customers on ADA complementary paratransit? Are there examples of states or agencies which have negotiated agency rates for these trips as allowed by the ADA?

The research team will likely conduct a survey of the NEMT programs across the country, in order to determine trends and put programs into several to-be-defined structural categories. This survey should help determine which states have recently or will be soon switching to a statewide brokerage system. These states should then be targeted for in-depth case studies to determine the longitudinal impacts of statewide brokerages.

These case studies would examine the fiscal effects of the statewide brokerages to determine whether they are cost-saving, -neutral, or -negative, both in terms of costs within the Medicaid health care universe and in the overall provision of transportation. It would also look at the before and after of local, regional, and state HST coordination. Finally it would examine whether there are any customer-level impacts from statewide brokerages: whether they cause a change in individual cost of transportation, changes in health outcome, or changes in the ease with which they can get their NEMT and other transportation.

Medicaid NEMT presents both a serious challenge and opportunity for transit, paratransit and human services transportation providers wishing to coordinate more closely the various trips being provided in their service areas. The most successful examples of coordination cited typically involve ADA paratransit, NEMT, and other human services trips coordinated on a local or regional basis. Yet, a growing number of states are moving to statewide brokerages for NEMT because of the potential to save money per trip, or, at least, set a fixed price contract which can more easily be budgeted.

Florida, a state which has historically allowed significant amount of state and regional coordination between NEMT and other transportation programs, will soon be moving to a statewide NEMT brokerage. This presents an excellent opportunity to study, longitudinally, the full effects on transportation providers and the coordinated delivery systems of statewide NEMT brokerages.

The outcomes of this research will be vital in developing options on how best to negotiate relationships between state NEMT programs and the coordinated transportation infrastructure. It will also impact future collaboration efforts of the Federal Coordinating Council on Access and Mobility, which tries to lower federal barriers to coordination.

■ Project C-22

Bus Operator Workstation Evaluation and Design Guidelines

Research Field: Engineering of Vehicles and Equipment
Allocation: \$275,000
TCRP Staff: Dianne Schwager

It has been 15 years since the publication of *TCRP Report 25, Bus Operator Workstation Evaluation and Design Guidelines*, the best reference available for transit agencies seeking to evaluate and procure buses based on ergonomic considerations affecting musculoskeletal demands and human factors considerations. In those years, much progress has occurred across the range of design issues in operator workstations. By clarifying available options for improving operator health and safety and reducing liability, time loss and disability, the transit industry can be brought closer to industry ideals and limit drains on scarce resources. Information technologies have also gone through quantum leaps in capacity, presenting options that were not feasible when *TCRP Report 25* was completed. Agencies need assistance in evaluating the impact of improved and emerging technologies, specifying how they integrate into the operator's workstation, and understanding how they impact a wide range of measures for service quality.

In addition to the physical and control changes, bus design, production and procurement processes have changed since the 1990s. The roles of key players in these processes have adapted to changing operational demands, design tool innovations, and changing financial pressures on agencies and manufacturers. An update to *TCRP Report 25* will contribute to making these processes more efficient in time and resources and to improving the exchange of information between users (transit agencies and bus operators), designers (in research and manufacturing), and safety oversight (at the agency, state and national levels).

The objective of this research is to update *TCRP Report 25* by examining how the guidelines can best be used in the design and procurement process, and reassessing the driver workstation in the context of available technologies and workforce changes. Each major interface offers opportunities for improved outcomes. An analysis of how *TCRP Report 25* has contributed to the design and procurement process will be used to improve the content, layout, and dissemination of the final document. The workstation assessment and guidelines development will produce a user-friendly manual that allows agencies to address concerns in both the physical operating environment and the cognitive and perceptual environment.

Major physical areas include:

A) Seats

As seen in *TCRP Report 25*, current commonly used seats can impose more shock loading on the operator than if they rode on the floor. Emerging technologies can resolve this complex issue and result in significant savings for employers and great improvements in the health and welfare of transit operators.

B) Pedals

Twenty years ago, today's optical encoders and digitally controlled adjustments were not available options, but today they offer cost effective ergonomic improvements of great significance to the industry. Bringing the TCRP recommendations up to date would be of great value to the transit sector.

C) Steering

Hydraulic steering, which requires many thousands of foot/lb. of effort daily, is being replaced by electric systems that are more efficient and less injurious to operators. These new designs integrate with active accident avoidance in current production vehicles, providing safety improvements missed by the transit industry. In addition, these digitally based electronic technologies provide a flexible and reprogrammable foundation for cost-effective

retrofitting as rapid evolution provides invaluable improvements on timelines far shorter than the life of fleet vehicles.

D) Switchgear

The current location, design, and adjustability of necessary switchgear do not meet current ergonomic best practices. Recommended specifications and layouts would be of great value to the industry.

Major cognitive and perceptual areas include:

E) Communications

Digital radio signals allow a revolution in the quality of information available to operators, and that information makes inevitable huge leaps in the quality of service we provide to our passengers. What is rapidly evolving starts with the “digital dash,” replacing analog instruments of century-old design with flat screens. Basic vehicle parameters, such as speed or malfunctions, can easily be displayed, along with vastly improved presentation of route and schedule information, eliminating the cost and cumbersome functionality of paper documents. Radio functions can also be integrated, eliminating separate boxes of hardware which take up scarce space and block vision. These systems also open the door to bringing customer assistance information within the operator workstation. Finding addresses, assisting with intelligent transfers between different routes and different modes, along with a broad array of other leaps in customer service are typical in smart phones and the freely available data streams can be brought to the operator on a display that only functions with the coach at rest.

F) Vision/hazard detection

Current mirror systems perform poorly in many operational conditions and safety can be greatly improved by integrating cameras into the driver workstation. Non-visual sensors such as radar for accident avoidance are similarly becoming common in passenger cars. Transit is far behind consumer vehicles in putting these systems on the road and agencies need assistance in evaluating and implementing these modern tools for mitigating risk.

Proposed research may include the following areas.

Research Area 1: Defining the use of ergonomics standards in transit bus procurement

- A. How are design and procurement currently done?
 1. How are Report 25 and the APTA Standard Bus Procurement Guidelines used?
 2. What other standards are referred to?
 3. What are the strengths, weaknesses, opportunities, threats in the current model?

Method: Brief industry-wide survey

- B. What are the design, specifying, and testing roles of
 1. Manufacturers
 2. In-house design and refit
 3. Operators
 4. Maintainers
 5. Technical resources – UTCs and other organizations
- C. What are the costs and savings of the current approach to bus ergonomics?

Method (B and C): Survey with targeted interviews

- D. What changes are needed to the current guidelines and process? For example:
 1. New design characteristics
 2. New communication, maintenance, operating considerations

3. More complex input and decisions process (e.g., a bus ergonomics consortium, operator/designer partnerships)
4. The role of the MAP-21 federal testing facility

Method: Consultation and collaboration-- subject matter expert, industry focus groups and Delphi Method analysis

Research Area 2: Setting a New Standard for Bus Workstation Evaluation and Design

- A. What is the current state of the art in seat design?
- B. What is the best available steering system design?
- C. How should the throttle and brake pedals be designed?
- D. How should the remaining controls be designed and located?
- E. What mirror designs, camera systems, or sensor combinations offer the best safety and ease of use?
- F. What range of adjustability is needed to accommodate the distinctive population of transit operators?
- G. What digital information systems best assist the operator in performing their duties and improving service?
- H. What operating conditions might influence the above parameters – e.g., passenger interaction; geography, weather and other regional variables; passenger and accessibility needs?

Method: Each area of design will be evaluated with, at a minimum:

1. A literature review
2. Catalogue of available options
3. Operator survey
4. Job task analysis
5. Manufacturer outreach
6. Professional input (ergonomics, health, engineering)

Method: Model and test systems, including integrating into a complete workstation?

1. Create a CAD-based mockup including the best designs for each sub-system.
2. Create a prototype for closed-track testing designed to model real-world workloads and hazards.
3. Obtain feedback from operators, engineers and manufacturers on each system as well as the entire guidelines package.
4. Obtain feedback from mechanics on the practicality, durability, and maintenance considerations of the proposed guidelines in the demanding transit environment.

The heavy burdens of operator injury, disability and third-party liability in transit, along with the extensive technological and information resources available to address the issues, make this both an urgent and a feasible research topic. Ongoing research has examined the impact of human factors problems in transit and shown increased rates of musculoskeletal disorders in bus operators. Cab design also affects operational safety, communications, health and wellness, and service considerations.

The biggest barrier to implementation of evaluation and design guidelines has been the inability of typical transit agencies to analyze and engineer up-to-date and agency-specific solutions to the endemic problems. Most of the solutions anticipated are already in use in one form or another within transportation, so barriers to implementation should be reduced once the research and analysis have been provided. A second barrier is the lack of a consortium approach to design, procurement and production needs that can make it easier and less expensive for manufacturers to respond to these needs. This research project should model a planning and decision process that can endure past the production of the guidelines.

This project will also set the stage for future needed research in these potential areas:

1. What is the best collaboration or consortium design model?
2. How do these lessons apply to other aspects of transportation planning and design?
3. What are the benefits of collaboration in design and specification?
4. What are the evolving characteristics of the better bus?
5. What training is needed to develop the improved model of design and specification?
 - a. For agency employees
 - b. For manufacturing professionals
 - c. For other groups

■ Project D-17

Detecting and Mitigating Low-Level DC Fault Currents in Transit Systems Thus Eliminating Electrical Fires in Tunnels and Rights-of-Ways

Research Field: Engineering of Fixed Facilities
Allocation: \$250,000
TCRP Staff: Stephan Parker

Low-level electrical fault currents are a phenomena 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 apparent effects of these faults go unnoticed for long periods of time as a result of their slow and progressive nature; however, if these faults are left undetected, evidence exists to show extensive damage to infrastructure of transit systems and those of adjacent private/public utilities. The main concern to 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 to any metallic structure (such as fences) is potentially lethal because they become energized to dangerous voltages.

Currently, there are no technologies available to detect low-level faults and protect passengers, the public, and the infrastructure. In order to detect low-level fault conditions, it is necessary to conduct extensive testing, which is extremely costly and difficult to accomplish, particularly, in areas remote from traction power substations. With current operating budget restrictions in the industry, consideration of this type of testing is not feasible. Recently, a transit system suffered damage to its electrification system due to low level faults in the central core area. The failure resulted in damage worth over a million dollars and impacted rush hour revenue service at the time of occurrence. The failure further necessitated service reductions for several days in the central core transit system area while emergency repairs were performed. Similar problems have occurred at other transit agencies.

The objective of this research is to develop a prototype system which is capable of detecting low-level faults (i.e., current magnitude and location of fault) in electrified transit systems. Faults must include those originating from subsurface conductors as well as third rail and overhead contact systems.

The prototype should be developed such that it (a) can be further developed by the private sector as a modular device which is microprocessor based and (b) testing would not require the shutdown of an electrified system except for connection of the module.

The research may include the following tasks.

- Collect data, identify and organize low level fault current in transit systems.
- Analyze the causes of low level faults and why they are not detected by existing technology.
- Develop a prototype monitoring and control system for low level fault detection.
- Test the effectiveness of device under actual transit conditions at an existing heavy and light rail property.
- Provide the transit industry with a prototype design for further development into production units by the private sector.

Currently there are no methods or devices available in the transit industry which employs detection and protection features in transit electrified systems. There have been documented cases of damage to transit system infrastructure and exposure to lethal voltage levels to the public which must be addressed and controlled.

■ Project F-21

Tools and Strategies for Eliminating Assaults Against Transit Operators

Research Field: Human Resources
Allocation: \$300,000
TCRP Staff: Gwen Chisholm Smith

Assaults on transit operators are a significant concern in the industry. In addition to injuring workers, this violence in vehicles, at bus stops and on platforms increases fear and negative perception of transit in the minds of the public, passengers, as well as the workforce. Passengers will not feel or be safe if the transit operator and other employees are at risk. Assaults on operators contribute to worker absence, productivity shortfalls, and increased levels of stress for the victim and for co-workers. Violence among passengers can also endanger the public and transit personnel. Conflict between passengers and operators in the past may have been regarded as unrelated and random events; however, we now understand that there are systematic roots for many of these events; some of these were identified within the categories used in *TCRP Synthesis 93: Practices to Protect Bus Operators from Passenger Assault*.

TCRP Synthesis 93 drafted a framework for understanding transit industry current practices, policies, and tools for addressing this complex, multi-faceted problem. However, further research is required to better define the conditions related to assault, including contributing factors, behavioral and sociological factors, training requirements, community outreach, and policy enforcement practices. Industry practices and operating procedures related to mitigating and responding to operator assaults are not uniform. The skills and training required of operators, as well as policies and procedures set by the transit agency, can shape mitigation approaches, but the format, scale, and implementation of these measures vary greatly from agency to agency.

Further, analysis of potential contributing factors and other incident data is not consistent across the industry, and many incidents go unreported and hence unanalyzed. (For example, only 130 lost day incidents involving transit and intercity bus operators were recorded nationally by the Bureau of Labor Statistics in 2009, and 50 in 2010, but the recordable events log of a single urban agency included more than 600 lost time events among bus operators from 2002-2007 – 100 per year – with 73 in the first 9 months of 2009).

More critically, research is needed to develop and apply prevention measures widely, and provide guidance for the industry on how to effectively deter and mitigate violence on transit routes, particularly assaults on operators. Efforts must also address the treatment and rehabilitation of injured or traumatized workers. Respondents in the *Synthesis 93* process identified the following areas of research interest: barriers, behavioral assessments of passengers, self-defense tools, video content analysis, and collecting and using workplace violence data (*Synthesis 93*, p. 5). The reviewers also highlighted several related areas requiring additional investigation: road rage (as it applies to transit industry), cross-industry workplace violence trends, the operator's perspective, personal wellness and fatigue, new fare-free or alternative fare payment interfaces, and bus design/procurement implications.

There is an urgent need for a consolidated, programmatic approach to the problem of assault in the transit workplace, one that provides tools for assessment, guidance on planning, executing and evaluating workplace violence intervention programs, and background information and support for organizations attempting to make the workplace safer for employees and the riding public. According to *Synthesis 93*: “States are required to establish workplace violence prevention standards at least as effective as Occupational Safety and Health Administration standards” (p. 61); however, there are in fact no OSHA violence prevention standards for private industry. The Amalgamated Transit Union identified 56 state assault regulations and bills as of 2010 to punish perpetrators. Although New York State has a public-sector violence prevention program standard covering transit employers and Washington State extends its workplace accident prevention requirements to violence in the workplace, in

most states there is no requirement and no clear guidance for transit agencies on what is effective. Many agencies have written policies, but they vary widely in content and scope, some focusing on employee-on-employee conflict, some addressing assault as a customer relations issue, others using sophisticated data analyses. But many simply use ad hoc responses to an increasingly pressing problem. By establishing practice-based guidance, the proposed project will be of value to transit management, personnel, industry stakeholders, and communities.

The objectives of this research would be to:

1. Review and catalog research and business literature on driver assaults and mitigations that are similar to the public transit environment, such as, but not limited to, taxi and over the road bus operations.
2. Assess practical approaches to deter and mitigate transit operator assaults, with review by subject matter experts including transit management, unions, line managers and operators, with outreach to public health professionals and academics active in the area of workplace violence prevention, and community members where indicated or appropriate.
3. Develop a compendium of best practices for guidance to the industry forming the basis for an effective assault prevention toolbox.
4. Design and disseminate a practical programmatic toolbox for agencies to evaluate their needs, plan a tailored program, execute needed activities and assess the program impact.

The research will potentially address these research questions in two overlapping phases:

Phase 1: Extending, amplifying and confirming the findings of *TCRP Synthesis 93*

1. What can be learned about the real-time impact of violence in transit, including health, safety and retention of operators, effects on operations and maintenance and costs, and recruitment of passengers and of employees? A survey and targeted interviews of transit agencies will be carried out to better characterize the impact, including quantitative data from occupational health and workers' compensation sources, human resources records of recruitment and training, and operations and maintenance budgets.
2. What approaches to workplace assault have been shown to be effective in the transit industry? Based on the case models described in *Synthesis 93*, integrating published research findings and aided by data collected from transit agencies and other groups, the approaches described in *Synthesis 93* and elsewhere will be analyzed for their overall effectiveness and for how they suit specific circumstances (e.g., agency size and mode, types and prevalence of assaults, use of technology, types of policing/security, community involvement or needs).
3. What are the components of a model assault prevention program? The research will produce a manual consisting of information, a program outline, templates and support materials. It will allow adaptation for characteristics such as agency size, geographical location, modes of service, severity of current problems, and budget. The draft manual will be derived from the findings of *Synthesis 93*, steps 1 and 2 of this new research, examples of existing programs in transit agencies, programs developed for other similar industries such as taxi driving, approaches tested in workplaces that have taken strides in responding to violence at work such as public services and health care, programs mandated by state or local legislative initiatives such as the New York State Public Employee Workplace Violence Prevention regulations, and the recommendations of violence prevention researchers at the National Institute for Occupational Safety and Health.

4. How can agencies, unions and other transit groups assess their needs, make data-based decisions, and evaluate program impact? Using models of program planning and evaluation, the industrial hygiene hierarchy of controls, cost and benefit analysis, and training and communications, the research will provide tools for data-driven decision making. The manual will provide templates for assessing patterns of assaults, program impact, costs, and return on investment.

Phase 2: Evaluating the impact of current and best practices

1. What is the value of effective intervention and prevention in protecting the workforce, improving service, and enhancing public support of transit? This area of research will require time and support during and following the initial phase, to track and measure the dissemination, and effects of the best practices. As Phase 1 is followed out and after the model program is developed, agencies using the tool kit will be asked to provide quantitative and qualitative baseline and follow-up data which will be analyzed to assess effectiveness and to identify innovative practices for addressing workplace assault. This phase may extend to assess the impact of legislative and community initiatives on assault.
2. What collaborations can be built to enhance violence prevention efforts? The project will make particular use of transit employee knowledge and experience, including properties of all sizes and locations, all levels and sectors of management and supervision, transit union representatives, police and security personnel, and front-line operators. How the public contributes to and helps prevent violence in the transit system will be explored as well as the public response to agency actions and programs. Input will also be invited from manufacturers of buses, barriers, cameras, and other equipment, and a feedback or communication system between the agencies, project researchers and manufacturers will be established.

As identified in *Synthesis 93* and in ongoing efforts within the transit industry, the problem of assaults on transit operators demands an immediate, cross-cutting response, which would be made more practical for many agencies by the final products of this project. The increasing incidence of assault, combined with the negative effects currently being felt first-hand by transit agency personnel, patrons, and other stakeholders, demonstrate a need for the industry to work collaboratively and swiftly on developing and implementing a model approach. The payoff potential of such a standardized approach being adopted, evaluated, and continually improved at each respective transit system is significant. This approach could avoid significant trauma and even loss of life for transit workers; reduce vehicles damage and costs; and potentially reduce insurance, litigation, and liability costs. Crucially for the public transit industry, a safer work environment will enhance the perception of passenger safety within any transit system, increasing needed public use and support.

■ Project F-22

Identifying Best Practices and Sharing Resources for Transit Technical Training

Research Field: Human Resources
Allocation: \$300,000
TCRP Staff: Gwen Chisholm Smith

The highly competitive airline, automotive and trucking industries all have a vested interest in ensuring that technicians are properly trained. Airlines demand a highly skilled workforce because of the obvious safety implications. Automotive and trucking organizations are dedicated to improving technician skills because vehicles that break down in service due to faulty workmanship produce significant business consequences. Although transit strives to achieve customer satisfaction through reliable and on-time service, it invests less in training than any other industry. Recent survey results show transit training investment of between 0.66 and 0.88 percent of payroll. Moreover, the current economic climate has forced many larger transit agencies to cut their training departments, while an alarmingly high number of small and even medium-size agencies lack training altogether. The shortage of training comes at a time when the technical complexity of transit vehicles is at its greatest and progressively getting more complicated each year. Sophisticated equipment such as automatic vehicle location (AVL) systems, clean propulsion systems and onboard camera systems will do little to improve customer satisfaction, the environment and security if technicians lack the necessary skills to keep these complex technologies operational.

Although it would be difficult for transit to match training investments being made by the private sector to prepare their workforce, it can maximize the benefits of its existing capacity by sharing; something private transportation modes cannot do because of competitive pressures. In transit, those with the forethought and resources to develop comprehensive and effective training programs are essentially free to extend these resources to their peers.

The need to take action and extend training to those who need it through sharing cannot be overstated. Transit faces historic technical workforce challenges arising from several causes:

- The loss of skilled “baby boomer” technical workers now retiring in large numbers;
- Increased demand for technical workers in other trades as more young people attend college and less emphasis is placed on those who engage in manual labor;
- The ability of the private sector to offer training and higher wages diminishes transit’s ability to attract this limited pool of workers;
- The increased maintenance requirements of an aging capital stock with a growing shortfall of state of good repair, currently estimated at \$78 billion industry-wide;
- A rapidly changing cycle of technology where new and increasingly complex equipment is introduced at an alarming pace; and
- Rapidly increasing ridership – up 38 percent from 1995 to 2008, with projections for continuing increases in the future.

The ability to address these challenges has been limited by a strong focus placed on physical capital and unusually low levels of attention paid to building and sustaining human capital. Transit, however, is fortunate to have several highly dedicated agencies with effective bus and rail training programs that others can benefit from at little or no cost. An effort is needed, however, to facilitate the sharing process. The alternative is to have each agency develop its own training program at great expense, something the industry simply cannot afford during these harsh economic times. Unfortunately, the burden is greatest on smaller agencies responsible for repairing the same level of advanced technology equipment found at larger agencies but with little or no training resources.

The objectives of this research would be to identify technical training techniques and resources that already exist, determine how effective they are, catalog resources according to content and usefulness, and determine procedures for disseminating the training resources to the transit community at large. The product of this research will be:

- A set of best practices in technical training consisting of a report that identifies:
 - Proven approaches to developing an overall training program based on compliance to national training standards, curriculum development and courseware;
 - Proven training delivery techniques that combine classroom instruction with hands-on exercises to engage students and appeal to young learners; and
 - Innovative training methods currently that involve distance learning (instructor-led real-time e-learning).
- A catalog of sharable bus and rail training resources organized by:
 - Mode (i.e., bus and rail with subcategories for engines, brakes, etc.);
 - Source and contact information (transit agency, vendor, third party, etc.);
 - Training material (curriculum outline, instructor guide, student handout, etc.);
 - Media type (hardcopy, CD, DVD, PowerPoint, etc.); and
 - Determination as to whether the materials have been validated to available National Training Standards.
- A proposal to disseminate the sharable catalog of bus and rail training resources with others within transit with consideration given to:
 - Legal issues;
 - Use of basic methods for obtaining materials such as contacting the source directly for distribution; and
 - Use of web technologies to disseminate collection of materials and engage transit training professionals and other stakeholders in interactive online sharing and dialog to improve technical training.

The research would potentially include the following tasks.

1. Perform a literature search and review best practices of technical training programs at U.S. and international public transportation agencies and related benchmark industries. This research would identify different technical training models and assess their effectiveness in addressing the specific learning needs of maintenance technicians. In addition to transit, this research would gather information from other organizations with effective technical training programs such as those

developed by automobile manufacturers and their dealer network; truck fleets - both private (e.g., UPS and FedEx) and public municipal truck fleets; and technician training programs developed by the airline industry. The literature search will focus on those materials where training is tailored to the specific needs and learning tendencies of technical workers with an emphasis on learning techniques that engage students in interactive exercises such as computer-based and hands-on training. The search will also identify training materials outside of those identified in # 2 below that could be purchased or shared freely with transit. Experiences related to e-learning will also be explored where students housed at various workshops can be provided with training from a single remote location. Adoption of this new approach to learning can greatly benefit transit agencies, especially the small to medium-sized organizations that currently lack the capacity for technical training.

2. Conduct detailed surveys of current technical training programs existing at public transportation to achieve three key objectives: (1) identify training programs where outcomes in terms of enhancing technical skills and knowledge have been proven and quantified, (2) identify training courseware and other resources available from public transit agencies and private vendors that could be shared with other agencies nationally, and (3) identify non-traditional approaches to training such as e-learning where results have been quantified.
3. Based on the survey results, develop a best practices report on training approaches, methods and techniques that agencies could use to guide and enhance their existing programs.
4. Develop a training resource cataloging mechanism for organizing training materials identified through the literature search and survey and populate it with a listing of training resources identified through this research. The catalog would include a description of each training resource, applicable costs, and contact information for obtaining the materials. It would include only those training materials proven to be effective.
5. Investigate and pilot a Web-based mechanism whereby training resources identified above could be disseminated and updated electronically.

Customer satisfaction, safety and the state of good repair of the nation's public transit system depends on a well-trained workforce. Given the talent loss of experienced transit technicians due to retirement, the need to keep abreast with more complex technologies, and the current economic environment, it is imperative that transit expand its training capacity in the most cost-effective manner possible. Failure to do so not only expands the opportunity for human error and accidents, but jeopardizes an agency's ability to sustain and improve customer satisfaction. The ability to keep transit vehicles operating reliably and safely falls squarely on the shoulders of the transit technicians, who unfortunately are too often not seen as an integral partner in the process of improving the transit experience. Adoption of a cost-effective approach to disseminate best training practices along with training resources and materials can greatly benefit transit agencies, especially small to medium-sized organizations that currently lack the capacity for technical training.

One major change occurring in the transit industry involves a transition between two different generations of workers within the same craft. Older workers came aboard when technology was basic and where an informal process of skills training was sufficient. In contrast, younger workers coming into the crafts today are generally more comfortable with adapting to new technology and tend to be more visual with better motor coordination, having grown up in environments where computer-based education and social activities have been the norm. Using traditional training techniques where instructors lecture and students listen is not an effective learning solution for today's generation of workers. The research provided here will introduce instructors to training methods better suited to younger workers, the type of worker currently replacing retiring baby boomers and

those actively being sought by other transportation industries. Methods that fail to engage these students to learn will likely result in them seeking skills training offered by other, more progressive organizations outside public transit.