Problem Statements Submitted for Consideration by the TCRP Oversight and Project Selection Committee

September 2007
The Transit Cooperative Research Program (TCRP) is seeking comments on research problem statements that will be considered for funding by the TCRP governing board at their October 25-26 meeting. Comments should be provided to tcrp@nas.edu by October 17th. Please reference the appropriate problem statement number located on the upper left corner of each (#1 through #41).
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<thead>
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<th>Research Field A – Operations</th>
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<tbody>
<tr>
<td>1. A Safety Policies Guidebook for Non-Urbanized Public Bus Transportation Systems</td>
<td>$250,000</td>
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<td>2. The Interface of Smart Cards and Transit Benefits</td>
<td>$300,000</td>
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<td>3. Guidelines for Queue Jumper Transit Lanes on Congested Arterials</td>
<td>$230,000</td>
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<td>4. Emergency Preparedness and Recovery Outreach and Communications to Vulnerable Populations</td>
<td>$350,000</td>
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<td>5. Quiet Cars: Threats to Safe Travel for Blind Pedestrians</td>
<td>$750,000</td>
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<td>6. Public Transportation Response Plan for a Pandemic</td>
<td>$600,000</td>
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<td>7. Bus Turnouts—Benefit or Curse</td>
<td>$300,000</td>
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<td>8. Operation of Street-Running Light Rail Transit at Higher Speeds, Phase II</td>
<td>$295,000</td>
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<td>11. Improving Transit Integration in Urban Area with Multiple Transit Providers</td>
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<tr>
<td>12. Measuring and Understanding the Use of Fixed Route Services by Riders with Disabilities</td>
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<td>13. The Role of Passenger Amenities and Traveler Information in Building Ridership</td>
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<td>14. Best Practices in Working with Retail Outlets for the Sale of Transit Fare Media</td>
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<td>15. Evaluation of the Decentralized Control Strategy (“Zoning”) for Paratransit Services</td>
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<td>18. Assessing the Return on Investment for CCTV Security Systems</td>
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<td>19. A Handbook for Lighting in Transit and Pedestrian Environments</td>
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<tr>
<td>20. Shared Use of Road Space by Buses and Bikes</td>
<td>$300,000</td>
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<td>21. Guidelines for Development of Performance Based, Transit Track Safety Criteria</td>
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<td>22. Crash Walls Versus Guard Rails in Urban Transit Projects</td>
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<td>23. Optimizing the Check Gauge of Restraining Guard Rail</td>
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<td>24. Guidelines and Guidebook for Stray Current Control and Monitoring in Transit Systems</td>
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<td>$300,000</td>
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<td>28. Lack of Substantive Outreach to Minorities for Executive Searches in Public Transit</td>
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<td>29. Recruitment, Performance and Retention of Quality Paratransit Managers—Skills, Qualifications, Needs, and Future Prospects</td>
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<th>Research Field G-Administration</th>
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<td>$300,000</td>
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<tr>
<td>Project Number</td>
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I. PROBLEM TITLE

II. RESEARCH PROBLEM STATEMENT
Written polices are an essential component of management for public bus transportation systems. Documented guidance for employees and supervisory personnel provide ways to increase efficiencies and avoid hazards creating potential loss and its associated liability and costs. They also reinforce the importance of following rules, and tell employees what treatment to expect, and what is expected of them. This can help build employee loyalty and support for the system's programs, and improve personnel effectiveness in such areas as safety.

These views are commonly accepted within system management in the bus transit industry. But the translation of this perception into documentation among rural and non-urbanized public providers is limited. The reasons for this include time and staff constraints; a lack of knowledge about pertinent subject areas, or where to access relevant information; and a reliance on verbal communication within an organization. There is also little evidence that the transit community has available resources which address this need, beyond materials which provide a conceptual framework for policy development rather than adaptable models or templates for this purpose.

The problem this creates is that no matter how well intentioned a system manager may be, without written guidelines operational procedures become inherently inconsistent, inefficient and unsafe. An organization is compelled to rely on its collective and often uncertain memory for direction if management should fail to prepare documented standards. This makes the need for coordinated system policy development, which provides both a rationale and procedures for each primary safety function within an organization, an essential requirement for public bus transportation.

III. OBJECTIVE
The purpose of this project is to make available to small and non-urbanized bus transit systems, providing demand-response (para-transit), non-fixed or deviated route service, a guidebook of policy templates that provide examples of a design and content which can be used in preparing a policy rationale and its accompanying procedures. The policies will be categorized by functional task, and related to industry loss data results. A computer based format will allow for the adaptation of the product to specific local transit conditions. The model documents will cover topics including mission statements; pertinent statutory regulations; vehicle operations and maintenance; bus operator behavior and monitoring; accident and incident procedures; and customer relations.

IV. RESEARCH PROPOSED
The purpose of this research is to address policy deficiencies within public transit by meeting this primary organizational need through a product development process that results in a guidebook which promotes organizational management and is adaptable to local industry conditions, and applicable to the knowledge and skill levels of non-urbanized
transit systems. To achieve these objectives this project will be conducted through the following steps:

β Conduct a review of pertinent documentation and resources to identify available or adaptive materials and/or methodologies.

β Identify and invite bus transit professionals to participate in this project. They will represent a geographically diverse and representative sample.

β Design, field, and evaluate a survey instrument for transit systems that captures representative opinion on format, substance and application of a policies guidebook.

β Apply the above results to the creation of an end-product that will discuss the policy process; provide templates of policy rationales, procedures, and best industry practices; and methods to communicate and evaluate policy efficacy.

β Develop a product dissemination mechanism that can include a hard-copy document, and/or computer based software to adapt the materials.

β Prepare a written report discussing and evaluating the project methodology and its results.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

<table>
<thead>
<tr>
<th>Phase I: Project Design</th>
<th>1 month</th>
<th>$ 10,000</th>
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<tr>
<td>β Resource identification/review.</td>
<td>1 month</td>
<td>15,000</td>
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<td>β Expert panel convened.</td>
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<th>Phase II: Project Development</th>
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<td>β Design, field, evaluate survey instrument.</td>
<td>4 months</td>
<td>20,000</td>
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<td>β Preparation of policy handbook.</td>
<td>6 months</td>
<td>80,000</td>
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<td>β Development of product dissemination mechanism.</td>
<td>2 months</td>
<td>10,000</td>
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<th>Phase III: Project Completion</th>
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<td>β Final draft report/revisions.</td>
<td>4 months</td>
<td>30,000</td>
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| Total Time and Cost              | 16 months | $165,000 |

VI. URGENCY AND PAYOFF POTENTIAL

This project constitutes a practical solution for a readily identifiable public transit requirement that has long been neglected, but which can provide significant organizational guidance for improvements in safety management, increased system efficiencies, and reduction of loss. The quantifiable payoff is unlimited, and can range from targeted savings through the application of particular policy formats, to the protection of total system assets by adopting and applying a comprehensive and integrated range of policies. Immediate project benefits include:

β A guidebook of pertinent policies for public bus transportation.

β A computer based format that provides adaptable policy templates.

β A format for improved uniformity and standardization of transit industry practices.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP STRATEGIC PRIORITIES
This project meets FTA strategic goals for (2) improving capital and operating efficiencies; and (3) improving safety, security and emergency preparedness. It also addresses TCRP strategic priorities to (III) continuously improve public transportation; and (V) revitalize transit organizations.

The proposed project brings informed knowledge and practical solutions to meet a constant and expanding transit management need in all areas and tasks of an organization. Written policies professionalize the operations of a transit provider. They establish standards of performance for evaluating management effectiveness. The actual results of guidelines can be compared with the policy to determine how well the members of the organization are meeting system objectives and needs. Well written and properly administered policies additionally minimize mistakes and reduce loss by integrating and synchronizing related functions into a systematic process. Consistent policies result in more rapid and consistent decision making, especially for recurring problems; and they offer managers and supervisors a firm basis on which to conduct informed and reasonable problem resolution. This approach applies to system safety, operations, and promoting and revitalizing public transit programs.

VIII. RELATED RESEARCH
The Michigan Transit Pool is a multi-million dollar risk retention program that has for 20 years insured the majority of public bus transit systems in Michigan. It has used its extensive and accumulated knowledge of public transit to prepare for its members targeted manuals, handbooks and policies on most transit operational and administrative functions in order to improve safety and efficiencies within these systems. It will additionally bring to this project two specialized resources which will improve and focus its end product. The first is a unique 20 year data set of loss claims information from Michigan transit sources that clearly identify pertinent risk exposures for public transit that should be addressed in system policies. The second resource is field audit results of public transit systems accumulated over many years that will further help to identify where policy development is needed.

IX. PERSON(S) DEVELOPING THE PROBLEM
Gordon L. Szlachetka, Ph.D.
Risk Management Consultant
Michigan Transit Pool
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Williamston, MI 48895
517-655-2408

Robert J. Niemi, Executive Director
Michigan Transit Pool
1702 Gray Street
Marquette, MI 49855
906-226-6208

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT
Problem statement was developed by the Risk Management Committee of the Michigan Transit Pool, under the direction of its Executive Committee, the MTP governing board.

XI. DATE AND SUBMITTED BY
Submitted on: March 2, 2007
I. PROBLEM TITLE
   The Interface of Smart Cards and Transit Benefits

II. RESEARCH PROBLEM STATEMENT

   Smart card systems and transit benefit programs are perhaps the most important fare-related innovations of the past ten years. To date, however, there has been relatively little integration of these two innovations. Transit benefits are most often provided using the physical distribution of transit passes or vouchers. To a much smaller extent, debit card systems are emerging as a way to provide transit benefits. To an even smaller extent, “direct transmission” programs are being used through which funds and data are provided directly from an employer (or benefits administrator) to the smart card system. Each of these approaches has appeal to certain segments of the diverse employer market, with segments including but not limited to government vs. private sector, small vs. large employers, white color vs. industrial businesses, internet-friendly businesses (and employees) vs. non-internet businesses (and employees).

   Some smart card systems began development before transit benefits became as prominent as they now are. Use of transit benefits will surely increase rapidly in the very near term. At least one smart card systems that is now being introduced was designed without a focus on the interface between employers and the smart card system, i.e., its framework was almost exclusively designed with regard to the interface between the individual rider and the smart card system. In effect, the employer, as a broker or source of a bulk orders for the smart card system, didn’t receive the attention that it might have. Another prominent transit agency developed its smart card and transit benefit programs in tandem and has had notable success. Essentially, there is a need to design smart card systems for both individual riders and employers, and recognizing that the latter has very diverse characteristics.

   This research would review available information, conduct interviews and generally make the case for integrating smart cards and transit benefit programs, with a goal of maximizing the use and efficiency of both programs.

III. OBJECTIVE

   The goal of the work will be to provide guidance to transit systems developing or considering the development of smart cards regarding the features and procedures that the smart card system should include in order to maximize the likelihood that there will be a successful integration of the smart card system with the provision of transit benefits. In so doing, the smart card system will maximize the efficiency of fare collection and also allow the full impact of transit benefits to be achieved.

IV. RESEARCH PROPOSED

   The research would include a literature review, interviews with leading transit benefit programs and services, interviews with management of transit agencies developing or planning development of smart card systems, profiles of the leading transit benefits and smart card programs, and development of appropriate recommendations.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

   Recommended Funding: $300,000 maximum.
   Research Period: 18 months.

VI. URGENCY AND PAYOFF POTENTIAL
Smart card systems are among the most expensive innovations a transit agency can implement. Transit benefit programs have very significant payoff in building transit ridership by delivering effective fare reductions of 40% or more, with revenue rising in tandem and at no cost to the transit agency. This research would be extremely timely, perhaps urgent given the rapid developments in the transit benefits and smart card fields. One concern, for example, is that the emerging transit debit card programs are, compared with the “direct transmission” approach, relatively incompatible with smart card programs because of the bank fees that the intermediary step involves.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP STRATEGIC PRIORITIES

This project clearly relates to the FTA current year Strategic Goal of Increasing Ridership, especially regarding the need to explore and evaluate the cost-effectiveness of different ways to increase ridership. It also serves the TCRP Strategic Priorities of Placing the Customer First, Enabling Transit to Operate in a Technologically Advanced Society, Continuously Improving Public Transportation, and Revitalizing Transit Organizations. As a key reason for developing a smart card program is the complexity of fares and transfers when different operators provide service, this project also serves the TCRP Priority of Flourishing in a Multi-Modal Environment.

VIII. RELATED RESEARCH

TCRP has performed research on both smart cards and transit benefits. This particular topic, however, has not received attention commensurate with its importance.

IX. PERSON(S) DEVELOPING THE PROBLEM

Richard L. Oram, President, Commuter Check Services Corp., 401 S. Van Brunt St., Englewood, NJ 07631; 201-833-9700; fax 201-833-8704; roram@commutercheck.com.

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Above draft written by Richard Oram.

XI. DATE AND SUBMITTED BY

6/15/05 by Karla Karash on behalf of the Public Transportation Marketing and Fare Policy Committee.
I. Problem Title:

Guidelines for Queue Jumper Transit Lanes on Congested Arterials

II. Research Problem Statement:

For decision makers exploring the merits of Bus Rapid Transit (BRT) and transit signal priority (TSP), comprehensive guidance can be useful to simplify the feasibility analyses, design, construction, and benefit/cost analyses of queue jumper lanes. Lacking such guidance, many BRT proposals in corridor studies throughout the United States assume virtually exclusive running ways, rarely considering mixed-flow options that may be more practical in constrained urbanized environments. Given the limited application and consideration of queue jumper lanes to date, the opportunity arises to develop a guide for planning and developing new facilities in combination with a synthesis of current applications. As with any multimodal travel improvement, sensitivity to travel demand for other traffic, emergency vehicles and pedestrians must be taken into account when designing queue jumpers. Sensitivity to context and right-of-way impacts must also be considered when making design decisions.

III. Objective

This research will lead to comprehensive strategies for stakeholders to (1) identify candidate arterial corridors and intersections for queue jumper lanes, (2) design such facilities with sensitivity to safety and multimodal efficiency, and (3) recognize the benefits, costs, and lessons learned from facilities currently in operation. This research effort is expected to expand the body of knowledge and level of awareness in the transit industry of potential benefits to be achieved from this focused application of intelligent transportation technologies. The intended results are visible and measurable enhancements of bus transit operations and productivity along congested arterial corridors. Secondary effects from travel time benefits may include an increase in bus transit ridership and a desirable mode shift in a corridor from single-occupant vehicle travel.

IV. Research Proposed

The study will coalesce and review existing research on intersection design, bus stop location, vehicle detection, signal phasing, signage, and BRT operations as they relate specifically to queue jumper lanes. Supplementing this data will be an assessment of existing and planned queue jumper transit facilities to identify decision making processes, design issues, related technology and policy applications, costs, benefits, and lessons learned.

V. Estimate of the Problem Funding and Research Period

The project funding estimate is $230,000. The estimated completion time for the study is 28 months (January 2, 2008 to April 30, 2010).

VI. Urgency and Payoff Potential

Data derived from queue jumper research may help expand the range of investment options considered within a congested travel corridor. Queue jumper planning may result in methodical corridor transit improvements that minimize right-of-way takings.

Queue-jumping capabilities may improve the productivity (e.g., peak-period passenger volumes, average speed, total travel time, on-time performance) of bus transit routes in congested corridors. Improved service reliability
and travel time benefits may contribute to increased transit utilization and reductions in air pollutant emissions, particularly carbon monoxide or fine particulate matter concentrations at hot-spot intersections.

Rising costs for conventional bus transit fuels make the examination of cost-effective improvements that reduce dependency on such fuels imperative.

VII. Relationship to FTA Strategic Goals and Policy Initiatives and TCRP Strategic Priorities

FTA Strategic Goals:
- Increasing Ridership
- Improving Capital and Operating Efficiencies
- Protecting the Environment and Promoting Energy Independence

Queue jumper research can assess the effect of improved operating efficiencies on mode choice and transit ridership, and the effect of improved capital efficiencies on travel congestion in a corridor or at an intersection. Gains in efficiency can translate into advances in environmental protection and reduced fossil fuel consumption.

TCRP Strategic Priorities:
- Place the Transit Customer First
- Enable Transit to Operate in a Technologically Advanced Society
- Continuously Improve Public Transportation
- Flourish in the Multimodal Environment
- Revitalize Transit Organizations

Queue jumper research acknowledges the internal and external values inherent in prioritizing the needs and interests of shared motorized-vehicle travelers ahead of those for single-occupant motorized-vehicle travelers. Queue jumper research allows for an assessment of impacts to total person-delay, instead of vehicle delay. The study of intelligent transportation systems technology and market positioning for the transit traveler in a multimodal context fits well within the new research paradigm for mobility management. The identification of best practices and lessons learned from implementation can enhance the organizational and technical capacities of transit systems in various urbanized areas.

VIII. Related Research


IX. Persons Developing the Problem

Derek R. Scott, Transportation Planning Consultant
URS Corporation
400 Northpark Town Center
1000 Abernathy Road, NE, Suite 900
Atlanta, GA 30328
Phone: (678) 808-8832
Fax: (678) 808-8400
E-Mail: derek_scott@urscorp.com

X. Process Used to Develop the Problem Statement

Derek R. Scott is the person responsible for the preparation of the problem statement.

XI. Date and Submitted by:

June 15, 2007

Submitted by:
Derek R. Scott, Transportation Planning Consultant
URS Corporation
400 Northpark Town Center
1000 Abernathy Road, NE, Suite 900
Atlanta, GA 30328
Phone: (678) 808-8832
Fax: (678) 808-8400
E-Mail: derek_scott@urscorp.com
Problem Statement:
The natural disasters encountered by the coastal states in 2005 increased national awareness of the role that public transportation has in planning, response, and recovery with regard to weather-related threats. State departments of transportation and their public transportation divisions were required to communicate and coordinate with local, state, and federal agencies with which they may have had little or no prior exposure. Emergency operation practices for natural disasters, such as hurricanes, flooding, tornadoes, and blizzards vary from state to state. In addition to varying on a state level, there may also be institutional differences in how operations and communications are handled among the highway divisions compared to public transportation and rail divisions.

Two separate reviews of how transit agencies prepare for emergencies with a focus on vulnerable populations (i.e. transit-dependent, disabled, poor, low English proficiency, racial and ethnic minorities, etc.) were conducted by the Federal Transit Administration’s Office of Civil Rights and the Conference on Minority Transportation Officials respectively. FTA’s 12-month review culminated in the May 1st release of Transportation Equity in Emergencies: A Review of the Practices of State Departments of Transportation, Metropolitan Planning Organizations, and Transit Agencies in 20 Metropolitan Areas. COMTO’s expedited 2-month review –completed with a white paper entitled Emergency Preparedness and Response for Vulnerable Populations-- will be the focal point of a June 25, 2007 discussion during its 2007 National Meeting & Training Conference. Both reports summarized existing preparedness and recovery policies and processes regarding vulnerable populations.

What is abundantly clear in both reviews is that vulnerable populations - residents who have no other means of transportation when an evacuation is called for - must rely on public assistance. With no discernable means of communications to this specific population, there is a gap of awareness regarding the role of public transit agencies versus the public emergency response operations and the impact on the communities they serve. This gap was appallingly evident during the evacuation of New Orleans residents during Hurricane Katrina. It was evident in the 12-month review conducted by the FTA as well as in the truncated two-month review conducted by COMTO, and it is apparent that this gap still has not been substantially addressed.

Objective:
The goal of this research is to identify and disseminate best internal and external planning, response, and recovery policies and practices pertaining to weather-related emergencies with an emphasis on specific outreach to vulnerable populations.

Proposed Research:
The proposed research goals will be reached through the following activities.
• Identify the best current weather-related emergency communication and response practices in a sample of states;
• Identify lessons learned from recent emergencies (e.g., Hurricane Katrina & Rita in addition to assessment of 2007 hurricane season);
• Identify key issues associated with the involvement of state and local public transportation operations in targeting vulnerable populations as specific state and local coordinated emergency planning activities;
• Identify best practice examples of internal and external preparations for communications targeted for vulnerable populations;
• Test results of analysis with a pilot program that mirrors the most effective communications outreach to vulnerable populations to be conducted in cooperation with New Orleans public transportation operations for evacuation of vulnerable populations.
• Capture results of analysis and pilot project through presentations that can be shared with other transit entities seeking to address vulnerable populations for specific outreach, preparation and response during emergency incidents

Research Period: 12 months

Problem Funding: $350,000

Urgency and Payoff Potential
Without question, more communications strategies need to be developed to address the gap confounded by public transit and public emergency response operations during the Hurricane Katrina and Rita evacuation debacles. There are myriad ways to identify vulnerable populations and provide them with vital information to be used in emergency situations, whether there are advance warning time frames or not. In 2007, the urgency is evident in that not enough has been accomplished on this subject over the past two years. The payoff is and will be saved lives.

Relationship to FTA Strategic Goals and Policy Initiatives and TCRP Strategic Priorities
This research would serve to address some of the conclusions raised in the FTA study and certainly “Improve Safety, Security and Emergency Preparedness,” while “Putting the Transit Customer First,” and “Enable Transit to Operate in a Technologically Advanced Society” and “Continuously Improve Public Transportation.” All of these categories speak to the overlapping relationship this research will provide to both FTA and TCRP goals, initiative and priorities.

Related Research: (as mentioned above)
FTA’s Transportation Equity in Emergencies: A Review of the Practices of State Departments of Transportation, Metropolitan Planning Organizations, and Transit Agencies in 20 Metropolitan Areas, and COMTO’s white paper on Emergency Preparedness and Response for Vulnerable Populations

Persons Developing the Problem:
Julie Cunningham, President & CEO, Conference of Minority Transportation Officials
Judith A. Burrell, Principal, BURRELL PROJECT CONSULT

Process Used to Develop Problem Statement:
Conference of Minority Transportation Officials and Joint Center for Political and Economic Studies Health Policy Institute
I. PROBLEM TITLE

Quiet Cars: Threats to Safe Travel for Blind Pedestrians

II. PROBLEM STATEMENT

When vision is reduced or completely eliminated as a means of understanding and interpreting the environment, hearing takes over as the main information channel. Those of us who are blind or visually impaired have learned to rely on our hearing to judge when it is safe to cross the street. Hearing also helps us verify that we are following a straight path and not veering into a parking lot or other undesired location.

Traffic is a primary source of auditory information. Traffic sounds give us information about position, direction, and flow that enables us to determine when we can cross a street. Traffic sounds allow us to determine the shape of an intersection. They also alert us to the presence of danger. The presence of traffic sounds that we can hear is crucial for blind and visually impaired people to travel safely.

The trend toward electric and/or hybrid cars represents a major threat to our ability to move with independence and safety. The engines in these vehicles operate with significantly less sound than the traditional combustion engine. Anecdotal reports of pedestrians who are blind or visually impaired indicate that these environment-friendly vehicles are extremely difficult and often impossible to hear.

III. OBJECTIVE
To research, identify, and test strategies to ensure that all vehicles regardless of engine type or configuration emit sound sufficient to be heard and localized by pedestrians who are blind.

IV. RESEARCH PROPOSED

Research is needed to determine the nature and scope of the problem, to determine possible technological solutions to the problem, to determine features of possible technological solutions which visually impaired pedestrians consider essential, to develop prototype solutions with the input of vehicle manufacturers, and to test these prototype solutions with pedestrians who are visually impaired. The following phases of research are needed:

1. Laboratory research to determine the intensity and spectral characteristics of vehicular sounds that are required for the following activities:
   • Accurately align with vehicles.
   • Judge the speed and distance of approaching vehicles accurately.

2. Comparison of intensity and spectral characteristics of noise emissions of different types of relatively quiet vehicles traveling at different speeds over different surfaces in wet and dry conditions. Comparison with the requirements of pedestrians with visual impairments identified in Phase 1.

3. Synthesis of vehicle detection technologies that have been developed for speed detection or for vehicular collision avoidance, and review to determine their feasibility for development as vehicular sensing systems for visually impaired travelers.

4. Focus group research to determine the characteristics of a vehicular sensing system that are necessary from the perspective of visually impaired travelers.

5. Technological development of prototype vehicular sensing systems for use by visually impaired pedestrians.

6. Evaluation of the usefulness of these technologies by persons with visual impairments.
V. FUNDING

$750,000 over three years

VI. URGENCY

Estimates are that by the year 2010, 20 million people over the age of 45 in the U.S. will report some level of visual impairment. This is in addition to the approximately 1 million children and young adults who have significant vision loss. At the same time, the automotive industry is directing great attention and resources towards addressing the need for reduction in harmful emissions from traditional engines. Collaborative and accelerated research is required to ensure that as we move toward more environmentally responsible transportation and other new technologies, we are not putting in danger the lives of an important and growing segment of our population.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This research specifically relates to FTA’s goals 1 and 4, and TCRP’s priority 1. It relates to the willingness of persons with visual impairments to utilize public transit. We need to have confidence in our strategies for independent travel, so that we can connect with transit, which has been a life line linking us to employment, education and leisure. This area of research needs to be considered as the critically important goal of energy efficiency is pursued. Finally, this research assures that customer needs remain paramount as technological and environmental advances are developed and implemented.

VIII. RELATED RESEARCH

From early childhood, children who are blind or visually impaired learn to use their hearing to identify, localize, and move toward sound sources (Ashmead, Wall, Ebinger, Eaton, Snook-Hill, & Yang, 1998). As these individuals gain the skills required for independent travel, the ability to “read” and utilize traffic sounds is a basic tool in orientation and mobility, including the safe negotiating of intersections (Guth, Hill, & Rieser, 1989; Wiener, Lawson, Naghshineh, Brown, Bischoff, & Toth, 1997).

It has been suggested that drivers will yield the right of way to individuals with visual disabilities. However, at least one study suggests that drivers are
more likely to yield on the basis of the configuration of an intersection rather than the perceived presence of an individual with a visual impairment (Guth, Ashmead, Long, Wall, & Ponchillia, 2005).

Deborah Kent Stein (2005) offers a revealing glimpse into the problem with her own personal experiment. She draws the sobering conclusion that it will take a significant number of casualties or deaths before meaningful action can be expected.

References


IX. PERSON DEVELOPING THE PROBLEM

Karen Gourgey, Ed.D., Chair, Committee on Quiet Cars, American Council of the blind of New York State

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Phone: (646) 312-1426
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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Representatives of the American Council of the blind worked with colleagues in the fields of psychology and orientation and mobility to develop the statement.

XI. DATE AND SUBMITTED BY

Karen Gourgey, Ed.D.
June 15, 2007
I. PROBLEM TITLE

Public Transportation Response Plan for a Pandemic

II. RESEARCH PROBLEM STATEMENT

Pandemic infectious disease, whether it is the result of a mutation of the H5N1 virus or some other emergent contagion, has become recognized by international and U.S. authorities, including the Centers for Disease Control, as a certain event with only an uncertain date of occurrence. The U.S. Department of Homeland Security and FEMA are in the process of updating the National Response Plan to include pandemic considerations and have directed states to develop their own response plans in recognition that due to the characteristics of a pandemic, federal aid will be minimally helpful. Affected communities will largely be on their own to fend for themselves. States such as Florida, who are otherwise savvy to emergencies like hurricanes, are slowly developing drafts of pandemic emergency plans and Continuity of Operations plans for government agencies. However this work is currently in its infancy and data collection phase. Unlike most other catastrophic events that cause destruction of infrastructure and require mass evacuation, a pandemic will strike not infrastructure but the personnel running it. It will require not an evacuation but a response that enables people to limit or halt travel while continuing their normal business and personal routines for up to two months per “wave” without spreading illness. Because the world’s people are so mobile, experts estimate that a pandemic starting anywhere in the world will likely reach North America no later than four weeks from onset. It may spread so fast that neighboring communities within a state will not be able to help each other. Up to now, most transportation considerations in response to pandemic have centered upon border control at airports and cargo processing at seaports. However, the SARS event a few years ago illustrates how fast a disease can spread across the world before anyone is aware enough to enact precautions. Even if authorities are aware of a problem and attempt to react, the recent incident of the American who conducted international travel despite having a strain of TB resistant to drugs illustrates the current limited abilities of border security. It also illustrates the possible lack of cooperation of patients and their families to abide by travel restrictions imposed by health authorities.

How does public transit relate to this issue? Transit has not been seriously considered up to now. Most responses regarding transit are to shut transit service down in the event of a pandemic. However, transit service provides transportation to work for nurses, sanitation workers and many other personnel who will be relied upon to provide emergency response during a pandemic. Additionally, public transit provides a life line to families for transportation to work. Lower income families living from paycheck to paycheck cannot survive in isolation for eight weeks. One of the most important recognized principles of community response during a crisis is to enable the population to maintain its normal routine as much as possible. In the absence of that, the next best is for a population under crisis to have productive things to do. An idle population forced to stay home for weeks while household cash, food and medicine run low is a recipe for civil strife, especially in the likely event that limited supply of flu vaccines will be initially distributed to priority populations only. Shutting down public transit is a simplistic solution but may be ineffective in slowing the spread of disease. While transit-dependent people are disproportionately burdened by immobilization, people with cars may continue to travel and spread disease. In all but the worst cases, shutting down transit might be an overly blunt and drastic step with many adverse consequences.

Many official emergency management plans in force at the national and state level are old versions that do not address pandemic. Newer versions are drafts that have not been released. At both national and state levels, there is a current flux and transition of authority and responsibility, both at the departmental and personnel levels. The Continuity of Operations Plan (COOP) for the Florida Department of Transportation is confidential due to security concerns and exempt from public records law. There is a lack of information and idea exchange. Current plans do not demonstrate an attempt to base actions on the development of scenarios. There are many unanswered questions about preserving essential functions, including establishing the authority of agencies to act, the determination of critical thresholds of employee absenteeism at which a shut down of operations is called, and the identification of core functions and placement of infrastructure to enable essential personnel to work from home.

III. OBJECTIVE

The objective of this research would be to thoroughly think through and describe in as much detail as possible, the range and potential courses of events during a pandemic, the impacts of these upon public transit and the possible responses of public
transit agencies to safeguard personnel and patrons, agency operations, and agency financial management. Most importantly, the research would explore how public transit personnel and capital assets can serve to support emergency responders as well as the community during the crisis. The products would be the creation of scenarios upon which to craft coordinated actions that flex in response to rapidly changing conditions, maintaining altered public transit service to preserve normalcy and minimize socio-economic disruption, while slowing the spread of illness so hospitals are not overwhelmed.

IV. RESEARCH PROPOSED

Below are the envisioned research tasks for preparing public transit agencies to respond to a pandemic.

1. Disseminate the facts on the risks to government policy makers and transit agencies. There continues to be a wide range of opinion among government policy makers on the importance of pandemic planning. For example, in 2006, the Florida House and Senate passed bills to purchase protective equipment, which the Governor vetoed. Lack of agreement wastes time and effort. Identify and explore the various arguments about pandemic and develop a consensus to take action.

2. Establish interdisciplinary dialogue and cooperation. Conduct brainstorming sessions to identify technologies that can be combined and brought to bear on pandemic planning. Specialists should include:
   - Epidemiologists
   - Geographic information systems experts
   - Industrial and management systems engineers with expertise in transportation logistics
   - Computer scientists with expertise in the application of unmanned systems (robotics) and cell phone technology to explore use of social distancing strategies
   - HazMat experts whose processes might have some carry over to pandemic procedures

3. Model the spread of infectious disease through a transit service area

4. Apply statistical and optimization tools for defining alternative service configurations and the level of risk associated with their use.

5. Develop decision trees for evaluation and alteration of transit operations on a daily basis during a pandemic

6. Develop table top exercises, conduct drills and debriefings using volunteer local areas
   - Transit agency management
   - Local government emergency operations centers, first responders, and emergency planning committees
   - Public and private sector major employers

7. Explore role of public transit to deliver food, medicine, equipment, and patients to support community isolation and quarantine orders

8. Develop thresholds at what percentage of absent transit employees, public transit must shut down

9. Document the findings of the table top exercises.

10. Develop a public transit procedural handbook and planning templates, containing appendices with example detailed interlocal agreements, decision trees and checklists tailored to a specific transit agency.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** Estimated cost of this project is $600,000.

**Research Period:** It is recommended that the time period to complete research should be compressed as much as possible to put a product into the hands of transit agencies as soon as possible. The level of interdisciplinary collaboration proposed will require 18 months, including 3 months for review and revision of a draft final report.

VI. URGENCY AND PAYOFF POTENTIAL

This issue is considered especially urgent. The payoff is the protection of lives and the recognition and integration of public transit as a key resource in the community. The main barrier to overcome is the current closed process of planning for pandemic outside the realm of public dialogue.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This issue closely addresses FTA strategic goal #3 to improve safety, security and emergency preparedness and the TCRP Strategic Priorities #1. Place the Customer First, and V. Revitalize Transit Organizations.
VIII. RELATED RESEARCH

Center for Urban Transportation Research. 2005. “Transit Emergency Planning and Response Assessment Initiative”, Center for Urban Transportation Research, prepared for the Florida Department of Transportation by Jay Goodwill and Amber Reep, University of South Florida, Tampa, September. This is a source of guidance on public transit preparedness during hurricanes. An electronic report copy can be found at http://www.cutr.usf.edu

National Cooperative Highway Research Program (NCHRP). 2006. Research Problem Statement 2007-SP-19, “Mass Transit and Contagious Diseases: Managing Risk during Preparedness, Response and Recovery for a High-Impact Infectious Disease Outbreak”. This was issued to AASHTO Special Committee on Transportation Security, December 2005, but not selected. Submitted by Firoz Verjee, Institute for Crisis, Disaster and Risk Management, The George Washington University, Washington, D.C. It was also submitted to the Transit Cooperative Research Program for TOPS Fiscal Year 2006 allocations, but was not selected.

IX. PERSON(S) DEVELOPING THE PROBLEM

Sara J. Hendricks, Senior Research Associate, Center for Urban Transportation Research, University of South Florida, 4202 E. Fowler Avenue, CUT100, Tampa, FL 33620-5375, (813) 974-9801, FAX (813) 974-5168.

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the product of an investigation of the Transportation Demand Management Team at CUTR in collaboration with Dr. Wendell Joice of the U.S. General Services Administration.

XI. DATE ANDSubmitted BY

June 15, 2007, same as IX above.

Submit to:

Christopher W. Jenks
Director
TCRP
Transportation Research Board
500 Fifth Street., N.W.
Washington, D.C. 20001
202/334-3089
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TCRP Problem Statement

PROBLEM TITLE

Bus Turnouts – Benefit or Curse

PROBLEM STATEMENT

Providing bus stop turnouts is very common requirement for new developments and road projects. While some view turnouts as a transit amenity, others view them as a detriment to providing quality transit service. Buses are delayed while waiting to re-enter traffic. They are often justified on safety grounds, yet evidence of safety benefits is questionable. Is there a greater chance of an accident by buses re-entering traffic or by autos hitting stationary buses stopped in the traffic lane? Does the need for extra right of way impact the location of bus stops resulting in less desirable locations?

A related issue is the effectiveness of yield to bus regulation. Is such regulation effective or not? If not, are there strategies that can improve the effectiveness of such regulations? Does the existence of such regulations reduce delay and improve safety of bus pull-outs? These are questions that this research is intended to answer.

OBJECTIVE

Conduct research necessary to determine the impact of bus pull-outs on transit operations, traffic flow and safety in different road environments. Also determine the same impacts of buses stopping in traffic lanes. Examine alternative bus stop arrangements such as bus stops in turn lanes. Examine the impact of yield to bus laws and determine if they mitigate the negative impacts of buses pulling out of traffic. The desired outcome of the research is to present data in usable form to inform the design of bus stops with a clear understanding of the impact on customers and safety.

RESEARCH PROPOSED

Research would be focused on the following areas.

Research on the Impact of bus turnouts on delay to buses, safety and traffic flow.

The research would compare buses pulling out of traffic to load and unload customers to stopping in the traffic lane to load and unload customers. It would take into account different roadway speeds and other factors as well as different designs for bus pull-outs. It would also identify and compare other conditions in which bus stops are located such as wide right traffic lanes or stopping in turn lanes. The impact of turnouts compared to stopping in traffic may depend on road speed, roadway conditions and bus dwell times to load and unload customers. These differences must be recognized. Furthermore delay should be measured in terms of person delay – the number of persons delayed on a bus and length of that delay to the number of persons delayed in automobiles.
Research on Yield to bus laws.

The impact of yield to bus laws will be examined to determine their effectiveness and the impact they may have on bus stop design and location, in particular if they mitigate against the negative aspects (delay and safety) of bus turnouts. If sufficient funding is available the research can also examine the impact of different approaches of marking the rear of buses to indicate to drivers that they need to yield to a bus pulling into traffic.

Research on impact bus pull-outs on location decisions

This research would focus on the right of way requirements of bus pull-outs and the impact they have on bus stop location decisions. It would determine if less desirable locations from both a customer and safety perspective result when bus turnouts are required.

ESTIMATED FUNDING AND RESEARCH TIME

$300,000; 24 months

URGENCY AND PAYOFF POTENTIAL

Decisions are made daily regarding the design and location of bus stops. Many of these decisions are made based on perception and not solid evidence. Providing a sound basis of information can improve decision making regarding bus stops and result in reduced travel time for buses that can increase ridership and reduce operating costs while improving roadway safety.

RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP STRATEGIC PRIORITIES

FTA Strategic Goals and Policy Initiatives: Ridership. Increase transit ridership can occur if there is reduced delay to buses and better bus stop locations.

TCRP priorities: Place the Transit Customer First. This project is an attempt to assure that transit customers (or potential customers) are given full consideration in planning and design of bus stops.

RELATED RESEARCH

TCRP B-6, D-8, H-4, H-7, and H-12; TCRP Synthesis SH-08

PERSONS DEVELOPING THE PROGRAM

Ron Kilcoyne
Chief Executive Officer
Greater Bridgeport Transit Authority
1 Cross Street
Bridgeport CT 06610
PROCESS USED TO DEVELOP PROBLEM STATEMENT


DATE AND SUBMITTED BY

June 15, 2007

American Public Transportation Association
Systems Management/Operations Planning Subcommittee
1666 K Street NW
Washington DC 20006
Phone: 202-496-4800
FAX: 202-496-4321
I. PROBLEM TITLE

Operation of Street-Running Light Rail Transit at Higher Speeds, Phase II

II. RESEARCH PROBLEM STATEMENT

Current practice as defined in the Manual of Uniform Traffic Control Devices (MUTCD) Part X requires use of crossing gates for operation of Light Rail Transit (LRT) trains through intersections at speeds of greater than 35 miles per hour (mph). Where LRT operates on-street or immediately adjacent to a street, there are segments where the parallel roadway traffic operates through the same intersections at significantly higher speeds. This puts public transport at a disadvantage in attracting ridership and in providing efficient utilization of investments.

The current project, entitled “Phase II”, will address next steps identified as a result of the successful conclusion of TCRP Project J-6 Task 65 including:

- Functional Analysis
- Test Evaluation
- Industry Review
- Summary of Recommendations / Proposed MUTCD Text

III. OBJECTIVE

The objective of this research is to identify the safety and operational factors involved in traffic control using crossing gates versus traffic signals, possibly in conjunction with supplemental safety measures, and to define traffic control treatments that would potentially allow for higher than 35 mph operation without use of crossing gates. Finally, with the active participation of a sponsoring agency, the ultimate objective is to test higher-speed operation with use of identified traffic control provisions and to recommend potential revisions to MUTCD Part X.

IV. RESEARCH PROPOSED

Four major tasks are proposed:

- Task 1 – Functional Analysis: Develop a functional analysis of safety and operational considerations for traffic control at selected typical intersection configurations, taking into account human factors with respect to device compliance; postulate supplemental safety measures and/or operational procedures potentially advisable to support higher speed operation without use of crossing gates.
Task 2 – Test Evaluation: A demonstration testing selected warning devices and other treatments would be developed for one or more transit operator sites. Elements of this effort would include:

- Contact candidate transit operators and develop potential research design (to include specific sites, proposed intersection modifications, warning devices to be tested and evaluation methodology).
- Select site(s) and develop agreement for carrying out the test.
- Coordinate with transit system(s) to design, implement and evaluate the new warning devices (wayside or vehicle based) and/or intersection modifications.
- Conduct focus group and/or survey research regarding the warning signs, signals and other devices being tested. This component would establish the public perception and understanding of the proposed devices.
- Coordinate with transit agency to identify conclusions and prepare summary of results.

Task 3 – Industry Review: Conduct a formal review of the proposed variance evaluation process described in Project J-6 Task 65. The draft evaluation process would be transmitted to a selected group of transit industry managers and consultants for their review and response to a survey. Follow-up interviews would also be conducted. The result would be a further refinement of the proposed process.

Task 4 – Summary and Recommendations: The final element of the work plan would be to integrate the results of the two research components (Test Installation and Industry Review), prepare a research summary and develop, if warranted based upon the Industry Review, recommended revisions to Part 10 of the MUTCD.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

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<th></th>
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VI. URGENCY AND PAYOFF POTENTIAL

Where LRT speeds are restricted to 35 mph, operation along a one-mile segment from station to station could require 2 minutes plus an additional 20 seconds for station dwell, taking into account acceleration and deceleration. At the same time, parallel highway traffic, if operating at 45+ mph with no stops for traffic signals could cover this same distance in about 1.5 minutes. In the event the LRT maximum speed could be increased to 45 mph, the station-to-station travel time would be about the same, resulting in a level playing field.

In the event it could be demonstrated that the marginal risk of marginally higher operational speeds could be mitigated by engineering and operational practices, development of higher-speed lines would benefit the public.

As the US is making major investments in at-grade LRT systems, and as these systems are increasingly being implemented in a low-density urban and/or suburban-type roadway environment (e.g., Phoenix), this research is urgently needed both to improve the competitiveness of LRT and transit as well as obtain the maximum efficiency from the public investment.

The biggest barrier to implementation of the results of this research is the potentially increased liability risk associated with participation in the project and/or implementation of the results. However, by conducting the research as a sponsored demonstration project, these risks could be reduced.

Another risk is the willingness of officials and expert panels responsible for developing and administering codes and regulations regarding LRT operation to accept and incorporate the results of the research.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP STRATEGIC PRIORITIES

By potentially improving operating speeds and increasing competitiveness with auto travel times, thereby potentially increasing the transit mode share in a travel corridor, this research would be consistent with the following FTA Strategic Goals and Policy Initiatives:

- Increase Ridership
- Improve Capital and Operating Efficiency
- Protecting the Environment and Promoting Energy Independence

This research is consistent with the following TCRP Strategic Priorities:

- Place the Transit Customer First
- Continuously Improve Public Transportation
VIII. RELATED RESEARCH

The proposed research would constitute and evolution of the research previously conducted on higher speed LRT operations conducted as part of TCRP Project J-65 as well as prior research and standards presented in TCRP Report 17, *Integration of Light Rail Transit into City Streets*, and TCRP Report 69, *Light Rail Service: Pedestrian and Vehicular Safety*.

IX. PERSONS DEVELOPING THE PROBLEM

Paul O’Brien
Rail Service General Manager
Utah Transit Authority
Chairman, APTA Light Rail Transit Technical Committee
Member, National Committee on Uniform Traffic Control Devices Railroad Committee

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X. PROCESS USED TO DEVELOP THE PROBLEM STATEMENT

This problem statement has been developed in response to concerns raised by Phoenix Valley Metro, Utah Transit Authority, and Santa Clara Valley Transit Authority as discussed at the APTA Light Rail Technical Committee and at the Manual of Uniform Traffic Control Devices Railroad Sub-Committee.
XI. DATE AND SUBMITTED BY

June 15, 2007

Paul O’Brien
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Light Rail Grade Crossings

At-grade crossing accidents between motorists and trains and pedestrians and trains on light rail transit systems have historically been a significant challenge to control during the operational phases of light rail projects. As existing light rail systems expand their current operations, and new Cities develop and implement light rail systems, the issue of mitigating at-grade crossing accidents continues to be the “Achilles heel” that is faced by all transit agencies. Unfortunately, such accidents often result in serious injuries or fatalities. When this occurs, the light rail transit industry is unjustly portrayed in a negative light by the media, and transit agencies end up spending their already-scarce operating funds to litigate these accidents.

Although there are existing standards that address the type and application of warning devices to use at light rail at-grade crossings, they are included in a variety of separate documents and research reports that do not lend themselves as an easy reference library. Furthermore, since the publication of these documents, nascent technologies have been introduced to further enhance grade crossing safety.

This objectives of this proposal are twofold:

1. To review the existing research papers (TCRP, ITE, universities) and standards/guidelines (APTA standards, FHWA Handbook, FHWA’s Technical Working Group (TWG) Guidelines, Manual on Uniform Traffic Control Devices (MUTCD), State Safety Oversight regulations, etc) and develop a consolidated reference document, with sketches, photos, drawings, for all light rail alignment types that identifies the hazards at a grade crossing and the possible mitigating measures. Included in this effort would be to identify all elements that should be considered as potential mitigating measures such as approach warning signs, pavement markings, warning devices, barriers, audible devices, active signs, and any new technologies not identified in the aforementioned documents.

2. To determine the level of effectiveness of each of the mitigating measures proposed.

Submitted By:

Bill Grizard, APTA, for the APTA Rail Safety Committee
I. PROBLEM TITLE

Connecting the Public to Transit: Circulator and Feeder Systems

II. RESEARCH PROBLEM STATEMENT

Circulator and feeder systems provide improved accessibility to travelers in a variety of transportation applications. Circulator systems are often found supporting public transportation systems in both rural and urban settings. Many regions have developed rail and express services as part of their transportation system in an effort to provide reliable transportation alternatives, direct future land use and development, and increase the long term capacity of the transportation system.

Passenger rail is an increasingly popular means of adding capacity to a transportation system, though many regions are not currently densely developed enough to create the demand needed at the home or destination end of the rail trip within walking distance of the station. The success of such a rail transit system depends heavily upon cultivating a ridership base upon which to operate, expand and improve the system and will require additional means to expand the accessible area of the train or express station beyond an acceptable walking distance. Commuter rail, for example, has been implemented only on existing rail right-of-way in the United States. Existing rail right-of-way does not usually coincide with commercial and residential demand centers and necessitates the use of a circulator system to expand the service boundary.

Circulator and feeder systems will serve an increasingly vital role in public transportation as the number of express bus and rail systems grows. Over the past 25 years there have been many efforts to aid in circulator route design and implementation. These efforts have been often hampered by computational resource restrictions and do not provide an adequate view of the tradeoffs inherent in circulator and feeder systems. Circulators and feeders increase the accessibility of the express or rail system; however, this comes at a cost. There are environmental costs, resource costs, traffic impact costs, and land use costs. This research would seek to quantify these relationships and tradeoffs and provide policy and design guidance.

III. OBJECTIVE

This TCRP research endeavor will provide the public transportation community with a comprehensive synthesis of circulator and feeder route characteristics and design efforts over the past quarter of a century. This research will also provide a quantitative analysis of environmental, operator resource, traffic, and land use impacts relative to circulator and feeder systems. Finally, this research will produce policy and design guidance for the implementation of circulator and feeder services in support of public transportation systems.

IV. RESEARCH PROPOSED

Three specific products will be developed as part of this research:

Synthesis of Existing Knowledge

This synthesis will serve as a thorough treatment of research and experience with circulator and feeder systems to date in a variety of applications. The role and function of circulator systems
will be carefully investigated which will help direct the future development of design guides and tools. This synthesis will incorporate both a traditional literature review and a survey of existing circulator systems serving express transit systems, dense urban areas, and large single demand generators.

Circulator and Feeder Route Design Tradeoff Analysis

Each of the four variables having relationships with circulator and feeder systems; environment, land use, traffic, and resources, will receive separate analytical treatment. It is likely that the separate treatments of the four variables will suggest that an overall model will be of use in planning and design contexts and will be pursued. This model may include regression, optimization, and statistical components (or some combination) and would serve well as technical guidance.

Complementing any model development would be a more macro-level analysis suitable for aiding policy and design decisions in less technical language. This analysis would seek to identify best practices for circulator and feeder implementation in clear, understandable terms that lend themselves to practical guidance. Microsimulation tools are one approach to quantifying these tradeoffs and identifying thresholds for circulator design and operation at which the additional costs of the system outweigh the accessibility benefits.

Policy and Design Guidance

Using the knowledge gained and lessons learned from the synthesis and analysis portions of the research, a policy and design manual will be developed focused on aiding the transit system operator in designing and operating a circulator or feeder system. Topics covered in such a manual would include:

- Survey of Existing Practices
- Methodological Developments of the last 25 Years
- Costs Associated with Circulator and Feeder Systems
  - User
  - Operator
- Unserved Demand
- Environmental Tradeoffs
- Land Use Tradeoffs and Impacts
- Traffic Impacts
- Lifespan of Circulator and Feeder Systems

These (and other) topics would culminate in a tool that could be used to help determine if a circulator or feeder system is warranted and help design the system.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $450,000

**Research Period:**

- Synthesis: 9 months
- Analysis: 12 months
- Guidance Preparation: 12 months
- Review and Revision of Reports: 3 months
- TOTAL: 36 months

VI. URGENCY AND PAYOFF POTENTIAL
Circulator and feeder systems will be more and more prevalent as express and rail public transportation systems continue to proliferate. As one example, there are currently 21 commuter rail systems in America and 21 additional in the planning stages. There are also 30 metropolitan regions currently unserved by rail that are good candidates for rail service in the coming years. If one considers only the 21 planned and 30 potential systems over the coming years, there is still a significant opportunity to improve our public transportation by acting now. Investing the time and effort to help current and future express and rail transit systems better connect the public to these systems will pay large dividends in improved Accessibility and improved efficiency through a better understanding of the environmental, land use, resource, and traffic impacts of circulator and feeder systems.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

Relationship to FTA Strategic Goals

Increasing Ridership

Improving circulator and feeder design and operation will improve the accessibility of express and rail transit services. This improvement in accessibility will directly correspond to an increase in ridership. In many situations the circulator and feeder systems will be the only means of accessing the express or rail service, a situation in which proper design and operation will be even more important in cultivating and retaining ridership.

Improving Capital and Operating Efficiencies

The quantitative analysis undertaken as part of this research will address the efficiency of capital and operating budget expenditures. Identifying the tradeoffs between providing circulator and feeder service and other system variables will define thresholds, beyond which circulator and feeder services would be less efficient at cultivating and retaining ridership than other programs and technologies.

Protecting the Environment and Promoting Energy Independence

Improving the efficiency of circulator and feeder systems will help direct resources to where they are most needed and away from unproductive endeavors. Targeting best practices will help optimize the circulator system, improve express and rail service ridership, and eliminate inefficient practices; all of which will contribute to lowering emissions and reducing fuel consumption.

Relationship to TCRP Strategic Priorities

Place the Transit Customer First

Improving the accessibility of our rail and express systems is a customer-oriented task. Providing better access through dedicated circulator or feeder service, the transit community is placing the customer first by reaching out to them and doing everything possible to provide access rather than expecting them to sacrifice to use transit.

Continuously Improve Public Transportation

The accessibility of public transportation systems will vary with time as regions, demographics, and needs mature and change. The knowledge and guidance produced by this research will enable communities to adapt their circulator and feeder systems to changing needs and continuously improve their public transportation.

Flourish in the Multimodal Environment
Circulators and feeders serving express and rail systems will inherently involve both rail and rubber-tire service. They will also have to coordinate with park-and-ride facilities that serve private automobiles and may involve other rubber-tire services such as paratransit, car-sharing or rideshare programs.

VIII. RELATED RESEARCH

Following is a brief sample of completed work that is relevant to the proposed problem statement.


Additional ongoing work that would be relevant to the problem statement:


IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the product of the individuals listed in § IX.

XI. DATE AND SUBMITTED BY

Submission Date: June 14, 2007

Submitted by:

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I. PROBLEM TITLE

Transit Corridor Trunk & Feeder Services Analysis

II. RESEARCH PROBLEM STATEMENT

To accommodate today’s dispersed travel patterns in a sustainable fashion, transit must offer convenient transfers; no matter what service configuration is chosen, transit cannot offer direct service among all destinations. A grid of high frequency routes is most attractive to customers, but is only sustainable in transit intensive areas. The timed-transfer is designed to offer an attractive connection that is sustainable with less frequent service and less intensive transit use.

FTA New Starts and Small Starts projects, for example, present opportunities for restructuring routes into trunk-and-feeder corridors that require new transfers that are perceived negatively. However, there is evidence that new light rail lines with well-designed feeder services have attracted substantially more riders than the one-seat express services they replaced. Current ridership forecasting models appear to overstate the problems of transfers, making it difficult to demonstrate passenger benefits. Travel behavior models typically take one-half the headway as the average wait time to transfer and do not usually accommodate timed-transfer. Service planning has few tools to estimate the effects that a well connected route structure has on transfers and ridership.

All this leads to erroneous ridership estimates and does not support good corridor service design. It also leaves the transit industry open to critics of unlinked trip counting and the “forced” transfer. Transit agencies conduct periodic transfer analysis using manual methods or new fare collection technologies. Origin-Destination data represent the linked trip, but are costly to collect and awkward to apply. This research proposes to develop techniques that better quantify the relationship between transfer ridership and service configuration and that will aid in the design and evaluation of transit corridors.

III. OBJECTIVE

This research will provide an analytical framework and set of tools for transit practitioners to use in the design and evaluation of trunk-and-feeder and multi-modal corridor configurations.

IV. RESEARCH PROPOSED

- A thorough review of the state of the art and practice of quantifying the relationship between transfer ridership and service configuration.
- An assessment of the practitioner’s requirements and resources to analyze transfers in a (multimodal) transit corridor.
- Identification of promising methods to provide practitioners with the needed analytical framework and how these methods should be deployed.
- Develop a framework and set of techniques.
- Illustrate application, especially sensitivity to service configuration.

Use of Geographic Information Systems (GIS) and data available from automatic passenger counters (APC) will facilitate this research. This research will refine both service planning and ridership modeling. The framework should revisit the basics of transit networks: (1) passenger trips - boarding, alighting, transferring and riding; (2) travel cost represented by travel times along trip paths, including access and transfers; (3) the environment represented by nodes and links that define trip paths; and (4) other characteristics including customer perception and accessibility.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $400,000
Research Period: 24 months.
VI. URGENCY AND PAYOFF POTENTIAL

Metro areas now recognize that continued expansion of roadway capacity no longer appears to be feasible or desirable. Policy makers and planners are now revisiting expectations of constituents and travelers, and the development of effective transit services may be crucial to the future vitality of our cities. Metro areas are planning and implementing new trunk-and-feeder corridors and hub-and-spoke networks with various modes. This research will help provide a more rigorous basis for analysis and development.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

FTA STRATEGIC GOALS
(1) Increasing Ridership This research is specifically aimed at developing transit service configurations that effectively accommodate today’s dispersed travel patterns and attract new riders.
(3) Improving Capital and Operating Efficiencies The restructuring of services results in significant operating efficiencies - usually more feeder services for the same total service hours. Capital improvements can then be identified that enhance the attractiveness to riders.

TCRP STRATEGIC PRIORITIES
I. Place the Transit Customer First The linked customer trip - the one that really counts - is the unique priority of this research.
II. Enable Transit to operate in a Technologically Advanced Society Employ APC, AVL and GIS technologies as tools and suggest supportive consumer technologies as appropriate.
III. Continuously Improve Public Transportation This research recognizes known deficiencies in and leads the way to the development of new methods of transit service development.
IV. Flourish in the Multimodal Environment This research specifically addresses intermodal connectivity to develop transit services that support the urban/suburban environment.

VIII. RELATED RESEARCH

TCRP Web Document 6 Transit Capacity & Quality of Service Manual
TCRP Report 95 Traveler Response to Transportation System Changes Handbook
TCRP Synthesis 55 Geographic Information Systems Applications in Transit
Recent research into stop and route level analytical techniques and using GIS and APC data
The Analysis of Transport Technology and Network Structure, Edward K. Morlok, The Transportation Center at Northwestern University, 1967

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the product of review and comments from individual members of standing TRB Committees.

XI. DATE AND SUBMITTED BY

Submitted: June 13, 2007
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PROBLEM TITLE

Improving Transit Integration in Urban Areas with Multiple Transit Providers

PROBLEM STATEMENT

One of AASHTO’s goals, which is supported by APTA, is to double transit ridership over the next 20 years. Successfully achieving this goal will require the transit network to be as seamless as the highway network.

Transit systems that carry over 90% of US transit riders interface with one or more other transit agencies. This occurs in both large urban areas and many smaller communities. Individual travel needs often transcend a particular transit agency service area. However, the seamlessness that exists in our street and road systems, where every city, county and state government is responsible for portions of the system, but individuals can drive from any point to any point oblivious of the multiple agencies involved, is not as prevalent in transit service. There is a consensus that public transportation should be seamless, and many specific efforts to improve integration have reaped significant increases in transit ridership; however these efforts tend to be piece meal, generally focused on one element of integration such as fares and not comprehensive or universal as is common in other developed countries. This would indicate that integration of public transport services analogous to what exists among the highway system could reap dramatic increases in transit use and improve the overall stature and image of transit in many communities.

While each region has its unique characteristics and history, the barriers to successful integration and the benefits that accrue tend to be universal. Identifying how the challenges to integration have been successfully addressed and measuring the benefits that have resulted from integration can provide the information needed for successful implementation. This will assist areas that have partial integration if transit services implement the additional elements needed for total integration. (For example a region may have a universal fare instrument but limited schedule and route integration.). As regions grow, new transit systems may be created or existing systems that currently do not connect with each other expand their service area to the point that they do. With a better understanding of how to address challenges and measures of the benefits; comprehensive integration be in place when the linkages are established.

OBJECTIVE

The best approach to integrate transit services provided by multiple transit operators may vary from region to region, however the challenges to and benefits of achieving successful integration tend to be universal. This research would examine approaches to successful integration of transit service, particularly among multiple providers. Each approach would be evaluated to determine the effectiveness in addressing institutional concerns; balancing local and regional perspectives in fare integration; service design and schedule coordination;
promotion and public information; design and location of transfer facilities; distribution of fare revenues and funding; consolidating overlapping special services often provided by non transit agencies; and any other issue that inhibits or enhances true transit integration. The research will examine the journey to implementation as this can highlight how to overcome existing barriers to optimum public transport integration. It will also identify and measure the benefits that have been achieved from integration. The final report will provide information that can be used by decision makers to determine which approach is most appropriate for a particular region, how to address the challenges and the steps needed to achieve optimum transit integration and the benefits that will accrue for successful integration.

RESEARCH PROPOSED

Review all aspects of transit integration (institutional, fares, service planning and scheduling, marketing and public information, funding, capital planning, etc.) in a representative cross section of large and small urban areas. Identify the challenges that needed to be overcome prior to implementation. The benefits, disbenefits, and outcomes of each approach would be identified. Reasons for success or failure toward achieving transit integration would be examined. The benefits of true transit integration would be measured. Among the most successful models of transit integration identified, articulate information that can assist decision makers in determining which model is most appropriate for a particular region, how challenges were overcome, the steps are needed to achieve full transit integration and the benefits that resulted from integration.

ESTIMATED FUNDING AND RESEARCH TIME

$300,000; 2 years

URGENCY AND PAYOFF POTENTIAL

Improving public transport integration could be one of the most cost effective strategies to increase transit usage. Travel patterns are not dictated by transit agency service boundaries. In many urban areas, both large and small, lack of transit service integration results in inferior service to the customer. In other cases duplicative services by multiple organizations wastes resources that could be more effectively deployed. Despite consensus that transit integration or seamlessness is needed to make transit more competitive with the auto and consequently increase transit market share; progress is spotty. A document that can articulate the benefits of integration, the models that work and the steps needed to implement an effective model will be a tremendous tool for bringing about true transit integration. The results would be increased transit market share and more cost-effective delivery of service with existing resources.

RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP STRATEGIC PRIORITIES

FTA Strategic Goals: Increasing Ridership. Empirical evidence indicates that regions with the best integration among transit providers and modes have the highest per capita transit ridership. There is significant potential for dramatic increase in transit use.
TCRP priorities: Place the customer first. The aim if this study is to better address customer needs, particularly among those who do/would use multiple public transport providers.

Flourish in the Multimodal Environment. Better integration will increase transit usage and reduce duplicative or excess capacity.

PERSONS DEVELOPING THE PROBLEM

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PROCESS USED TO DEVELOP PROBLEM STATEMENT

Developed by APTA Ridership Subcommittee
DATE AND SUBMITTED BY

June 15, 2007

American Public Transportation Association
Ridership Subcommittee/Marketing Committee
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I. Problem Title

“Measuring and Understanding the Use of Fixed Route Services by Riders with Disabilities”

II. Research Problem Statement

Operators of fixed route public transit are required by the Americans with Disabilities Act (ADA) to make their services accessible to persons with disabilities. While the DOT regulations implementing this requirement were issued in 1991, many transit systems are still working to achieve full accessibility. Designing, operating, and maintaining fixed route service that persons with disabilities can and want to use offers several benefits over providing ADA complementary paratransit service for both riders and operators, including: greater travel flexibility for the passengers; lower fares for passengers; and significant savings in operating costs to the transit system.

How successful have transit systems been in attracting persons with disabilities to their fixed route services? In other words, what has the fixed route ridership been of persons with disabilities? How do transit systems measure this ridership? How has this ridership changed in absolute numbers? As a proportion of total fixed route ridership? And in comparison to ADA complementary paratransit service ridership?

Second, what are the factors that transit systems can point to that have led to atypically large proportions of ridership by persons with disabilities, and/or large increases of ridership by persons with disabilities?

III. Objective

This research has two primary objectives:

1. Quantify the ridership of persons with disabilities on American fixed route public transit.
2. Identify successful policies and practices of transit systems to increase fixed route ridership of persons with disabilities.
3. Develop a baseline of information on fixed route ridership by persons with disabilities and recommendations for the ongoing collection and reporting of this information.

IV. Research Proposed

1. Conduct a literature review directed towards two topics: passenger counting and ridership sampling techniques; and attracting persons with disabilities to fixed route service.
2. Develop and conduct a survey of the public transit industry on current policies and practices to measure fixed route ridership by persons with disabilities and to attract the disabled community to the fixed route. Analyze the survey responses.
3. Based on the survey responses, develop a national estimate of fixed route ridership by persons with disabilities. Estimate this ridership by various modes and transit system sizes.
4. Based on practices identified in the survey, recommend a range of techniques for use by transit systems to measure ridership by persons with disabilities. These techniques will include methods practical for different modes, different system sizes, and different levels of available technology.

5. Develop recommendations for collecting and reporting fixed route ridership by persons with disabilities, as part of the National Transit Database reporting process or through other means.

6. Present case studies that demonstrate different successful policies and practices that transit systems have used to attract persons with disabilities to fixed route service.

V. Estimate of the Problem Funding and Research Period

**Recommended Funding:** $350,000  
**Research Period:** 24 months

VI. URGENCY AND PAYOFF POTENTIAL

Many fixed route transit systems face ongoing growth in paratransit ridership and the associated costs for paratransit service. Shifting current paratransit ridership as well as potential future ridership to fixed route services would help temper the growth in paratransit ridership and costs. Knowing the level and reasons for its own success in achieving this, as well as the reasons for success by other transit systems, can also help a transit system better serve persons with disabilities.

VII. Relationship to FTA Strategic Goals and Policy Initiatives and TCRP Strategic Priorities

**FTA Strategic Goals**

1. **Increasing Ridership.** This research intends to identify policies and practices that attract persons with disabilities to use fixed route services, and thereby help other transit systems to increase their ridership of persons with disabilities. In addition, many service improvements directed toward the disability community have the added benefit of creating more attractive service for all riders, e.g., better signage, better lighting, more clearly defined paths of travel.

2. **Improving Capital and Operating Efficiencies.** A concern of the public transit industry is the increasing proportion of resources allocated to paratransit service. This research will identify ways to shift some of the demand for paratransit service to more cost effective fixed route service.

**TCRP Strategic Priorities**

**Place the Transit Customer First.** How have some transit systems succeeded in attracting and serving persons with disabilities on fixed route? This is important information as the American population grows older and will need more accommodations to continue (or begin) to use public transit.

**Continuously Improve Public Transportation.** This research will provide information about how to count fixed route ridership by persons with disabilities—a basic piece of data that can be helpful in measuring transit performance and planning future service, yet which many systems do not currently have. Along with identifying ways to attract riders with disabilities, this will provide ideas and tools for transit systems to improve themselves.
VIII. Related Research

- TCRP Report 9, “Transit Operations for Individuals with Disabilities”
- TCRP Report 24, “Guidebook for Attracting Paratransit Patrons to Fixed-Route Services”
- TCRP Project B-28, “Improving ADA Complementary Paratransit Demand Estimation” (Final Report expected summer 2007)
- “Assessment of ADA Research and Development Needs,” published by FTA, July 1997
- “Strategies for Implementing a Standee-on-Lift Program for Fixed-Route Bus Service, published by FTA, June 1993

IX. Person(s) Developing the Problem

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X. Process Used to Develop Problem Statement

This problem statement is the product of members and friends the TRB Committee on Accessible Transportation. It was discussed with the Committee members and friends at the 2007 TRB conference and was developed with subsequent input from the Committee.

The final problem statement is endorsed by the Committee on Accessible Transportation and Mobility (ABE60).

XI. Date and Submitted by

Submitted: June 15, 2007

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TCRP PROBLEM STATEMENT

I. PROBLEM TITLE

The Role of Passenger Amenities and Traveler Information in Building Ridership

II. RESEARCH PROBLEM STATEMENT

TCRP Project B-10, completed in 1998 and published as *TCRP Report 46*, "The Role of Transit Amenities and Vehicle Characteristics in Building Transit Ridership: Amenities for Transit Handbook and The Transit Design Game Workbook," identified passenger amenities and transit vehicle characteristics that attract ridership, evaluated their relative impact on ridership, determined their relative cost-effectiveness, and provided the industry with tools to assist transit professionals and policy makers in analyzing investment decisions.

The proposed research will provide an update to this work, but instead of specifically examining the role of vehicle characteristics in building ridership, it would focus on advanced traveler information technologies such as trip planners, real-time transit arrival information, and automatic stop annunciation. The research could also examine the role of traditional sources of transit information such as timetables and maps, and how their effectiveness compares to non-traditional sources. In addition, the research would explore the effectiveness of passenger amenities and traveler information on recruiting new riders and influencing a potential rider’s decision to choose transit over other modes.

Given the increased availability of traveler information technologies, many transit agencies are examining the trade-offs between investing in passenger amenities and technology, versus providing additional transit service (e.g., additional routes, more frequent service, etc.). Research that explores how peer agencies have dealt with this issue can greatly assist agencies considering investing in such technologies.

III. OBJECTIVE

The objective of this research is to identify the role of passenger amenities and traveler information on the decision of existing and potential riders to use transit.

IV. RESEARCH PROPOSED

The proposed research will consist of a literature search of relevant material published since the release of *TCRP Report 46*, a survey of a selection of transit agencies that currently have advanced traveler information tools in order to document their experience with these tools as well as other amenities, and an evaluation of the effect of these amenities and technologies on the decision of existing and potential riders to use transit.
V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $250,000 to $375,000.

**Research Period:** Twelve to 18 months. The estimated research period is relatively short, given that this research will largely build on the work completed in *TCRP Report 46*.

VI. URGENCY AND PAYOFF POTENTIAL

Since transit-related technology changes rapidly and can quickly become obsolete, some degree of urgency in identifying and then disseminating transit amenities and technology that could lead to increased ridership is reasonable. In addition, many forms of applicable technologies are becoming more accessible and available to smaller transit agencies. Thus, providing information that identifies potential tools that can provide financial savings and/or increase ridership has some degree of urgency as well.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES, AND TCRP STRATEGIC PRIORITIES

The proposed research would support the FTA strategic research goal of increasing ridership. It is hoped that the research will identify passenger amenities and developing technologies that through application and use can lead to increased transit mode share and, thus, ridership.

The research would also support the TCRP strategic priority of placing the customer first. A transit agency’s focus on--or at least a recognition of the importance of--passenger amenities demonstrates that a high priority is being placed on customer satisfaction. This research would identify amenities that have the largest impact on the customer.

The strategic priority of enabling transit to operate in a technologically advanced society would also be supported by this research. Those technologies that aid the transit customer most effectively and that can adapt to evolving customer needs would be identified in this research. Similarly, the priority of continuously improving public transportation is consistent with finding passenger amenities and technologies that will attract additional transit customers and adapt to evolving customer needs and operating environments.

VIII. RELATED RESEARCH

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement was developed by an internal TriMet team named the Research & Analysis Coordinating Committee. This team is comprised of employees with a significant portion of their duties devoted to analysis and research. The Committee’s purpose is to coordinate and consolidate analysis and research efforts agencywide.

XI. DATE AND SUBMITTED BY

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on June 14, 2007.
I. PROBLEM TITLE

Best Practices in Working with Retail Outlets for the Sale of Transit Fare Media

II. RESEARCH PROBLEM STATEMENT

Transit agencies try to make it as easy as possible for customers to purchase transit fare media such as 7-day or 31-day passes, or multi-ride tickets. These types of fare instruments can usually be purchased at transit stations, transfer centers, or administrative facilities. In addition, transit agencies often cooperate with local retail stores and businesses that serve as points of sale for transit fare media. Places such as chain supermarkets and pharmacies often sell such transit fare media at their establishments. The stores often do this to provide another service for their customers and possibly to give themselves a competitive advantage over other similar stores. For transit agencies, using retail outlets for the sale of fare media is a way of partnering with community businesses and a relatively inexpensive way of providing a convenience for their passengers. Retail outlets generally are compensated in some fashion such as receiving a commission for all the media they sell. However, the arrangements between transit agencies and the retail outlets vary considerably.

Commissions offered by transit agencies to retail outlets vary from zero to as much as six percent of the value of the passes sold. One transit agency has reported that instead of providing sales commissions to retail outlets, it provides them with advertising opportunities that the transit agency receives in trade with media companies that advertise on their buses. Some transit agencies require the retail outlets to pay for the value of all passes received prior to selling them, while others work with retail outlets on a consignment basis. Some transit agencies trust retail outlets to sell the full range of fare media including discounted passes, while others restrict retail outlets to selling only full-fare media due to concerns that the staff members at retail outlets change too frequently and won’t understand the nuances of needing to check for identification when someone asks for a senior or disabled pass. Some transit agencies are moving to smart cards and added-value cards and now have retail outlets sell only those types of instruments at their locations. Some transit agencies try to have as many retail outlets as possible, while others offer exclusive rights to major chains that agree to sell their passes. Some don’t use retail outlets at all, and now sell passes through their websites. Some only sell passes through their fareboxes.

III. OBJECTIVE

The goal of this project would be to identify best practices that exist between transit agencies and retail outlets that sell transit fare media. Using retail outlets to sell transit fare media can help promote more transit ridership, but it can also invite problems of discounted passes being sold to ineligible people, causing the transit agency to lose revenue. There might be wonderful working relationships that have been developed between transit agencies and retail outlets that very few transit agencies are aware of. This project would identify the types of agreements that seem to offer the best opportunities for healthy, fair, and productive relationships that work well for the transit agencies, retail outlets, and customers.

IV. RESEARCH PROPOSED

The research would include a literature review, a survey of marketing managers of transit systems throughout the country, and follow-up telephone interviews with marketing managers to obtain more details as necessary. In addition, the research should include telephone interviews with at least a dozen representatives of retail outlets to gain their perspective of the advantages and disadvantages of providing
such services. The project should also include conducting focus groups among passengers to help identify their concerns, interests, and priorities regarding their ability to purchase transit fare media at places other than the transit facilities.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $200,000 maximum.

**Research Period:** 18 months.

This project could conceivably be done as a synthesis, but providing additional funding would allow more in-depth research and analysis to be done from the viewpoints of transit agencies, retail outlets, and transit customers.

VI. URGENCY AND PAYOFF POTENTIAL

Many transit agencies may be missing opportunities to expand their sale of passes because they are using outmoded means of working with retail outlets. For instance, the transit agency that provides free advertising opportunities for retail outlets has been told that the value of the advertising is much greater than the amount of commission the retail outlet would receive on the sale of passes, plus the advertising attracts more people to the retail outlet. Everyone wins. There might be many other best practices that could be more effective than existing commission agreements. Some agencies might have found more foolproof ways of allowing retail outlets to sell discounted passes while ensuring they are only sold to eligible users. There are lessons to learn in terms of technology and how it can help make selling transit fare media more efficient from the retail outlet’s point of view. Passengers who use passes tend to use transit more often since they have pre-paid for the service. When transit passengers use things such as passes, it speeds the boarding process since passengers don’t have to fumble for change or cash. Having more passengers using such media will help buses keep their schedules more reliably, which leads to more attractive transit service and greater usage of transit.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP STRATEGIC PRIORITIES

This project most strongly relates to the FTA Strategic Goal of Increasing Ridership since people who use passes tend to ride more often, and since the use of passes will help speed bus travel and improve schedule reliability. It also serves the TCRP Strategic Priorities of Placing the Customer First, Enabling Transit to Operate in a Technologically Advanced Society, and Continuously Improving Public Transportation. While it might not be an established goal, this project furthers the objective of helping transit agencies build relationships with other community entities as a way of gaining more community support for transit.

VIII. RELATED RESEARCH

The only known research on this was done by the Center for Urban Transportation Research as part of a project done for the Washoe County Regional Transportation Commission. That project only lightly touched on the topic as it reviewed and identified various methods to help fixed-route buses move more quickly on their routes, many of which were tight and having trouble making connections for passengers.

IX. PERSON(S) DEVELOPING THE PROBLEM
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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

As noted above, this subject was identified as an opportunity to improve transit operations as CUTR provided assistance to the transit agency in Reno, Nevada. It was then discussed at the 2007 TRB Annual Meeting with the Public Transportation Marketing and Fare Policy Committee, whose members voted unanimously in favor of submitting this problem statement for potential funding through the TCRP program.

XI. DATE AND SUBMITTED BY

6/15/07 by Joel Volinski on behalf of TRB’s Public Transportation Marketing and Fare Policy Committee.

Submit to:

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TCRP Problem Statement

I. PROBLEM TITLE

Evaluation of the decentralized control strategy ("zoning") for paratransit services.

II. RESEARCH PROBLEM STATEMENT

The passage of the American with Disabilities Act (ADA) revolutionized the requirements and expectations for transit agencies, forcing them to provide demand responsive paratransit services to the disabled. As a consequence, the demand for this type of services has experienced tremendous growth in the last dozen years, nearly doubling their ridership. The operating costs have tremendously increased as well and, because these services are currently still not cost-effective, transit agencies are forced to rely on heavy subsidies from the federal government.

A few transit agencies in the U.S., mainly the ones operating within very large cities (such as Los Angeles), adopt a decentralized control structure, the so called “zoning”, as opposed to a centralized one. This operating practice consists in dividing the whole (large) service area into several independent sub-areas, served and operated by different providers, with the intent to ensure an easier, smoother and less costly management of the entire operations. The pick-up location of each customer determines the sub-area and its service provider.

Demand responsive services rely on “ridesharing” to significantly reduce their operating costs. However, given that the drop-off location of each customer might be outside the pick-up sub-area, the “zoning” might cause to considerably increase the costs of these services; in fact a service provider is not allowed to pick-up customers outside its own service sub-area, thus forbidding the ridesharing and increasing the so called deadhead miles (miles driven with no customers onboard). Furthermore, customers having pick-up and drop-off location in different sub-areas are required to rely on two different providers for their trip.

III. OBJECTIVE

The objective of this research is to study the impact of the “zoning” practice for paratransit agencies, identifying what circumstances would justify its use and providing recommendations and guidelines to decision makers with the aim to minimize the overall operating costs, thus improving the service productivity.

IV. RESEARCH PROPOSED

The proposed research will respond to the need of quantifying the benefit and costs associated with the operating practice of “zoning” to help in the design of the organizational structure of paratransit agencies and will consist of the following key points:

- Review of the current practices adopted by paratransit agencies concerning the decentralized vs. centralized control strategy.
- Identify the costs structure associated with the management of paratransit service providers and particularly the relationships between the cost and the size of the service area.
- Perform simulation analyses to analyze the “zoning” effect on the operating costs for different demand distribution and size of service area. Also, analyze the possibly significant impact of different scheduling practices on the overall performance, within the “zoning” scenarios. Extensive sensitivity analyses will also be performed to embrace a wide variety of scenarios.
With the goal of minimizing the overall cost, identify break-even points in terms of demand distribution, size of service areas, typology of customers and possibly other variables, which would represent switching points between a centralized and a decentralized (“zoning”) control strategy.

Conduct case studies by collecting representative actual demand data from paratransit agencies. Ideally, we will consider three representative cases (“small”, “medium” and “large” agencies).

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $250,000-300,000.  
**Research Period:** 2-3 yrs.

VI. URGENCY AND PAYOFF POTENTIAL

Demand for paratransit services consistently increased during the last 10-15 years and transit agencies are struggling to cope with the associated high and raising operating costs. In addition, urban sprawl, one of the most obvious phenomena of the last few decades, will only contribute to further increase the demand for these services and simultaneously enlarge the service area.

Under these circumstances, transit agencies may be interested in organizing themselves in a decentralized fashion (“zoning”). A few of them are already adopting it. However, this operating practice has not been thoroughly evaluated in all its aspect yet. A quantification of the benefit and cost associated with it will be beneficial the transit business to maximize the productivity of their service.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

The proposed research will directly address the following FTA and TCRP strategic priorities:

- **Improving Capital and Operating Efficiencies:** A better understanding of the benefits and costs of “zoning” will enable transit agencies to make better decisions about their organizational forms and ultimately contribute to contain their already high costs of maintaining and operating their services.
- **Continuously Improve Public Transportation:** Public transportation as a whole will benefit from this study. In fact, while the “zoning” control strategy is currently and specifically related to paratransit services, future developments of the industry might also include an extensive use of flexible or demand responsive service for traditional transportation services for the general public.

VIII. RELATED RESEARCH

PATH/CALTRANS: “Productivity and cost-effectiveness of demand responsive transit systems” – completed (P.I.: Maged Dessouky)

IX. PERSON(S) DEVELOPING THE PROBLEM

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Linda K. Cherrington  
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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement has been developed by Dr. Luca Quadrifoglio (Texas A&M University) in collaboration with a group of transit researchers from the Texas Transportation Institute, led by Linda Cherrington.

XI. DATE AND SUBMITTED BY

Luca Quadrifoglio, Ph.D.
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Submitted on June 15th, 2007

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202/334-3089
FAX 202/334-2006
Evaluation of Impact of SMART Bus Electrical Loads

I. PROBLEM TITLE

Evaluation of Impact of SMART Bus Electrical Loads

II. RESEARCH PROBLEM STATEMENT

Over the past decade, the advent of Intelligent Transportation Systems had exponentially increased the demands of the electrical systems on buses to where the batteries and charging systems only marginally meet the load demands of these systems. The buses now come equipped with gas detection systems, cameras with digital video recorders, passenger counters, GPS vehicle location systems, head signs, electronic fareboxes, radio systems, in addition to the other on-board electronics. While these systems come equipped with "sleep modes", the sleep modes do not become active for a period of time after the bus is turned off, which results in a drain on the batteries each time the bus is turned off. In many cases, the buses may need to be shut down several times during servicing and maintenance, which results in an extended drain on the batteries.

The increased electronic loads and static design of the bus charging systems and battery storage systems has resulted in a significant increase in No Start problems. In addition, the electronic control systems currently used on buses requires constant and consistent voltage. The problems with low battery voltage has also resulted in a significant increase in engine related road calls, since low battery voltage will trigger Check Engine Lights from the engine electronic control system or Stalling problems when the current in the low voltage systems is below the minimums required to operate the systems.

The goal of increased ridership can only be accomplished by transit agencies providing reliable, cost effective service. Patrons will not be enticed to ride public transportation unless they can be assured that they will arrive to school, work, or other functions on time. The reliability problems resulting from marginally designed electrical charging and storage systems impact the public's perception of transit and has a direct bearing on the satisfaction and continued patronage of the riding public.

III. OBJECTIVE

The objective of this proposal is the development of a comprehensive report that identifies the increased loads resulting from the addition of SMART bus technologies, review battery storage systems designed to effectively provide power to these systems along with other bus electronic systems and subsystems, and evaluate charging systems that provide power to effectively operate these systems along with maintaining an adequate state of charge to the storage systems. The report is expected to consider alternative designs that would be more effective in maintaining the state of charge for the electrical systems, including improved "sleep modes" that shut down sooner and have lower draw than current designs and the potential for primary battery storage systems for bus starting and operating systems and secondary battery storage systems for ancillary loads.

IV. RESEARCH PROPOSED

It is proposed that the TRB set up a panel of industry experts to oversee a study of the electrical systems on buses and to develop recommendations to improve these systems.

Batteries - review of battery systems used on buses. Consider new gel cell (Optima) and dry cell (Odyssey) batteries that reduce charging times, provide improved cold cranking amperage, greater deep cycle capability, and increased warranties. Evaluate the increased cost of these new battery
systems in comparison to the higher failure rate of the traditional lead acid batteries and resulting labor requirements to address no start road calls and impacts to service as a result of these road calls.

System Design - the current battery storage systems on buses allow for ancillary systems to drain the only battery pack, and result in no start situations and interruption in service. Engineers and industry experts need to evaluate whether a separate battery storage system should be established for starting the vehicle and another separate system to provide power for the ancillary systems. The provision of dual systems, with a separate battery pack dedicated to the engine starting and electronic controls, would ensure that the drain from ancillary systems and situations where operators failed to turn off lights or other systems would not have an impact on buses starting and eliminate the interruption to service and inconvenience to our patrons.

Charging Systems - the current 24 volt alternator / charging systems have been used in transit buses for decades. While there have been minor improvements over the years, these systems need to be evaluated to determine if they have the capacities to operate all of the new electronic systems installed on the Smart buses over the past decade and the additional capacity needed to charge the battery storage systems. In addition, it should also be evaluated whether a dual system with dual battery storage systems (starting system and ancillary system) would require two separate charging systems that work independently.

Sleep Modes - Current sleep modes on buses turn ancillary systems off from 30 minutes to 2 hours after a bus is shut down. However, the systems can be ineffective when buses are involved in servicing activities, which require the bus to be started several times during the day and/or evening hours. The constant drain from the ancillary systems along with the high electrical load when starting the engine can lead to drained batteries that will not recover from normal operations when a bus is idling on a busy inner city street. An evaluation needs to be completed for all ancillary systems in the new Smart Bus configurations to determine the optimal period between shut down and initiation of the sleep mode. Passenger counters and fare box systems might be considered for immediate shut down, while gas detection systems on natural gas buses may be limited to 30 minutes of operation after shut down to reduce the drain on the battery storage systems.

The research should consist of a review of existing technologies along with an analysis of any new technologies that would improve the management of the ancillary electronic systems and/or the performance of the battery storage and charging systems. The research program should also consider case studies of five to six transit agencies and review actions that these agencies undertook to resolve problems related to high electronic ancillary loads and/or insufficient battery storage system design.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: The estimated cost of this research is $250,000, including the cost of the five to six transit agency case studies.
Research Period: The estimated period of time needed to complete the research would be 18 months, with an additional 3 months for review and revision of a draft final report.

VI. URGENCY AND PAYOFF POTENTIAL

With the continued advancement of electronics, the demand for more and more ancillary electronic systems is likely to increase. Five years ago, providing news and entertainment on systems, such as Transit TV, on buses would have seemed like an unrealistic endeavor; however, Transit TV systems are now installed on thousands of buses with many agencies equipping their entire fleet with this new technology. With communication systems advancing at a rapid pace, we
can expect that Wide Area Network systems will be in demand on buses in the near future to allow patrons to communicate and interact via the Internet while commuting throughout our large cities. The addition of these and other electronic systems will result in an urgent need to ensure that the electronic systems on our buses have the capability to provide power for the continued expansion of these electronic systems on the fleets of buses operated throughout the country.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This proposal supports the FTA goal of Increasing Ridership and Maintaining Existing Ridership. The first sentence of the FTA goal notes that the FTA strives to make affordable, reliable, accessible, and efficient public transportation available to all Americans, as ridership is critical for realizing the economic, environmental, and mobility benefits of Federal investments. By improving the reliability of the electrical systems used on transit buses, the efficiency and reliability of the overall system will improve, which will result in an improved public perception of public transportation and increased ridership.

This proposal supports the TCRP strategic priorities. The proposal places the Transit Customer First by ensuring that the customer has a reliable transportation system to commute to school, work, or other community functions. The proposal also supports the continued integration of state-of-the-art technology in public transit to allow the installation of future technologies, such as Wide Area Network capabilities, that will allow patrons to communicate via the Internet while traveling on board public transportation. Finally, the proposal is designed to improve public transportation for a larger and larger segment of the population in support of communities throughout the United States.

VIII. RELATED RESEARCH

I am not aware of any comprehensive research programs that are closely relevant to the proposed problem.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the product of an individual who works for a public transportation agency.

XI. DATE AND SUBMITTED BY

Submitted: April 24, 2007
I. PROBLEM TITLE

Documenting the Potential of Electric Trolley Bus technology

II. RESEARCH PROBLEM STATEMENT

In the 2005 State of the Union Address, President Bush called attention to our addiction to imported oil and the problems it created. He described how this addiction has distorted our national economy with deficits in our balance of payments, and he called upon America to break the addiction.

Of the road transportation options available to United States the only ones that are not ultimately dependent on a fossil-fuel based propulsion system are battery powered vehicles and electric trolley buses. Both of these technologies minimize locally emitted pollution by using electricity that can be generated remotely using renewable technologies such as hydro-electric, wind and solar. Where these clean natural energy sources are not available, remote generation of electricity at a highly efficient fossil or nuclear generation station offers the potential of minimal local emission where the power is generated and zero emission where it is consumed.

Electric vehicles date from about 1900, and electric trolley buses, initially developed during the 1920’s, were widely used in the transition from streetcars to diesel buses in the 1950’s. Electric trolley buses are considered old technology and have fallen out of favor. But six cities in North America and numerous cities in Europe and Asia have electric trolley bus systems and voice strong support for their continued operation.

III. OBJECTIVE

Document the operational characteristics and costs for the design, construction and operation of a modern electric trolley bus service based on the North American operating conditions and focusing on the experience within the United States (Sound Transit, Muni, MBTA, and the Dayton RTA).

IV. RESEARCH PROPOSED

Investigate and report on the current state of the electric trolley bus technology, cost structure, service capabilities and maintenance requirements. The report should investigate near-term innovations being developed locally and internationally.

The analysis should also include an evaluation of the opportunity for utilizing batteries and electric drive systems technology developed for hybrid-electric buses on an electric trolley bus. This evaluation should consider the merit of operation beyond the end of the catenary for passenger gathering and distribution. The extension would be powered by on-board batteries charged while the bus is operated under the catenary. This should be explored in light of battery and drive systems being developed for “plug-in” hybrid electric propulsion for automobiles and trucks.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** Nine professional staff months of effort is required costing $125,000. Administrative support of one-half staff year costing $50,000 will bring the total cost to $175,000.

**Research Period:** The research period for this effort should be six months with an additional three months for review and revision of a draft final report, for a total of nine months.
VI. URGENCY AND PAYOFF POTENTIAL

If the United States is to reduce its dependence on foreign oil, it will be through the use of technologies that do not require the use of on-board petroleum-based fuel. Within the transportation sector, the options for zero petroleum-based propulsion are limited to electric automobiles, electric trucks, electrified trains, and electric trolley buses. Aircraft and domestic water transportation are limited to fossil or chemical fuels and can use electric-drive propulsion en route only if the electricity is generated from an on-board fuel supply.

Automobiles with battery electric systems have demonstrated the ability to operate for 50 to 100 miles between battery charges but require an extended time period for recharging. Electric trains operate under a continuous catenary for their power supply but are limited to railroad tracks with overhead catenaries. Electric trucks have a limited use in mining and industrial sites.

All of these systems lack the capabilities needed to demonstrate large-scale transportation services, such as the flexibility to operate offline on adjacent streets and roads without costly centenary and traction power systems. An electric trolley bus could be powered by a traction power/overhead wire system and equipped with the battery systems found on today’s hybrid buses. This modernized configuration would have the capability to operate continuously despite a vehicle breakdown under the catenary and with route extensions beyond the power lines. There would be no local emissions and no use of foreign oil.

VII. RELATIONSHIP TO FTA RESEARCH GOALS and TCRP STRATEGIC PRIORITIES

Three of the five FTA Strategic Research Goals are addressed by the problem statement (in order):

2. Improving Capital and Operating Efficiencies

The TCRP Strategic Priorities are enhanced:

II. Enable Transit to Operate in a Technologically Advance Society

VIII. RELATED RESEARCH

I have been unable to identify any recent research on electric trolley bus technology or service.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

The project was developed by John Bell and discussed with Tony Zakel and the TRB Light Rail Committee, Electric Trolley Bus Sub-Committee (AP065).

XI. DATE AND SUBMITTED BY

Submitted on June 15, 2007 by: John G. Bell, Anthony Zakel
Title: Assessing Return on Investment for CCTV Security Systems

Research Problem Statement:

Since 9/11 there has been a dramatic rise in the awareness of security on public transit systems across the country. Federally mandated threat and vulnerability assessments have inspired thousands of new closed circuit television (CCTV) cameras and ballooning security budgets for transit agencies with hype and federal funds. And as those of us who have been around a while know, eventually the federal money will run out and the agencies will be left holding the bag.

The difficulty with security is that the need is real and the expectation is that agencies should do everything to protect the traveling public. To do less is to risk being maligned in the local papers or worse. So, how do we, the industry, keep up security with less. The answer is we do it smarter, but how?

Objective: the objective of this study is to obtain a systematic assessment of the total cost vs. the total return/savings for the various types of CCTV installations so as to provide a guideline to all transit agencies implementing or contemplating CCTV systems. This study is intended to be incorporated into a CCTV recommended practice being develop by the Communications Subcommittee and may also be used by the Infrastructure Security Standards Working Group.

Research Proposed: We propose to do a comprehensive data gathering exercise and analysis on the following:

1. Total cost, as an industry average, to build, operate and maintain a CCTV system for each type of installation and monitoring policy (active monitoring, alarmed event monitoring only, or passive monitoring)
2. Potential savings to be found for each type of installation in:
   a. Reduced vandalism and theft
   b. Reduced liability from slips and falls
   c. Reduced security or operating cost
3. Estimation of the ridership gains or losses from adding or removing CCTV cameras

Estimate of the Problem Funding and Research Period
We estimate the project will take two FTE persons 6 months of research plus another month to write up the report. Total expected budget is anticipated at $240,000 plus an approximate $50,000 in travel and other expenses.
Urgency and Payoff Potential

Transit has needed this data for some time. The results of the report will aid the operators and designers of transit systems deploying these technologies in the areas where the greatest returns can be expected. This is fundamental to the decision making process but it beyond any one group’s ability to collect or predict the results.

We estimate that the payoff for this consists of three parts (1) reduced cost of labor, (2) reduction of risk, and (3) reduced capital cost. The magnitude of savings will be on the order of $1 - $5 million over 5 years for any agency deploying more than about 50 cameras.

Relationship to FTA Strategic Goals and Policy Initiatives and ACRP Strategic Priorities

Project fits into both the FTA’s and APTA’s strategic research goals of improving capital and operating efficiencies and the effectiveness of technology and capital projects.

Related Research

None that we are aware of.

Person(s) Developing the Problem

APTA Communications Subcommittee
Chair: Jonathan McDonald, Principal Consultant - Communications, LTK Engineering Services, 401 S. Jackson, Seattle, WA 98104
Phone: 206-398-5458, Fax: 206-689-3339

Process Used to Develop Problem Statement

Problem was developed by committee and has been reviewed by APTA’s Infrastructure Security Standards Working Group.

Date and Submitted by:

Submitted by: Jonathan McDonald 6-22-06
TRANSIT COOPERATIVE RESEARCH PROGRAM PROBLEM STATEMENT

I. PROGRAM TITLE

A Handbook for Lighting in Transit and Pedestrian Environments

II. RESEARCH ROBLEM STATEMENT

Accommodating an aging population, ensuring passenger safety and security, enhancing employee productivity and coping with rising energy costs are challenges confronted by the operators of transit terminals. The development of a Handbook for Lighting in Transit and Pedestrian Environments provides transit operators with a tool for addressing these challenges with more appropriate and more energy-efficient lighting.

Older adults, an increasingly important transit market niche, need more light to see, are more sensitive to glare and cannot adapt to large changes in brightness. Adequate lighting in transit terminals is essential not only to avoid potential accidents, such as falls, but also to encourage older adults to use transit by offering a hospitable environment. Lighting in the pedestrian environments around the terminals is also important. Excessive outdoor lighting can create glare which may reduce visibility for drivers and pedestrians around transit terminals. Inadequate lighting can reduce safety and security and feelings of safety in older pedestrians.

Lighting in transit and pedestrian environments also contributes to the productivity of individuals who work in transit terminals. The level and quality of lighting can not only facilitate performance of visual tasks, but can also aid alertness, making it easier for employees to carry out their responsibilities. This is particularly crucial to facilitate personnel who are charged with ensuring passenger security and working early morning or late night shifts. Humans are diurnal species and expected to be awake during the daylight hours and asleep during the nighttime hours. Performing cognitive tasks during nighttime hours may result in decrement in performance. Light of certain characteristics applied at night has been shown to increase objective and subjective alertness and improve certain types of performance. Just as important, well-designed lighting can decrease energy usage and operating costs in transit terminals.

III. OBJECTIVE

The objective of this research is to identify measures to close the gap between current lighting practices and standards in transit and pedestrian environments and the lighting that is needed to support older transit users, employee productivity and energy efficiency. This will be accomplished by assessing the effectiveness of current lighting practices in meeting the visual requirements of passengers at different ages as well as the visual requirements of
employees inside the terminal and adjacent pedestrian areas. Lighting practices will be evaluated as they affect the alertness and well-being of employees working early-morning and late-night shifts and contribute to energy efficiency and lower terminal operating costs. General lighting guidelines and specifications and design patterns (where applicable) will be proposed to overcome some of the identified gaps and reduce energy use in transit terminals and surrounding areas. The results of this research will be conveyed in a Handbook for Lighting in Transit and Pedestrian Environments.

IV RESEARCH PROPOSED

The following tasks are being proposed to be executed in this research project

1. **Conduct literature review** to identify the current practices and standards used in transit terminal lighting in terms of lighting quantity, spectrum, distribution, and energy-efficiency, as well as present some examples of the application of these standards in specific terminals.

2. **Perform limited measurements of lighting levels in public indoor and pedestrian outdoor areas of specific terminals.** (at least 4 terminals in the United States) to document the lighting characteristics currently found in terminals and associated pedestrian areas (quantity, spectrum, distribution, timing and duration) as it affects the visual systems of the users of terminals, as well as the alertness and well-being of those working in transportation terminals.

3. **Document required lighting practices and standards.** The effectiveness of current lighting practices in meeting the visual requirements of passengers at different ages will be assessed. How lighting can help with improving visual information for those transit terminal users who are 65 years of age or older, the effectiveness of current lighting practices in improving alertness of those working early-hours and late-night shifts, and the evaluation of lighting in the pedestrian areas around the transit terminals as it relates to visibility, glare and light pollution will be reviewed. Mathematical models are available and can be applied to predict discomfort glare as well as an outdoor site performance metric to quantify light pollution, glare and light trespass. The model predictions will be used to suggest improvements to the indoor and outdoor lighting in transit terminals.

4. **Identify gaps between current lighting practices and standards in terminals** needed to meet the needs of the target groups and current lighting practices and standards. The assessment will focus on the visual requirements (light levels, glare, light distribution, aesthetics) as well as the requirements needed to maintain alertness and performance.

5. **Analyze potential energy savings and benefit/cost relationships** of improved lighting systems. This will be accomplished by using the outdoor site performance metric to assess the potential for reducing wasted light, glare and light pollution in pedestrian areas around transit terminals. The potential energy and cost savings associated with the indoor transit terminal lighting will also be analyzed. The payoff potentials related to energy-savings and possible increase in productivity can be significant if there is a better understanding of the current lighting practices.
6. **Document findings by preparing** a draft and final Handbook on Lighting in Transit and Pedestrian Environments with general lighting guidelines and specifications and design patterns (where applicable) for improving lighting standards and practices.

V  **ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD**

The estimated funding for the project is $400,000 and the research period is 24 months.

VI. **URGENCY AND PAYOFF POTENTIAL**

This research is crucial to ensure that lighting in terminal and pedestrian environments meets the needs of users, including the older adult customers, enables employees to carry out their responsibilities during their shifts and assists operators in controlling energy costs in an environmentally friendly manner. Lighting accounts for 22 percent of the total electric energy use in the United States and transit terminals have lighting systems that are in operation 24 hours a day, 7 days a week. The aging of the population will produce 63 million people 65 years and older by 2025, about 18 percent of the United States population. This research will demonstrate how lighting in transit and pedestrian environments can: help improve visual information and safety for the older (and younger) transit passenger, discuss how lighting can help with maintaining alertness of those employees working early-morning and late-night shifts and, provide some insight into the potential energy savings associated with lighting in transit terminals around the nation. This research will also promote less wasted outdoor light and, thus, less light pollution. The payoff potentials related to energy-savings and possible increase in productivity can be significant if there is a better understanding of the current lighting practices. Further, a better understanding of how current lighting practices in terminals and surrounding areas can be improved to meet the needs of the aging eye can help encourage older adults to use transit.

VII. **RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP STRATEGIC PRIORITIES**

This research project addresses all of the FTA strategic research goals. By providing a more hospitable and safe environment for older adults through improved lighting, it encourages more ridership. Enhanced lighting better enables security personnel to carry out their responsibilities and to ensure the safety of passengers. Analyzing energy savings through lighting systems identifies potential operating efficiencies of different systems as well as reduction of wasted light and light pollution in outdoor applications. This research project also supports TCRP strategic initiatives by meeting the needs of the transit customer, and applying technological innovations to support worker productivity, reduce energy usage and control operating costs.

VIII. **RELATED RESEARCH**
Lighting principles for the aging eye have been developed and applied by researchers at Rensselaer’s Lighting Research Center (LRC). Those lighting principles are well-understood and can be applied to transit terminals and pedestrian environments. Outdoor site performance metric has also been developed by the LRC and can be used to prepare recommendations for lighting pedestrian areas around transit terminals. Research on the light’s effect on alertness and well being of those working night-shift has also been conducted by various laboratories around the world, including the LRC. It is now well established that quantities of white light higher than the ones typically found in indoor environments are needed to maintain high alertness and improve performance of those working at night. Finally, new lighting technologies and applications have been developed in recent years that can allow terminal management to reduce costs associated with energy usage.

IX PERSONS DEVELOPING THE PROBLEM

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<th>Harry P. Wolfe, PhD</th>
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X. PROCESS USED TO DEVELOPMENT PROBLEM STATEMENT

The problem statement was a collaborative effort of Harry P. Wolfe and Mariana Figueiro. Input was also received from Dr. Kit Mitchell and Dr. Kate Hunter-Zaworski, co-chairs of the TRB Committee on Accessible Transportation and Mobility, Russell Thatcher, Chair of the Research Subcommittee, TRB Committee on Accessible Transportation and Mobility and Jim Crites, Chair of the TRB Aviation Group.

XI. DATE AND SUBMITTED BY

June 13, 2007; submitted by Dr. Mariana Figueiro and Harry P. Wolfe
I. PROBLEM TITLE

Shared Use of Road Space by Buses and Bikes

II. RESEARCH PROBLEM STATEMENT

It is becoming quite common, as part of a program for “complete streets” to include accommodations for bicycles as part of the roadway cross-section. These may be either as marked lanes, typically four or five feet wide, just to the right of the right-most auto travel lane, or as an unmarked area in a wider than normal curb-lane. These are the lanes typically used by transit buses for traveling and/or stopping to board and alight passengers.

In a session on “complete streets” at the APTA Bus and Paratransit conference in Nashville in May 2007, a slide of a “complete street” with a bus stopped blocking the curbside bike lane was presented. This elicited comments from some in the audience that this represented an unsafe condition since buses would have to avoid bicyclists, potentially on the right of the bus, when pulling to the curb to serve passengers. Similarly, bicyclists could be tempted to swerve around stopped buses exposing themselves to auto traffic in the travel lane or to the bus when it pulls back into the travel lane after serving passengers. Others replied that they operated with this condition and had not had poor crash experience or other safety related problems. It became clear the there was a difference of opinion but all were based on anecdotal evidence with no solid data.

The research to be conducted is to identify metropolitan areas in which various forms of bike accommodations have been provided; to assemble data on the crash rates in these areas; to compare these rates to the crash rates 1) on roadways in the same areas having similar ADT, bus and bike volumes but no special bike provisions and 2) on roadways in other metropolitan areas having similar bus volumes, ADT’s, and bike usage. The research will be conducted using data from available sources. No original data collection is anticipated. If there are too few reported crashes for full crash rate analysis, the research will document the reported experience and the “maximum expected crash rate” based on the available observations.

III. OBJECTIVE

To provide transit agencies and agencies having roadway design responsibilities with sound, research based information about the problems or lack of problems related to shared use of roadspace by buses and designated bike lanes. To provide guidelines to agencies about the conditions (e.g. roadway type, cross-section, bus volumes, bike volumes, bus stop frequency, etc.) under which share use of space is acceptable and under what conditions it should be avoided.

IV. RESEARCH PROPOSED

The research will include 1) identifying metropolitan areas that meet the conditions for the study design – e.g. bus and bike use of shared space – and having accessible crash data; 2) compiling the crash data and other relevant information; 3) conducting the analysis; 4) documenting the findings; 5) preparing guidance on the shared use of roadspace by buses and bikes

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $300,000  
**Research Period:** 21 months, including TCRP review

VI. URGENCY AND PAYOFF POTENTIAL

The use of designated bike lanes that are also used for bus operations or bus boarding and alighting activity is growing. Many states and municipalities are adopting roadway standards that require the provision of special lanes for bikes. If this is a potential safety issue, transit agencies need to know the potential magnitude of the problem and the conditions under which objections should be raised to shared use in order to avoid potentially fatal bus/bike crashes.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This project would respond directly to FTA Research Goal (3) Improving Safety, Security and Emergency Preparedness and TCRP Strategic Priority IV. Flourish in the Multimodal Environment

VIII. RELATED RESEARCH

Transportation Research Record: Journal of the Transportation Research Board (TRR: Journal), No. 1982 contains 24 papers on the subject of pedestrians and bicycles but the specific topic of bus/bike interactions is not addressed. The Federal Highway Administration has an active program of research related to safety of pedestrians and bicyclists, but no project that directly addresses or seems to consider the potential hazards related to shared use of roadspace by buses and bikes.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Product of an individual after discussions with staff of transit agencies, persons engaged in bicycle systems planning and persons engaged in traffic safety research.

XI. DATE AND SUBMITTED BY

Submitted June 14, 2007  
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I. PROBLEM TITLE

Guidelines for Developing Performance Based, Transit Track Safety Criteria

II. RESEARCH PROBLEM STATEMENT

The Rail Transit Agencies of North America do not have a unified system of track safety criteria. The Federal Railroad Administration’s (FRA) Track Safety Standards were developed for the railroad industry. Although not applicable by statute, these standards are commonly used as a template by many transit agencies and for the minimum track safety standards developed in-house. However, because the Rail Transit industry does not share common equipment or even track gauge and wheel profiles as the railroads do, the FRA railroad standards do not address many issues specific to individual Rail Transit properties.

In order to provide operational assistance to its members in this area, the American Public Transit Association Rail Transit Task Force (RT-S-FS-008-01) developed, “Standards for Inspection and Maintenance of Fixed Structure – Transit Track”. This standard is an excellent template for Transit Systems and is quite comprehensive in scope, but it is also fairly general in nature as it is intended as a model for all Rail Transit systems. The APTA document is intended as a safety guideline for each transit system to use in developing the Agency’s own standards. However, each transit system that adopts standards that differ from the APTA standards must document their changes and provide the engineering basis for those differences. In many cases, the engineering basis for specific standards differences is either lost in antiquity or has been developed empirically over time and lacks adequate theoretical support to comply with the documentation requirements, which causes compliance problems.

Because of its comprehensive nature, the above referenced APTA “Standard” does not differentiate among the various track designs, wheel profiles and wheel/rail interfaces nor the associated vehicle dynamics issues that actually exist. Each Transit system is different; not very many systems have the same vehicle, and thus there are many different wheel / rail interfaces throughout North America. The current TCRP Panel D-7 in concert with TTCI is investigating and developing guidelines for Transit Flange Wheel Climb. The current research is discovering and documenting how the wheel profile plays a major role in wheel climb accidents. In fact, the choice of wheel flange can significantly increase or decrease the potential for a particular vehicle to derail under otherwise identical conditions. These flange profiles vary substantially among the systems, and need to be taken into account in the development of Agency-specific track safety standards.

From a practical standpoint, the North American Railroad and Transit industries depend on the AREMA Manual of Recommended Practices and the AREMA Portfolio of Trackwork Plans for controlling the design, manufacture and installation of materials used in the construction and maintenance of track, especially for special trackwork. This reliance on the AREMA Manual further complicates the issue, as transit operators have long recognized the potential incompatibility of their transit wheels with the AREMA switch designs and they have developed designs of their own or imported European designs to obtain improved life and ride comfort. This is especially true of Agencies with street-running trackage. The divergence between railroad and transit equipment, the physical layout and track geometry as well as operating conditions negates the possibility that the AREMA Recommended Practices and Plans can be applied uniformly to all Rail Transit systems. This lack of applicability of a widely respected Manual emphasizes the pressing need for a methodology to develop minimum track safety criteria that addresses the track component and vehicle design combinations unique to each system.

To summarize, all the Rail Transit agencies have steel wheels, steel rails and other general similarities, but there are significant differences in the designs of their vehicles and track structure systems. The minimum safety standards for each property will necessarily have different details to address the design issues of their specific transit vehicles, track structure and unique track geometries, and their interactions. We believe what is needed is not a “one size fits all” approach to developing Standards, but rather a system of performance based criteria, i.e. a “how to” guide, for developing minimum safety criteria for each rail system that is not regulated by the FRA. This effort is not intended to compete or conflict with the APTA effort, AREMA or the FRA Track Safety Standards.
Rather, this effort is to build on APTA, AREMA and FRA in order to create a uniform, practical, and theoretically sound method that enables each Agency to develop or improve its own Transit Track Safety Standards. The improved standards would be compliant with all applicable APTA and industry standards, yet fit the conditions unique to that Agency’s system.

III. OBJECTIVE

The objective of this research is to create a “how to” guide for developing individualized, system-specific, performance based track safety criteria that are based on passenger vehicle characteristics (such as vehicle size, truck design, wheel profiles, solid axles, and independently rotating wheels), transit track geometries and transit track components. The research should redevelop, through engineering analysis, the limits to be applied to track gage, check gage, back-to-back gage, track surface, cross level and alignment, and especially the combinations thereof. $V_{\text{max}}$ limits for maximum vehicle speeds on curves shall also be examined through this research. This research may also discover unrecognized adverse interactions between vehicles and track. The compilation of the research shall be the “how to guidelines” which will incorporate the vehicle characteristics into the development of the guide and to provide the practical and theoretical basis for specific recommendations. The “how to guide” shall establish the formulae and methodology which can be universally applied to produce track safety standards for a specific vehicle or fleet of vehicles, and the track structure systems on which they operate.

IV. RESEARCH PROPOSED

Phase 1: Review the development of the FRA track safety limits, the APTA Rail Transit Task Force report, “Standards for the Inspection and Maintenance of Fixed Structures – Transit Track”, AREMA Recommended Practice, and other similar publications and evaluate the applicability of those practices and methodology to the development of transit track safety limits. Summarize the findings to identify where additional investigation, analysis and testing are required in order to develop the guide.

Phase 2: Complete the additional research identified in Phase 1. Develop the “how to” guide based upon the findings of Phase 1 as well as the additional research.

Phase 3: Create computer program or programmed spreadsheet that will allow Transit Properties to input their specific vehicle and track data that will output recommended track geometry safety limits based upon that found in Phase 1 and 2.

Phase 4: Using the data from Phases 1 through 3, field validate the recommendations from Phase 2 and 3, with particular emphasis on Direct Fixation and Embedded track forms unique to the transit environment. Field validations should include track strength measurements. If necessary, update results from Phase 2 and 3.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

FUNDING:

- Phase 1: $50,000
- Phase 2: $120,000
- Phase 3: $80,000
- Phase 4: $150,000
- TOTAL: $400,000

Note: If insufficient funding were available for all phases then the efforts of incremental phases would be beneficial.
VI. URGENCY AND PAYOFF POTENTIAL

The potential payoff is high, particularly for transit systems with non-FRA regulated track. The current research concerning wheel flange climb clearly shows the importance of this single factor on safety and preventing derailments. With the results of this proposed research, the transit agencies will be able to concentrate on their primary tasks of operations and maintenance, rather than on an effort to justify their existing track standards. This effort is needed as quickly as possible so that transit properties will have a guide for developing their own APTA-compliant standards that builds on the existing APTA I&M Standards as well as the basic FRA Standards and AREMA Recommended Practices that underlie all Safety Standards.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This research will help Transit Agencies improve their operations (and possibly increase operating speeds), their inspection programs and maintenance programs to enhance safety and improve reliability thus “Improving Safety, Security and Emergency Preparedness,” and indirectly “Increasing Ridership” by virtue of improved comfort levels and better on-time performance.

Regarding the TCRP Strategic Priorities, the development of performance based track safety criteria enhances “Place the Customer First,” as the development and implementation of appropriate standards will result in improved service with fewer delays, less noise, and a more comfortable ride. Although infrastructure improvements are not readily visible to the average patron, the resulting improved operations are definitely apparent. Improved track safety standards also mesh with the priorities to “Enable Transit to Operate in a Technologically Advanced Society” and to “Continuously Improve Public Transportation.” Additionally, a uniform method of performance based track safety criteria will enable Transit organizations to develop better track safety standards, which in-turn will help Transit organizations to “Work Better and Cost Less” while “Improving Capital and Operating Efficiencies.”

VIII. RELATED RESEARCH

Other related research is ongoing by TTCI under the TCRP Program: Wheel Flange Climb Safety Criteria, and Transit Switch Design. Both of these efforts should produce valuable information that can be used in developing appropriate Safety Criteria using the “how to” guide proposed herein.

APTA and AREMA have very recently entered into a cooperative agreement whereby the future development of infrastructure Recommended Practices relating to rail transit will be within AREMA’s purview, with support from affected APTA groups, Committees and Technical Forums. Conversely, if the new documents are “Criteria” covering rail transit infrastructure or operations, then APTA will develop and disseminate these criteria, with
possible formative input from AREMA or individual AREMA members. We do not see that this development between APTA and AREMA will have significant effect on the need for the research advocated and proposed herein.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement was developed under recommendation of the following Technical Forum and Committee:

1. TRB Committee AP080, Rail Transit Systems Design, Bruce R. Smith, Chair
2. APTA Track, Noise and Vibration Technical Forum, Richard A. Brown, Chair.

XI. DATE AND SUBMITTED BY

Date Submitted: June 15, 2007  
Submitted By: Anthony P. Bohara (see Section IX, above).
I. PROBLEM TITLE

CRASH WALLS VS GUARD RAILS IN URBAN TRANSIT PROJECTS

II. RESEARCH PROBLEM STATEMENT

In urban Transit Projects in situations where Light Rail Transit (LRT) tracks are located next to existing freight railroad tracks, because of the limited right-of-way availability, most of the time the freight tracks are located less than 25 ft from the nearest LRT track. In these situations where the freight tracks are located next to LRT aerial guideway, AREMA guidelines require crash walls at all piers of the LRT structure support locations to protect the guideway from any impact from a possible derailment of the freight train. These crash walls are very massive in size and have a significant visual impact on the surrounding urban environment and moreover they are expensive to build.

As an alternate to using crash walls mandated by AREMA, this research proposal recommends the use of Guard Rail on the freight tracks in the vicinity of the LRT aerial guideway to confine a derailed freight train to a limited lateral movement and prevent the possibility of an impact with the LRT support structure.

III. OBJECTIVE

The objective of this research is to develop and provide reliable data regarding the effective use of Guard Rail(s) in the freight track structure to confine a derailed Freight train and to prevent it from ever hitting the LRT support structure. This research is also suppose to assess the safety of operations and the cost effectiveness of using guard rail vs. crash walls.

IV. RESEARCH PROPOSED

The research objective can be accomplished through the following phases:

Phase 1:

1. A literature search of prior research work or currently under way, especially private studies carried out in North America, which could be pertinent, and can possibly be incorporated into this research.
2. A study of present practices on a significant number of operating properties, in North America, stressing those that operate similar vehicles on similar tracks and evaluating derailments, effectiveness of each method, economics of implementing each measure and costs of maintenance for each type.
3. If needed, Computer modeling to determine if there are substantive theoretical differences in the performance of the two different philosophies and practices.
4. Publication of Phase 1 Report.

Phase 2 - If the results in Phase 1 indicate that there are potential benefits from the Guard Rail method vs. current Crash Wall practice, then Phase 2 will be implemented

5. Develop optimum recommended method of effectively using the Guard Rail in lieu of Crash Walls.
6. Implementing and testing Guard Rail concept using various speeds for the freight tracks. This will probably best be performed using the facilities and equipment of at least two (2), preferably three (3), cooperating transit Agencies: one light rail, and, optionally, one heavy rail, if funding permits.
7. Publish the Phase 2 Report. Comparing use of Guard Rail instead of Crash Walls and address the issues in a comprehensive document.

Phase 3 - If the verification test results in Phase 2 are positive, then Phase 3 will be implemented, predicated on additional transit Agencies volunteering to do the testing primarily at their expense

8. If the benefits are substantial on an improved performance and cost/benefit basis, then have other Agencies volunteer to install Guard Rails instead of Crash Walls.

9. Publish the Phase 3 Report, and provide all the research results to an organization empowered to draft the information into a form suitable for inclusion in a Manual of “best & recommended practices” used universally by the rail transit industry.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: The research is envisioned as being in three (3) Phases so that positive results in a Phase will result in activating further research in the next Phase; negative results will result in research termination at the end of the Phase in question. The Phases, as listed above, are estimated to require the time and funding as listed below:

Phase 1
Phase 1 is estimated to require funding in the $25,000 to $35,000 range. It is anticipated that the literature search, Agency practices profiling can be done simultaneously.

Phase 2
Phase 2 will require funding in the $40,000 to $60,000 range, based on the facilities being Agency furnished, operated and maintained at no cost to TCRP. The research effort will require the installation and monitoring of the instrumentation required, but will not require a full-time presence at the test sites.

Phase 3
Phase 3 is estimated to require funding in the $45,000 to $75,000 range, depending on how many Agencies volunteer for the test program, and how closely the researchers monitor their progress.

Total Funding Required:
Based on the premise that the research is promising and that all three Phases are implemented, the total funding requirement will be in the $110,000 to $165,000 range.

Research Period: In each Phase listed, time is allowed for drafting the Final Report.

We estimate that the Phase 1 literature search, profiling of current practices, and computer modeling will take three(3) to six (6) months. The Phase 2 field-testing and verification will take from four (4) months to (12) months. Phase 3 will probably extend over at least one (1) year, perhaps more, depending on the number of volunteer Agencies, and how extensive research support is required for their testing. The researchers would help the Agency personnel to draft their Final Report, which would be published by the Agency, not TCRP.

The total Research Period is estimated to extend over approximately 2 years.
VI. URGENCY AND PAYOFF POTENTIAL

The urgency of the proposed research program is driven by the following considerations:

1. The potential safety issues involved; as we don’t presently know the effectiveness of Crash Walls or Guard Rails as it is presently applied.

No impediments to applying the results of this research are foreseen. To change these type installations would have to be analyzed on a cost/benefit basis to see if it makes sense. New installations should not present any real problems to implementation.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

The research is pertinent to at least three FTA Initiatives: (1) Improving Safety, Security and Emergency Preparedness - helping transit agencies increase safety; (2) Improving Capital and Operating Efficiencies – limiting the escalation of Capital costs, which often cascade over into capital programs;

VIII. RELATED RESEARCH

None that we are aware of.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This issue of Crash walls Vs. Guard Rail has been debated vigorously (mainly as a cost saving measure) on the current DART Phase II extension Project as the current alignment consists of more than 10 miles of LRT Aerial guideway which runs parallel to an existing Freight Track on DART Right-of-way with only 20 ft track center distance between Freight and the nearest LRT Track. This alignment is designed with Crash Walls for each of the LRT structure column, which falls within the 25 ft distance from Freight Track as per AREMA Guide lines.

XI. DATE AND SUBMITTED BY

Submitted: June 15, 2007 (anticipated)
Submitted By: Eduardo Ugarte P.E. and Reddy Chidananda P.E. (refer to Section IX, above)

Submit to:

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I. PROBLEM TITLE

Optimizing the Check Gauge of Restraining Guard Rail

II. RESEARCH PROBLEM STATEMENT

Restraining guard rail¹ (hereinafter RestRail) is commonly used in the track structure of North American rail transit systems. RestRail systems consist of a rail installed along the inside of the inner running rail (low rail) of horizontal curves, including the curved leads of turnouts. The flangeway opening between the low rail and RestRail is typically in the range of 1.50-in. (38mm) to 2.12-in. (54mm), depending on the wheel flange nominal width. The back of the wheel flange of the lead axle in a truckset bears against the gage face of the RestRail to provide some or all of the steering guidance to the wheelset, and thereby to the truckset and vehicle. RestRail is installed on many rail transit properties because it is either stipulated in the Agency’s track standards or recommended by their consultants, in the expectation that the RestRail will provide the following benefits:

- Increase the safety of operation by preventing flange-climb derailments, especially when the wheels have small and/or worn flanges
- Prolong the service life of the outer, high rail by decreasing rail wear, especially on the gauge face
- Reduce the noise associated with wheelsets negotiating curves

Assuming that the RestRail actually provides these benefits and therefore justifies its cost of installation and maintenance, the most important question is: what is the correct check gauge that should be used to obtain optimum performance? Check gauge is the dimension between the gauge face (point)² of the high rail opposite the RestRail installation and the gauge face (point) of the RestRail itself, where the flange backside contacts the face of the RestRail. This dimension will determine whether the flange of the wheel on the high rail makes contact with the gauge face of the rail, or never makes contact.

This dimension is crucial in determining whether the RestRail performs its function in an optimum manner and delivers the anticipated benefits. In North America, almost uniformly among Agencies but with a few exceptions, track designers and Agency track standards call for “shared contact,” on the basis that the high rail and RestRail will share the curving forces and associated wear more or less equally, and the check gauge and track gauge is set to allow this “sharing”. It is hoped that the high rail and RestRail will wear out and be replaced during the same maintenance track outage.

Conversely, in Europe the normal practice is to increase the check gauge dimension and track gauge so that no flange contact with the high rail will occur under any combination of wear and tolerances, so that the RestRail resists all the curving forces and therefore experiences all the gauge-face wear; the high rail sees only top wear. This is accomplished by simply widening track gauge. Why do the Europeans do this? According to several operating transit Properties in both Germany and France, their reasoning is:

- that because of the variations in the wheel mounting back-to-back dimensions, wheel flange wear, rail gauge face wear, and track gauge variations, it is impossible to have “shared” contact with both the high rail and RestRail in any reliable manner
- that when contact is shared intermittently, adverse steering forces are introduced into the trucks, resulting in rapid oscillation and in significantly increased nosing forces possibly damaging the track, such as gouging wear of both the high rail and RestRail, and breaking the bolts holding the RestRail
- that the sudden, adverse steering forces likely result in a lurching, uncomfortable ride in the vehicles, especially affecting standees
The obvious question is: are the North Americans or Europeans doing it the right way? It is an important question, as if the Europeans are right, then we here in North America are perhaps using a practice that is not only less than optimal but may also lead to operating safety issues, premature wear or damage to the track that increases the maintenance requirements, makes for an uncomfortable ride, and may also result in additional noise and vibration generation.

The existing literature is not much help, here. The American Railway Engineering and Maintenance of Way Association (AREMA) Manual of Recommended Practice and other published design guidelines address none of the issues noted above. The AREMA Manual, for instance, does not list “Restraining Rail” as a topic in any chapter. TCRP Report # 57 states in Chapter 4 that the owning Agencies vary widely in their design criteria, but offers no guidance regarding proper installation criteria. Most of the track standards developed and used on various properties are based simply on prior practice without independent verification that the practice is appropriate or effective. Therefore, there is a significant lack of knowledge about this issue that has serious implications in operating safety, passenger comfort, and maintenance requirements.

From a transit planning perspective, knowing the optimum RestRail check gauge measurement may significantly reduce potential noise and vibration issues. This in-turn may result in lower capital costs due to the need for fewer sound walls, floating slabs and other remediation techniques. From a larger noise and vibration perspective, knowing the optimum check gauge could simplify design alignments for new construction, particularly in urban / suburban locations.

III. RESEARCH OBJECTIVE

The objective of this RestRail check gauge research is to provide reliable data regarding the effect on safety of operation, passenger comfort, noise and vibration generation, and maintenance requirements resulting from the use of the “shared” contact philosophy generally used in North America versus the RestRail only contact used on many Properties in Europe and a few in North America.

IV. RESEARCH PROPOSED

The research objective can be accomplished through the following phases:

Phase 1:

1. A literature search of prior research work or currently under way, especially private studies carried out in North America and in Europe, which could be pertinent, and can possibly be incorporated into this research.
2. A study of present practices on a significant number of operating properties, both North American and European, stressing those that operate similar vehicles on similar tracks, comparing their check gauge practices, and evaluating derailments, rail wear, wheel wear and wheel truing practices, costs of maintenance, and curving noise.
3. Computer modeling to determine if there are substantive theoretical differences in the performance of the two different check gauge philosophies and practices.
4. Publication of Phase 1 Report.
Phase 2 - If the results in Phase 1 indicate that there are potential operating benefits in the European practice vs current North American practice, then Phase 2 will be implemented

5. Develop optimum recommended plans for check & track gauge, and lubrication/friction control for typical applications on both heavy rail, light rail, and streetcar.

6. Perform vehicle and track verification under controlled conditions, with specific vehicles, wheel forms and trucks/suspensions. This will probably best be performed using the facilities and equipment of at least two (2), preferably three (3), cooperating transit Agencies: one heavy rail, one light rail, and, optionally, one streetcar, if funding permits. A test curve or curves modified to prevent high rail flange contact would be paired with a matching curve(s) using current practice. Both would be instrumented and measured, and the vehicle dynamic responses, noise and vibration measured periodically, and track reaction forces and wear measured over a significant length of time, probably at least six (6) months, possibly up to a one (1) year, to allow a useful comparison.

7. Publish the Phase 2 Report, comparing the track reaction results and rail wear, noise and vibration generation, and vehicle dynamic responses from the test curves in a comprehensive document.

Phase 3 - If the verification test results in Phase 2 are positive, then Phase 3 will be implemented, predicated on additional transit Agencies volunteering to do the testing primarily at their expense.

8. If the benefits are substantial on an improved performance and cost/benefit basis, then have other Agencies volunteer to perform similar tests, but perhaps without full-depth instrumentation needed; mainly to assure compatibility compare ride comfort, rail wear, and noise.

9. Publish the Phase 3 Report, and provide all the research results to an organization empowered to draft the information into a form suitable for inclusion in a Manual of “best & recommended practices” used universally by the rail transit industry.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** The research is envisioned as being in three (3) Phases so that positive results in a Phase will result in activating further research in the next Phase; negative results will result in research termination at the end of the Phase in question. The Phases, as listed above, are estimated to require the time and funding as listed below:

**Phase 1**

Phase 1 is estimated to require funding in the $35,000 to $45,000 range. It is anticipated that the literature search, Agency practices profiling and computer modeling can be done simultaneously.

**Phase 2**

Phase 2 will require funding in the $115,000 to $140,000 range, based on the facilities and vehicles being Agency furnished, operated and maintained at no cost to TCRP. The research effort will require the installation and monitoring of the instrumentation required, but will not require a full-time presence at the test sites.

**Phase 3**

Phase 3 is estimated to require funding in the $45,000 to $75,000 range, depending on how many Agencies volunteer for the test program, and how closely the researchers monitor their progress.

**Total Funding Required:**

Based on the premise that the research is promising and that all three Phases are implemented, the total funding requirement will be in the $195,000 to $260,000 range.
Research Period: In each Phase listed, time is allowed for drafting the Final Report.

We estimate that the Phase 1 literature search, profiling of current practices and computer modeling will take four (4) to six (6) months. The Phase 2 field testing and verification will take from eight (8) months to 15 (15) months; however, a full-time researcher’s presence is not required. The researcher(s) will make periodic visits to monitor the instrumentation and make wear and noise/vibration measurements, probably at about two (2) month intervals after installation of the test. Phase 3 will probably extend over at least one (1) year, perhaps more, depending on the number of volunteer Agencies, and how extensive research support is required for their testing. The most feasible arrangement would be for the research team to instruct Agency maintenance personnel in the proper way to monitor wear, noise and vehicle responses, with instrumentation belonging to the Agency. The researchers would help the Agency personnel to draft their Final Report, which would be published by the Agency, not TCRP.

The total Research Period is estimated to extend over approximately 2½ years.

VI. URGENCY AND PAYOFF POTENTIAL

The urgency of the proposed RestRail research program is driven by four (4) considerations:

1. the potential safety issues involved; as we don’t presently know the effectiveness of RestRail as it is presently applied
2. the ride quality and possible passenger injury associated with sudden lateral accelerations caused by extraordinary steering forces applied during curving
3. the possible reduction in noise and vibration generation
4. the possible reduction in rail wear, especially caused by nosing, and track damage, such as broken RestRail bolts, leading to reduced life-cycle costs and maintenance requirements

No impediments to applying the results of this research are foreseen, except as it may make obsolete the materials and practices currently in use on many Agencies. On installations on concrete ties and Direct Fixation, it may not be feasible to adjust the track and check gauge. To change these type installations would have to be analyzed on a cost/benefit basis to see if it makes sense. New installations should not present any real problems to implementation.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

The research is pertinent to at least three FTA Initiatives: (2) Improving Safety, Security and Emergency Preparedness - helping transit agencies increase safety; (3) Improving Capital and Operating Efficiencies – limiting the escalation of operating costs, which often cascade over into capital programs; and, (4) Protecting the Environment and Promoting Energy Interdependence – reducing noise pollution and heavy-metal dust/filings. In these Initiative areas, improved RestRail check gauge practices that result in less derailment risk and rail wear would improve operating safety, reduced noise generation, and also reduce life-cycle costs. Reduction of rail wear reduces the frequency of replacement, which not only lowers operating costs, but also reduces the track outages required for rail relay. Track outages open access that can be an opportunity for vandals to enter the property and damage facilities.

Regarding the TCRP Strategic Priorities, the research envisioned applies to I. Place the Transit Customer First, as the potentially smoother, quieter, more comfortable ride fits in this category. This is especially true for elderly or physically-challenged patrons, who may find being a standee in a lurching train is not an option for them, and therefore don’t use public transit. In addition, the reduced track outages for maintenance result in better adherence to operating schedules and less inconvenience and annoyance to the customers.

The research also has implications in III. Continuously Improve Public Transportation, based on the same improvements to safety, operations and customer satisfaction. If the research results in a quieter, lower-maintenance installation, then the research will also satisfy the requirements of V. Revitalize Transit
Organizations, by reducing the track and roadway staffing necessary to lubricate, adjust, and maintain the curving trackage, leading to a “Work Better – Cost Less” result. In addition, the application of advanced technology and methods to improve performance and reduce repetitive maintenance chores will attract higher-caliber, more technically qualified employees, resulting in a safer, better maintained and lower life-cycle cost system.

VIII. RELATED RESEARCH

The Transportation Test Center, Inc. at Pueblo, Colorado, is currently conducting research on frog guard rails, and under the TCRP D-7 Project, has researched some of the RestRail issues; that work is now completed and published. Also, TTCI recently completed research and prepared a report on “Wheel Flange Climb Derailment Criteria” which is directly applicable to this proposed research.

UMTA (now FTA) published a 2-volume report in 1981 titled, “U.S. Transit Track Restraining Rail – Volume 1: Study of Requirements and Practices; and Volume II: Guidelines.” These documents, UMTA-MA-06-0100-81-6 and –7 are now quite dated due to advent of many newer systems, especially LRT’s.

IX. PERSONS DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This Problem Statement was developed under the sponsorship of one APTA Technical Forum and one TRB Committee:

1. APTA Track, Noise and Vibration Technical Forum; Richard A. Brown, Chair
2. TRB Committee AP080; Rail Transit Systems Design, Bruce R. Smith, Chair
3. (Perhaps) AREMA Committee 12 Rail Transit, Craig Goodall, Chair
XI. DATE AND SUBMITTED BY

Submitted: June 15, 2007 (anticipated)
Submitted By: Anthony P. Bohara (refer to Section IX, above)

Footnotes:

1. Restraining guard rails are sometimes improperly termed “guard rails” which can be confused with anti-derailment guard rails, bridge guard rails or frog guards, which are not covered herein; within this document the term “guarded” refers to the use of restraining rail applied to the low rail of a curve, and sometimes to the high rail, as well. In practice, a “guard” rail is not intended to contact the wheel when the wheels are in the proper running position on the rails.

2. Although there is a gauging “point” where the gauge dimension is measured, in this document we are using the term “gauge face” as the wear is distributed over most of the face, not just at one point.
TCRP Problem Statement

I. PROBLEM TITLE

Guidelines and Guidebook for Stray Current Control and Monitoring In Transit Systems.

II. RESEARCH PROBLEM STATEMENT

Stray current is produced by DC traction systems which are used in public transit systems worldwide. It is invisible and hard to measure, but the evidence of stray current exists in the corrosion found in reinforcing steel of infrastructures and private/public utilities’ metallic pipelines adjacent to transit systems. If stray current is not controlled and monitored, it can cause damage to pipelines and cable resulting in huge repair costs.

In the engineering practice, insulated running rail installation is generally used to reduce stray current. But still, there are other issues that may result in corrosion if stray current is not addressed. For instance, what can be done in some special track sections where insulted running rail installation is impossible? What can be done if the insulation of the running rail does not work well? Can something be done with the track bed and the tunnel structure to reduce the stray current further? Is there a margin for optimization in power supply systems; the source of stray current? Can engineers from other disciplines do something to collaborate with power supply engineers to minimize the stray current? What is an efficient way to monitor the corrosion status and stray current distribution?

The majority of these issues are related to stray current control and monitoring. Unfortunately, there is no in-depth study and no guidelines for design engineers; not even for power supply engineers. There are only some discrete solutions for separate transit systems and consulting companies.

III. OBJECTIVE

The object of this research is to develop guidelines for use when designing a new transit system or maintaining/modifying an existing transit system. These guidelines will help optimize stray current control and monitoring and ultimately protect the property of transit agencies and public/private utilities.

IV. RESEARCH PROPOSED

• Describe the corrosion threats to metallic structures along and adjacent to the DC transit system.
• Prepare and assemble typical corrosion cases worldwide cause by stray current.
• Collect, identify, organize, and describe the methods of stray current control and monitoring worldwide.
• Analyze the advantages and disadvantages of every method.
• Use simulation software to quantify and qualify each method (if financially available).
• Interview experienced engineers and conduct some field testes at typical locations (if financially available).
• Generate guidelines that can provide standard approaches for engineers of different disciplines when designing and maintaining/modifying a transit system.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: In order to accomplish the objectives stated in Section III, the estimated cost for this research should cover two professional staff-years, which means approximately $150,000. We have already taken the software simulation and field test into consideration.

Research Period: Two years is required to accomplish the objectives, three months for review and revision of a draft final report are included.

VI. URGENCY AND PAYOFF POTENTIAL

Presently, there are more and more transit system projects being constructed, but these transit projects are all without standard approaches that address stray current control and monitoring. Stray current control and monitoring methods must be considered and designed during the construction period of a project. Little can be done to prevent stray current when the projects are complete. So the urgency of this research cannot be stressed enough.

There are many corrosion cases reported due to the lack of stray current control and monitoring. If a comprehensive guidebook was available to help prevent such corrosion during the engineering stage, the payoff would be priceless. This is because it is nearly impossible to replace corroded reinforcing bards in transit tunnels and other structures without rebuilding them. It is also impossible to repair corroded metallic utility pipes except to replace them.

Currently, there are no institutional, political, or socio-economical barriers to implement this anticipated research.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This research can meet the FTA strategic goals :Improving Capital and Operation Efficiencies.
This research can meet the TCRP strategic goals: Enable Transit to Operate in a Technologically Advanced Society.

VIII. RELATED RESEARCH

None.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT


XI. DATE AND SUBMITTED BY

Edward J. Rowe
July 15, 2007
TCRP FY 08 Problem Statement: Improving Signal and Traction Power System Stability While Reducing Stray Current Corrosion for DC Powered Transit Systems

I. PROBLEM TITLE

Improving Signal and Traction Power System Stability While Reducing Stray Current Corrosion for DC Powered Transit Systems

II. RESEARCH PROBLEM STATEMENT

Recently constructed DC powered, Light Rail Transit projects have been faced with six figure repairs and modifications to signal and traction power systems because of ineffective negative return rail isolation. Problems with negative return rail isolation, the result of inconsistent design and implementation standards, have rendered signal systems inoperable and the traction return rails electrically low in resistance to earth. The failures also increased potential stray current transmission from the traction power system to adjacent utilities; the stray current decreases the life of both the transit property's assets and surrounding utility infrastructure. The substantial costs associated with using ineffective running rail electrical isolation requires a compilation of recommended design criteria, construction practices, and standards to provide the designer, constructor, and operator with a guide to state of the art technology and common pitfalls to avoid. An indication of the magnitude of the financial costs is cited in a comprehensive research report published by the IEEE in 1990's, where it is estimated that a major portion of the estimated $500 million dollars per year from stray current corrosion losses is borne by DC-powered transit properties and the surrounding infrastructure assets. Please note that this figure does not take into account the costs associated with signal problems and repairs.

III. OBJECTIVE

The objective is to develop a compendium of best practices and methods for developing design and construction criteria for negative return electrical isolation. This compendium would be developed through research of systems that are in various phases of construction and operation. This document should also include the full description of the types of stray current control and signal protection technology used, acceptable stray current and isolation levels, a menu of proven corrosion control techniques, and appropriate measurement and testing methods.

IV. RESEARCH PROPOSED

The proposed research consists of performing a 2-phase study of DC powered transit systems in North America. The initial phase of the study would evaluate the present corrosion control and signal protection practices of DC powered transit properties. The data obtained would be assembled into a matrix of the associated practices, stray current levels, control criteria developed, identified problems, and costs associated with the corrosion control programs. This research would focus on the elements of the track structure, especially the rail mountings and supports, including the contact rail mountings. These components are the principal stray current leakage points in most non-ballasted track systems. The problems are, of course, exacerbated by the presence of water; the research will strongly focus on identifying and recommending isolation methodologies that still maintain their effectiveness in wet environments.

Phase 2 of the program would compile a manual of recommended practice for developing design criteria associated with stray current corrosion control using both passive and active techniques. The manual will include topics such as electrical continuity of concrete reinforcement, stray
TCRP FY 08 Problem Statement: Improving Signal and Traction Power System Stability While Reducing Stray Current Corrosion for DC Powered Transit Systems

current test stations, track-to-earth resistance, rail-to-rail resistance, impedance bonding, power system modeling, and galvanic and impressed current cathodic protection.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1</td>
<td>$ 300,000</td>
</tr>
<tr>
<td>Phase 2</td>
<td>$ 150,000</td>
</tr>
</tbody>
</table>

Research Period: 24 Months

VI. URGENCY AND PAYOFF POTENTIAL

The cost of light and heavy rail transportation systems has been increasing steadily due to these exact issues. What levels of stray current are acceptable? How large is the transit corridor for protection? What levels of track-to-earth and rail-to-rail resistance are required? What maintenance testing is required? What costs and safety issues are related to signal system failure? How is the maintenance testing conducted? The need for specific criteria for these areas is required for the transit community to make appropriate decisions concerning the costs and implementation of these measures.

This research should be considered as a top priority since it will influence new system construction, extensions, and maintenance and operation of existing systems. Assuming the loss through stray current corrosion is close to the IEEE’s estimated dollar cost cited in the opening statement, and the annual savings through applying feasible and available technology is roughly 10%, then the annual savings to both the transit systems and their affected neighbors is in the neighborhood of $50,000,000. In addition, that does not take into account the considerable dollar value of achieving more reliable and safer train operations.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

The research proposed in this problem statement relates directly to the following FTA strategic initiatives:

**Improving Safety, Security and Emergency Preparedness** – The protection of grounding systems and transit system safety equipment is essential. In addition, the reduction of stray current corrosion is a safety issue due to the possible failure of the rail equipment including fire lines and the surrounding utility structures such as gas lines and water lines. Moreover, it is understood that there are severe implications resulting form signal system failures in revenue tracks.

**Improving Capital and Operating Efficiencies** – Understanding and addressing stray current issues will help to improve operational efficiency and cost-effectiveness of major transit investments. Long-term, reliable operation of rail transit systems will be dependent on the safety, infrastructure, and equipment considerations surrounding the stray current corrosion and signal protection issues.

**Protecting the Environment and Promoting Energy Independence** - Stray current can definitely be considered an environmental pollutant and hazard; reducing stray current helps to
TCRP FY 08 Problem Statement: Improving Signal and Traction Power System Stability While Reducing Stray Current Corrosion for DC Powered Transit Systems

protect the environment. Spending fewer resources on both material and manpower to repair stray current damage requires less energy and helps promote energy independence.

In addition, the problem statement relates to the following TCRP Strategic Priorities:

- **Place the Transit Customer First** – the reduction of repair outages to repair stray current damage, including signal system failures, results in fewer slow orders and more reliable on-time service

- **Enable Transit to Operate in a Technologically Advanced Society** – the technology advances that provide better control of stray current will put DC-powered rail in the technology forefront

- **Continuously Improve Public Transportation** – the elimination of stray current as a rail transit problem area is a continuous improvement of the mode

- **Revitalize Transit Organizations** – the elimination of infrastructure damage, repetitive repairs required and operational interruptions fits the description of “Work Better – Cost Less.”

VIII. RELATED RESEARCH

Rail fasteners, rail embedment materials, rail bonds and cabling, isolation membranes, concrete admixtures for resistivity increases, electrically-isolating coatings and treatments, built-in testing ports for instruments, electronic instruments for recording stray currents.

IX. PERSONS DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

The problem statement was developed under the sponsorship of two Technical Forums/Committees:

APTA Track, Noise and Vibration Technical Forum; Richard A. Brown, Chair
TRB Committee AP080; Rail Transit Systems Design, Bruce R. Smith, Chair
XI. DATE AND SUBMITTED BY

Submitted by: Edwin A. Wetzel, P.E., and William H. Moorhead (see Item IX, above).
Date Submitted: June 19 2006
I. PROBLEM TITLE

Establishing the National Joint Transit Industry Rail Vehicle Technician Certification Program: Building for Success.

II. RESEARCH PROBLEM STATEMENT

The development and implementation of new rail vehicle technologies in transit systems around the country have had profound effects. While these technologies have greatly benefited customers and agencies alike, they also have led to difficulties. The internal training capacity of the transit industry has had trouble keeping up with the pace of innovation, and it has become increasingly difficult to hire new external applicants with the specialized skills needed for the new equipment. Upgrading the skills of the workforce that maintains this new technology and developing a system that does this on an ongoing basis is of the utmost importance to the industry.

A number of TCRP and TRB reports have analyzed the transit skills crisis. A common thread in their recommendations for resolving this skills crisis is that management and labor should work together in creating a joint system for developing the skills needed in this industry. TCRP Report 29, Closing the Knowledge Gap for Transit Vehicle Maintenance Employees: A Systems Approach, demonstrated that “the onus is on the transit agencies themselves to find ways of closing the skills gap” and TCRP Report 96, Determining Training for New Technologies: A Decision Game and Facilitation Guide, indicates that “[a] successful program must involve partnering with the employees being trained and with labor unions whose members are affected.” The best approach is for all the major players in the transit industry, labor and management, to work in partnership to develop new approaches to training and certification. The Community Transportation Center’s 2007 research summary, People Make the Hardware Work: Transit Experts Call for Labor-Management Training Partnerships, contains excerpts from seven reports from TCRP, TRB and APTA on this subject.

This joint approach is what has proven so successful in the development of national standards for transit maintenance training. With funding support from TCRP, FTA and the US Department of Labor, a national partnership linking APTA, transit labor (ATU and other unions in transit) and the Community Transportation Center has implemented a data-driven partnership process over the past two years to develop national training standards for transit bus mechanics. Over the past year the same partner organizations have worked together to begin development of national standards for training in four transit rail occupations: rail signal maintainers, elevator-escalator, wayside power, and rail vehicle mechanics.
National standards for training and certification jointly developed and maintained by transit management and transit labor offer the best approach for meeting the skill needs of the transit industry for rail car mechanics and other maintenance occupations. The ongoing national partnership process for developing maintenance training standards starts with interviewing subject matter experts (skilled transit mechanics, trainers and supervisors) to develop task lists (statements of required knowledge, skills and abilities). The task lists are then used to develop standardized curricula and systems for sharing courseware materials that correspond with the curricula. Key players in this effort include APTA, ATU, representatives of other unions in the transit industry and the Community Transportation Center through its DOL-funded project, “Building Capacity for Transit Workforce Development” and ongoing support from the Federal Transit Administration.

A joint approach to certification is the logical next step in the standards development process, and rail vehicle maintenance is a ripe subject area in which to develop and pilot such a joint system of certification. Test questions and the testing system should be based on the same underlying skills and knowledge identified as essential for the national training standards. The core stakeholders in transit maintenance – transit system managers and transit mechanics and their unions – are already at the table in the earlier stages of this process for rail vehicle maintenance and other transit maintenance occupations. Joint ownership of training is important for the most successful training systems and, given the sensitivity that surrounds certification, joint ownership becomes vital.

Joint participation by transit labor along with transit management will assure that the system raises and certifies standards in ways that will build success for current and future transit rail mechanics, rather than serving as a punitive mechanism. It is essential that important priorities for workers are fully and effectively addressed in the new system of certification. While 90 percent of overall transit operations and maintenance employees are estimated to be represented by labor unions, the percentage is undoubtedly still higher for transit rail systems, which tend to be larger organizations with a high degree of union representation. Transit labor and transit management will both “own” the certification system resulting from this joint process – an essential element of a successful system of skill certification.

Like the training standards currently under development, the proposed rail car maintainer skill certification system will be consistent with the APTA Manual of Standards and Recommended Practices for Rail Transit Systems. Combining the effort to develop standards for training with the development of certification will assure that both labor and management have ownership over the process and the product, and that the results will be embraced by all parties involved. With the development of a unified system of national certification and training standards for transit rail maintenance, transit properties will satisfy federal regulations concerning the maintenance and inspection of transit rail vehicles. Regulations concerning the training and qualification of transit rail maintenance technicians fall under the oversight of State Safety and Security Oversight agencies as
prescribed by CFR, Part 359 generally referred to as the State Safety Oversight Rule. These regulations may necessitate a review by the individual state oversight agencies of proposed training standards for transit rail vehicle maintenance and technician certifications.

III. OBJECTIVE

The proposed research program will develop a National Transit Rail Technician Certification Program. This effort will build on the foundation provided by the ongoing labor-management partnership work creating national standards for training for rail car mechanics.

This system of certification testing will be closely related to existing systems of skills training and certification developed by labor-management partnerships in other industries' technical occupations such as electrical trades, plumbing, and heavy equipment maintenance. A joint national steering committee will draw members from participating transit systems and local unions to create the national standards for local implementation within an agreed national framework. The transit rail car national labor-management maintenance skills partnership will create banks of test questions in each of twelve skill areas critical to rail car maintenance. Local administration of certification tests will be based on a random and confidential selection of test questions from these large banks of questions. Scoring and evaluation of paper-and-pencil tests would be the responsibility of the national partnership. In addition to written tests, the national partnership may also propose practical hands-on tests of skill in diagnosis and repair.

The proposed National Transit Rail Technician Certification Program would address the twelve skill areas critical to rail car maintenance as defined by the national joint committee for Rail Vehicle Maintenance:

1. Electrical and Electronic Control Systems
2. Coupler Systems
3. Truck and Axle Systems
4. Brake Systems
5. Current Collection and Distribution Systems
6. Door Systems
7. HVAC Systems
8. Propulsion and Dynamic Braking Systems
9. Auxiliary Inverter and Battery Systems
10. Pneumatic Systems
11. Hydraulic Systems
12. Rail Vehicle Electrical and Electronic Troubleshooting

Cross-cutting within each of these twelve modules would be areas of ongoing concern such as safety and health and preventive maintenance inspection.
IV. RESEARCH PROPOSED

A joint oversight committee representative of experts from transit management and transit labor unions is expected to provide guidance to this project. Maximizing overlap with the existing national joint committee for rail vehicle maintenance will ensure effective coordination and integration of training standards and certification systems. The job tasks are already being identified through the DOL/FTA funded work on standards for training. The research work plan is proposed to be a five-year program, as follows:

A. Years 1-3: Develop Certification Framework and Procedures

1. Complete and review the ongoing development of rail car maintenance task analysis, consensus skills curriculum in the current labor-management project identifying task lists, required knowledge, skills and abilities, and curriculum and courseware. Compare those results with already existing certification systems in transit agencies and railroads.

2. Analyze and report on testing methods, including paper-and-pencil and hands-on testing, used by labor-management partnerships in other relevant industries (electrical industry, heavy equipment, railroads etc.).

3. Building on this research base, develop an initial proposed framework for testing and certification in transit including implementation guidelines that will work well for all transit stakeholders. At the discretion of the joint oversight committee, this testing may include hands-on testing in addition to pencil and paper.

4. Prepare this initial agreed framework with necessary materials and support systems for pilot test implementation.

B. Year 3: Initial Pilot Testing

1. Initial pilot implementation at partnering sites with cooperating transit systems and unions for tests developed each year.

2. Rigorous evaluation of pilot implementation experience, including quantitative measurements and participant survey analysis.

3. Modification of first testing and certification framework based on evaluation

C. Year 4: Second Round Pilot Testing

1. Second round pilot implementation of complete testing program at partner transit sites.
2. Evaluation of pilot results, with recommendations for further improvement.

3. Proposal for final system, including system of “evergreen” maintenance for future years as new technology is introduced.

D. Year 5: Final Pilot, Evaluation and System Rollout

1. Final pilot implementation of final system.

2. Collection of metrics and evaluation.

3. Finalize ongoing structure and system to support training and testing in rail car maintenance occupations.

V. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended funding:

The estimated TCRP funds required for this research are $400,000 for each of the first three years, with the Community Transportation Center providing $150,000 for each of those first three years. It would be beneficial for staffing the program if TCRP could make an initial commitment to the first three years of the project, with each year’s actual funding contingent on the continuing high quality of the work undertaken.

Requested TCRP funding for the final two years would be $200,000 per year.

The total five year budget would be $2.05 million, with requested TCRP funding of $1.6 million over five years and $450,000 provided by the Transportation Center, with approval from other federal funding sources (FTA and US DOL).

Research period:

The estimated research period is sixty months (60) month, divided into five 12-month periods

VI. URGENCY AND PAYOFF POTENTIAL

The lack of transit industry capacity for standardized training and certification exacerbates today’s urgent skill shortages in transit rail maintenance of all kinds, including rail car maintenance. It has been estimated that 40 percent of all transit mechanics would be eligible to retire by 2010. In some transit rail systems up to 70 percent of skilled mechanics will be able to retire in the next five years.
The track of these retirements is on a collision course with the growing technological requirements of rail maintenance and the expansion of transit rail systems and ridership. Anything short of a major effort mobilizing all the major transit stakeholders in expanding training and certification will guarantee failures of transit rail service due to insufficient capacity to maintain rail systems.

Creating a joint rail car technician certification system to complement the emerging national standards, models and materials for rail car maintenance training will provide positive incentives for transit systems and their employees to step up and meet the impending skills crisis in rail car maintenance. The cost of not having a working system of training and certification could well be catastrophic.

Conversely, creating an initial national joint system of certification for transit rail maintenance at a cost to TCRP of only $1.6 million over five years would certainly be cost effective for the transit industry. The structures and processes that this joint approach will develop for certification of rail car mechanics could also be adapted with relative ease to certification systems for other transit rail occupations facing similar skill shortages.

Using industry standards for transit training, educational institutions could be able to develop courses specifically for the transit industry – particularly in areas that correspond to general skill areas that can be applied across a wider base of potential students. The establishment of a certified national transit rail technician occupation would also promote additional interest from the external job market, technical schools, high schools and colleges. With national standards established, mechanics from other industries would be able to cross over to the transit industry once they were able to learn or acquire the identified qualifications and skill competencies. Transit authorities would be able to establish resources for qualified personnel to fill vacant positions. With a well-staffed and qualified rail transit workforce, vehicle availability would be increased, vehicle downtime would be reduced and passenger safety would be enhanced.

As indicated from evaluations of partnership-based transit training programs, the return on transit's investment in this kind of data-driven training and certification should be very high (See Community Transportation Center 2007, Measuring Up, Volume 2.) If individual transit agencies can save millions of dollars from this kind of program, the industry as a whole should save those millions of dollars many times over.

Finally, a joint national effort sponsored by transit labor and management provides a strong foundation for the ongoing sustainability and future evolution of a quality certification program. In addition, a national labor-management partnership program for rail car technicians could easily become the model program for other areas of transit rail maintenance.

For all these reasons the proposed research should be considered a high priority item for TCRP and the transit industry.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This proposal is directly related to several FTA strategic research goals that align with the FTA Strategic Research Plan, and support the FTA vision of making public transportation the mode of choice in America, as follows:

**Improve Capital and Operating Efficiencies**

- Return on investment is maximized by ensuring that operations are both cost effective and efficient over its useful life.
- Objectives include identifying practices and technologies to control capital costs, identifying solutions to control operating costs, identifying methods and technologies to improve transit operational efficiency, identifying solutions to improve infrastructure maintenance, and improving the capacity of the transit industry and workforce.
- Strategies include identifying appropriate standards needs; analyzing costs of technology adoption on operations; identifying and analyzing platforms for systems integration; researching and demonstrating methods to improve rail and heavy-rail efficiency; examining operational delivery strategies involving fleet operations, mobility management, and ITS; analyzing technologies and practices to improve demand response performances; researching improved inspection and integrated maintenance systems.

In addition, this problem statement directly relates to the following TCRP Strategic Priorities:

I. Place the Transit Customer First

The importance of the transit rider as well as the community at large as the customer was a principal outcome of the TCRP Future Search. The American consumer society is demanding; no industry can prosper that does not place the customer first.

III. Continuously Improve Public Transportation

The TCRP will support communities throughout the United States to continuously improve public transportation.

V. Revitalize Transit Organizations

Information technologies, changes in the work force, and new roles and partnerships are revolutionizing the workplace. By reinventing themselves, transit organizations can “Work Better – Cost Less.”
VIII. RELATED RESEARCH

TRB and TCRP have conducted extensive research on the need for a larger and more effective commitment to skill development, including certification. As indicated above, most of these reports call for a joint labor-management approach for the transit industry in addressing its skills crisis:


The Community Transportation Center has carried out extensive analysis of the benefits of a partnership-based, data-driven approach to improving skill development in the transit industry. Two reports from early 2007, *Measuring Up: Volume 2*, and *Transit Partnership Training: Metrics of Success*, quantify the benefits to transit systems and their workers from this kind of joint approach. An earlier study conducted survey research showing that transit maintenance employees and their supervisors had exceptionally high levels of satisfaction from this kind of approach:
As indicated in the research work plan above, extensive research will be needed to identify critical features in the organizational structure and processes of successful labor-management training and certification programs in comparable US industries with technically skilled workforces and high levels of union representation. In related work funded by US DOL and FTA, the Community Transportation Center has already been studying transit certification systems; this work will be continued and deepened.

IX. PERSONS DEVELOPING THE PROBLEM

Dr. Brian Turner, Director, Community Transportation Center, served as the primary drafter of this proposal, in consultation with many of the transit industry managers, mechanics and union officials who are working together in developing joint standards for transit maintenance training and a joint framework for transit maintenance apprenticeship.

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

The problem statement has grown directly out of the ongoing joint labor-management work to develop training, national standards for training, and apprenticeship in the transit industry. It builds on the experience gained in two years of joint work defining bus maintenance training standards and more than one year in four transit rail maintenance occupations, including rail car maintenance.
XI. DATE AND SUBMITTED BY

Submitted June 15, 2007, by:

Warren S. George, International President, Amalgamated Transit Union (ATU)

Brian Rydell, Acting Deputy Executive Officer, Rail Fleet Service, Los Angeles County MTA

James Lindsay, Recording/Financial Secretary, ATU Local 1277, Los Angeles

Cynthia Gannaway, Director, Operations Training, Washington Metropolitan Area Transit Authority

Roland Jeter, First Vice President / Assistant Business Agent for Maintenance, ATU Local 689, Washington DC metropolitan area

Z. Wayne Johnson, Chief Administrative Officer, Sacramento Regional Transit District

Darryl Norris, Business Representative, International Brotherhood of Electrical Workers, Local 465, Sacramento

Randy Welsh, Director of Maintenance Training, Utah Transit Authority

Robert Baty, President/Business Agent, ATU Local 382, Salt Lake City, Utah

Joe Coccio, Secretary-Treasurer, Transport Workers Union of America, Local 234, Philadelphia
I. PROBLEM TITLE

Establishment of a National Transit Rail Maintenance Technician Certification Program.

II. RESEARCH PROBLEM STATEMENT

Transit rail vehicle technology is progressing at an unbelievable rate. As a result, it is difficult for transit authorities to hire qualified external applicants for the position of transit rail car maintenance technician. As was indicated in *TCRP Report 77: Managing Transit’s Workforce in the New Millennium*, the “Grow Your Own” strategy is the standard among transit authorities. Also, as was indicated in *TCRP Report 29, Closing the Knowledge Gap for Transit Vehicle Maintenance Employees: A Systems Approach*, “the onus is on the transit agencies themselves to find ways of closing the skills gap.”

The lack of a national certification credential for the transit rail industry has transit authorities initiating their own in-house certification. The APTA Manual of Standards and Recommended Practices for Rail Transit Systems, Volume 2, establishes the standards for rail car maintenance and inspection procedures and practices. However, the volume doesn’t elaborate nor define the training standards, testing or resources in order to obtain the objective of the recommended practices in the volume. This research will help to close the skill gaps, minimize the skills shortage and standardize the industry so that authorities are not constantly “reinventing the wheel.” In addition, establishing the certification will provide for the establishment of transit rail maintenance training standards and resources. With the development of a national certification and training standards for transit rail maintenance, transit properties will satisfy federal and/or state regulations concerning the maintenance and inspection of transit rail vehicles. Examples of regulations that address the training and qualification of transit rail maintenance technicians include, but are not limited to, CFR 49: Transportation, Part 238 – Passenger Equipment Safety Standards, Subpart B – Safety Planning and General Requirements, Section 238.109 – Training, Qualification and Designation Program.

III. OBJECTIVE

The objective of the research will partner the transit industry, as a result of a Request for Proposal (RFP), with a company, organization or institution that has the capability to develop a National Transit Rail Technician Certification Program. One such institution that has the network and capability to develop a National Transit Rail Certification Test series is the independent National Institute for Automotive Service Excellence (ASE). ASE certification serves as an impartial, third party endorsement of knowledge, skills, and experience on a national basis. In order to achieve and maintain ASE certification requires the continual need for enhanced training, knowledge and skills. ASE has developed, implemented and maintained several national certification programs for specialized industries.
The proposed National Transit Rail Technician Certification would challenge the knowledge, skills and competencies in accordance with the following established transit rail car maintenance systems:

1. Transit Rail Car Third Rail and Pantograph Current Collection Systems
2. Transit Rail Car Pneumatic and Friction Brake Systems
3. Transit Rail Car HVAC Systems
4. Transit Rail Car Coupling Systems
5. Transit Rail Car Door Systems
6. Transit Rail Car Battery and Auxiliary Power Systems
7. Transit Rail Car Electric Motor Propulsion Systems
8. Transit Rail Car Preventative Maintenance Inspection
9. Transit Rail Car Propulsion Control Systems
10. Transit Rail Car Truck Systems
11. Transit Rail Car Electrical Systems

IV. RESEARCH PROPOSED

Working with representatives from the transit industry and associated transit labor unions, an oversight committee would be established to evaluate and recommend the best means to initiate and implement the Request for Proposal process. It would be the responsibility of the company, organization or institution awarded the project to work with industry professionals to identify the required competencies of transit rail car maintenance technicians. The means to accomplish this may include a job/work analysis group to identify the specialized job skills and competencies required of each job task as define in the above transit rail systems. Another phase of the project would include using the identified job tasks to develop questions that challenge the skills, competencies and experience of transit rail car technicians. The awarded company, organization or institution must also have the means to present the tests nationally and at impartial test centers.
V. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended funding: The estimated funds for this research are proposed at $500,000.00

Research period: The estimated research period is sixty months (60) months.

VI. URGENCY AND PAYOFF POTENTIAL

The lack of industry standards for training, certifications and testing, job definitions, and apprenticeship standards has each individual transit authority expending resources to develop the necessary criteria, programs, training and testing. If industry standards were developed and implemented, the cost of implementing a program or certification would be negligible.

Using the industry standards for transit training, educational institutions could develop training curriculums specifically for the transit industry. The establishment of a national transit rail technician occupation would promote additional interest from the external job market, technical schools, high schools and colleges. With national standards established, mechanics from other industries would be able to crossover to the transit industry once they were able to learn or acquire the identified qualifications and skill competencies. Transit authorities would be able to establish resources for qualified personnel to fill vacant positions. With a well-manned and qualified workforce vehicle availability would be increased, vehicle downtime reduced and passenger safety enhanced.

The establishment of a national certification program would promote individual pride and ownership in the occupation. This would relate to individual recognition in the form of salary increases, bonuses or promotions based on increased knowledge and skill competencies, which relate to effective and efficient vehicle repair and maintenance. Efficient and effective vehicle repair and maintenance would reduce downtime, improve schedule performance, increase ridership, and lower operating costs.

The return on the investment from all of the above is immeasurable at this time. The qualification of the transit rail technician directly equates to improved reliability of the equipment and the overall safety of the customers that use the transit service. Considering the potential for reducing operating costs, improved service and safety, the cost savings realized from a national transit rail technician certification program could be estimated in the millions of dollars from an industry point of view. Therefore, this research should be considered as a high priority item.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES
and TCRP STRATEGIC PRIORITIES

Of the four FTA strategic research goals that align with the FTA Strategic Research Plan, and support the FTA vision of making public transportation the mode of choice in America, This research has a direct relationship to the following:

**Improve Capital and Operating Efficiencies**

- Return on investment is maximized by ensuring that operations are both cost effective and efficient over its useful life.
- Objectives include identifying practices and technologies to control capital costs, identifying solutions to control operating costs, identifying methods and technologies to improve transit operational efficiency, identifying solutions to improve infrastructure maintenance, and improving the capacity of the transit industry and workforce.
- Strategies include identifying appropriate standards needs; analyzing costs of technology adoption on operations; identifying and analyzing platforms for systems integration; researching and demonstrating methods to improve rail and heavy-rail efficiency; examining operational delivery strategies involving fleet operations, mobility management, and ITS; analyzing technologies and practices to improve demand response performances; researching improved inspection and integrated maintenance systems;

In addition, this problem statement directly relates to the following TCRP Strategic Priorities:

I. Place the Transit Customer First

The importance of the transit rider as well as the community at large as the customer was a principal outcome of the TCRP Future Search. The American consumer society is demanding; no industry can prosper that does not place the customer first.

III. Continuously Improve Public Transportation

The TCRP will support communities throughout the United States to continuously improve public transportation.

V. Revitalize Transit Organizations

Information technologies, changes in the work force, and new roles and partnerships are revolutionizing the workplace. By reinventing themselves, transit organizations can “Work Better – Cost Less.”
VIII. RELATED RESEARCH

The extent of any related research that may be completed, pending or in progress, at this time, is not known.

IX. PERSON (S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

The problem statement is the product of the need for our industry to acquire formal recognition of the Transit Rail Car Maintenance Technician as a professional occupation. And as a unique professional occupation requiring such a high level of combined skills and competencies that national testing and certification is required to establish employee credibility to acquire and satisfy public confidence as it pertains to use of service and return of public monies invested through tax and fare dollars.

XI. DATE AND SUBMITTED BY

Submitted on May 14, 2007 by Dennis M. Cristofaro
TCRP Problem Statement

I. PROBLEM TITLE

A Guidebook for Bus Fleet Maintenance Staffing

II. RESEARCH PROBLEM STATEMENT

A critical resource needed to keep a transit bus fleet available for revenue service is the maintenance staff. There are a number of factors in transit operations throughout the country that make it impossible to develop simple rules-of-thumb that any agency might use in developing their own program. In fact, there is considerable risk in an agency implementing another agency’s practice without fully understanding the critical inputs under which it evolved. There is general consensus that models developed in the past will no longer work. More importantly, there is the feeling that the process of staffing is so unique at each agency that generalized models, even sensitive to changes in some of the critical inputs, simply no longer apply.

With fleet maintenance making up approximately 20% of an agency’s operating budget, combined with the capital investment that goes into the acquisition of the fleet, it is critical that the business process of staffing be tailored to each individual agency. Unfortunately, there is no single, up-to-date authoritative source on how to go about managing this aspect of a transit operation and, until recently, there hasn’t been a way to quickly get the word out on potential best practices. As important as managing the skill set of the individual staff members is the management of the staffing of the program itself.

III. OBJECTIVE

The objective of this work is to help an agency to identify the critical inputs to staffing a bus fleet maintenance program, then suggest how those inputs can be developed into a strategy that makes sense for their particular needs, complete with metrics to help in managing the process. These inputs will be outlined in a guidebook that an agency can use in either staffing up a new program, or re-aligning an existing program. A case-study format will be developed and an on-going method of sharing experience through an accessible knowledge base will be proposed.

IV. RESEARCH PROPOSED

Research is needed to identify the key inputs to staffing a fleet maintenance program. Experience suggests that such inputs may include:

- Fleet size, manufacturer, model, year
- Technology deployed
- Types of maintenance service offered within the agency vs. services contracted out
- Tools and equipment available to do the work
- An on-going analysis of work orders
- The extent to which procedures are documented and standards exist
- Transit service currently offered as well as planned for the future
- Corporate culture and past history
- The importance of monitoring daily weather
- Maintenance philosophy
- Maintenance policies, programs and OEM recommendations
• Transit system management structure
• Overall productivity at the agency
• Access to the local labor pool
• Negotiated work rules (contract implications)
• Un-written practices
• Regulatory requirements
• The willingness to seek and share knowledge
• Facility and capacity constraints
• Continuous improvement in response to changes in any of these inputs

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $300,000
Research Period: 18 months

VI. URGENCY AND PAYOFF POTENTIAL

This proposal is urgent in that:
• Fleet maintenance makes up about 20% of an agency's operating budget.
• Continuous changes in technology require changes in skill sets.
• Provides a basis for improving material forecasts based on work scheduled along with staffing needs.
• Provide a methodology for resource allocation

Payoff potential:
• A comprehensive staffing tool will support work force development and succession planning.
• Reducing wasted material and labor resources.
• Provide a basis for identifying resource usage compared to plan.
• Changes in skill sets drives the development and cataloging of training modules.
• A well trained staff is more likely to maximize the useful life of the fleet, adding some relief to replacement.

VII. RELATIONSHIP TO FTA STRATEGIC RESEARCH GOALS and TCRP STRATEGIC PRIORITIES

FTA Strategic Research Goals

(2) Improving Capital and Operating Efficiencies – realizing the greatest economic useful life of the fleet, through the management of the fundamental business process of staffing, are the motives behind this research.

TCRP Strategic Priorities

V. Revitalize Transit Organizations – not only is it important for an agency to become aligned with technologies, changes in the work force, and partnerships, it is critical that management understand how to keep up with changes as they occur.

VIII. RELATED RESEARCH

• Profile of a Successful Transit Maintenance System, APTA Annual Meeting, October 1984, R.L. Hauser, GMC.
- E-5 TCRP project on developing and disseminating maintenance practices.

**IX. PERSON(S) DEVELOPING THE PROBLEM**

The 2004 proposal was opened up for comment from the industry using the committee’s web board.

**X. PROCESS USED TO DEVELOP PROBLEM STATEMENT**

A problem statement was first developed and submitted in 2004. Though it was not selected for funding, discussion continued on the committee’s web board and a brief poll suggested that there is still value in researching the topic. Comments were solicited from within the fleet maintenance community and the problem statement was updated. This proposal is supported by TRB’s committee on transit fleet maintenance.

**XI. DATE AND SUBMITTED BY**

June 15, 2007

Stephen Stark
Chair, Committee on Transit Fleet Maintenance
I. PROBLEM TITLE

UNSCHEDULED BUS OPERATOR ABSENTEEISM: TRENDS, CAUSES, AND SOLUTIONS

II. RESEARCH PROBLEM STATEMENT

Bus operators make up the vast majority of all employees in a bus operating organization. They are the organization's critical link in providing quality service and represent more than 60% of the budget in most bus transit systems. (For purposes of this research, unscheduled bus operator absenteeism is defined as an absence that is unplanned by the system or employee other than specific time off for pay that can be scheduled in advance and was negotiated in the labor agreement (i.e., floating holidays, vacation ...).) Time off for sickness (whether paid or unpaid) would be considered unscheduled absenteeism.) High rates of absenteeism by bus operators impacts the ability of the system to deliver service and contributes to huge increases in cost.

It is "urban legend" that rates of bus operator absenteeism are excessive and have been made even more of a problem with abuse of the provisions of the Family and Medical Leave Act (FMLA). One major system in the Southeast has seen unplanned absenteeism rates increase more than 300% since 2002. This has resulted in bus operators averaging in excess of 15 unscheduled absences in 2006 in addition to paid benefits such as vacations and holidays. This is a rate of 6.2% of scheduled days worked. It compares unfavorably to the national average of 2.5% as measured in the 2006 CCH Unscheduled Absence Survey. Such levels of absenteeism lead to excessive personnel costs due to the need to replace absent employees to maintain service. Many times the replacement employees are paid at overtime because of staffing levels at most systems.

The real problem is that information about bus operator absenteeism is primarily anecdotal. There is no empirical research to answer basic questions on the issue. What is the best (or standard) way to measure absenteeism? What are the actual rates of absenteeism? What are the trends? Are the current rates of absenteeism normal? How do they compare to employees in other service industries? What are the root causes of absenteeism? Is the absenteeism rate related to the pay rate of the employee? How should systems track absenteeism data? How can managers use absenteeism data to improve performance? Are there successful programs (inside or outside of transit) to promote attendance? How have established employee attendance incentive programs reduced unscheduled absence? How do work rules and employee benefits impact rates of absenteeism?

III. OBJECTIVES

This research would have the following objectives:

- Provide an exhaustive and comprehensive study of bus operator absenteeism in the transit industry
- Describe the impact and cost of bus operator absenteeism on transit systems
- Provide a management tool kit to accurately measure and evaluate bus operator absenteeism
- Inventory discipline and incentive programs to improve bus operator attendance
- Provide guidance to transit managers and labor unions for programs to improve attendance

IV. RESEARCH PROPOSED

The specific research proposed is a combination of survey, analysis, and recommendations. A representative sample of fixed route transit systems would be surveyed to establish a baseline of data
regarding bus operator absenteeism. This would include how systems measure absenteeism, current rates and trends in absenteeism. The specific research approach and tasks could include:

- Literature search and summary of employee absenteeism in transit and comparable service industries
- Identification of methodology to measure bus operator absenteeism
- Statistically significant survey of fixed route bus systems to identify bus operator absenteeism rates and trends
- Comparison of bus operator absenteeism rates and trends to comparable service industries
- Analysis of the cause and effect of bus operator absenteeism in the transit industry
- Quantify the potential and magnitude of payoff from potential improvement in operator attendance
- Identification and analysis of absenteeism control programs and measurement of their success in the transit industry

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** This project could be completed for an approximate budget of $300,000.

**Research Period:** Eighteen (18) months.

VI. URGENCY AND PAYOFF POTENTIAL

This particular research has a high degree of urgency. Transit system budgets are impacted daily by the effects of bus operator absenteeism. In an environment where funds are tight, operating dollars that are wasted due to abnormal levels of absenteeism could better be spent on service improvements that address congestion, land use and global warming issues.

This research will be most valuable because it should produce an immediate payoff to transit systems when they implement the identified programs to improve attendance. The research will quantify the potential and magnitude of that payoff. An initial estimate, however, can be made from the experience of the transit system described in Section II above. If the research facilitates achievement of the national average for unscheduled absenteeism (2.5%), the annual savings for that transit system alone (based on current wage rates) could be in a range between $750,000 to $1.5 million. In addition, better attendance should reduce health care costs. There also should be some “softer” benefits. These include less operator stress and improved employee morale.

There could be some potential institutional, political and socio-economic barriers to implementation of the anticipated research products. The major institutional barrier would be resistance from labor unions. It is reasonable to assume that this barrier could be overcome because transit unions are knowledgeable about this problem and their members suffer from the high rates of absenteeism. Operators who do report to work have increased stress and much longer hours due to the unscheduled absences of other operators. The best evidence that unions would help overcome this barrier is the current pattern of labor settlements that include incentives and discipline programs aimed at improving attendance. Another way to address this potential barrier is to include labor union representatives on the oversight panel.

The potential political barrier is related to the Family and Medical Leave Act (FMLA). Legislative efforts are being contemplated to further enhance the provisions of FMLA. While the suggested research is not critical of FMLA, it will identify areas in which FMLA is being abused by employees or not strictly enforced by management. These findings could become entangled in the politics of FMLA revision.

The potential socio-economic barrier is the perceived impact adoption of stricter attendance policies will have on “blue collar” employees who many believe struggle to make ends meet from pay check to pay check. This barrier should be relatively easy to overcome since better attendance by these workers will
increase their take home pay. Implementation of positive attendance incentive programs also will contribute to increased pay.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

The proposed research is consistent with the FTA strategic research goals as follows:

1. **Provide transit research leadership.** This research will be ground breaking in its analysis of a critical transit operating issue. No other research or organization is leading the effort in this area.

2. **Increasing transit ridership.** The improved attendance brought about by the implementation of this practical research will promote the reliability of service through a more stable workforce. Increases in ridership depend on providing reliable service.

3. **Improve capital and operating efficiencies.** The research most strongly supports this goal. Improvement in attendance will reduce costs on many levels and improve the ability of systems to efficiently schedule their operators. Reductions in overtime will be an added benefit.

4. **Improve safety and emergency preparedness.** The research partially supports this goal. Better attendance will reduce overtime on individual operators allowing them more rest time, less job related stress and higher morale. All of these factors are major contributors to a more safety conscious workforce and organization. The very fact that more operators will be available due to increased attendance will contribute to better emergency preparedness.

5. **Protect the environment and promote energy independence.** The contributions of this research described above should promote more reliable transit systems that attract more riders. Better transit systems will contribute to achievement of this goal.

The proposed research also supports the TCRP Strategic Priorities. Principally it supports the priorities of continuously improving public transportation and revitalizing transit organizations. The ultimate goal of the research is to improve attendance with the related benefits in organizational development, employee satisfaction and morale described above.

VIII. RELATED RESEARCH

Not aware of any ongoing or competed transit research that is on this topic. There are human resource associations and businesses that conduct generic research and surveys on absenteeism (as noted above). These could be used as resources for the research.

IX. PERSON(S) DEVELOPING THE PROBLEM

**Anthony V. Johnson**  
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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the product of an individual who has to manage the effects of excessive absenteeism every day and has negotiated with labor unions to improve attendance.

XI. DATE AND SUBMITTED BY: April 23, 2007
Problem Statement:
In annual reviews of the makeup of executives within the nation’s public transit systems, people of color do not emerge as the most senior leaders within the organizations. Because it is clear that the ridership of the nation’s public transit systems is predominantly people of color, it seems regressive that the entities’ leadership has not grown similarly diverse. For example, in urban areas, African Americans and Latinos comprise 62% of bus riders, 35% of subway riders and 29% of commuters. Yet, in the top 20 public transit agencies, only three are lead by CEOs of color—all African American.

In addition, the U.S. census estimates that neither Whites nor any other race will make up a majority of the country’s population. In six out of eight of the largest metropolitan areas, minorities—people of color—are the collective majority. When these realities are coupled with the results of reviews about increased diversity in the workforce and the workplace creating greater productivity, efficiency and positive impact on the business environment, the business case for more diverse leadership is obvious.

With the nation’s overall population trending to majority minority populations across multiple regions of the country, it is time that executive recruitment and positions within the nation’s public transit industry count success as reversing the existing trend and comporting with the population’s reflection of the communities they serve.

Objectives:
The goal of this research would be to create a set of guidelines for public transit search committees to use in conducting their work for executive openings at their entities. It would also serve to seek the input of search committee members and professional recruiters in the draft of these criteria. Once adopted, these criteria would also be disseminated to all human resource professionals working in the public transit recruitment arena.

The objectives of this research are to:
- Create a task force of search committee members and recruiters of public transit agency executives
- Identify the next top 50 executive openings within the nation’s public transit agencies
- Establish a database of professional candidates for the top positions
- Develop a criteria for public transit agency search committees to guide their choice of executive recruiters
- Benchmark the use, value and results of the criteria by tracking the final selection and announcement of the 50 positions
• Publish a report of the process with a potential timetable for reviewing and updating the criteria for ensuring candidates of color are incorporated into executive recruitment in a meaningful way
• Create a management level career presentation that public transit human resources professionals may use for internal and external public transit outreach to continue to grow the ranks of professional candidates of color

**Research Period:** 12 months

**Problem Funding:** $300,000

**Urgency and Payoff Potential:**
The reputation of this country’s public transportation arena has long been noted as a “good old boy network.” The reason for this is the gender and racial/ethnic minority make-up of its leadership. The industry is overdue in its commitment to meaningful diversity in its executive ranks. This research would create effective ways to address the well established lack of minority executives at the highest ranks with the input of minority candidates of color and the selection committees and processes in use. Many programs have been put forth with piecemeal approaches and scattered results. This research will serve to devise a pervasive and lasting way to approach executive searches in the public transit arena in the near term and for the future. The business case for diversity at the highest levels of any organization, private and public, has been made time and again.

**Relationship to FTA Strategic Goals and Policy Initiatives and TCRP Strategic Priorities:**
The research would serve to “Continuously Improve Public Transportation” and “Revitalize Transit Organizations.” These efforts would also create the environment for management improvements in operational efficiencies, safety, security, the workplace and the environment. Current federal transportation diversity policy underscores that “Throughout DOT, senior leadership is committed to ensuring diversity management is an integral part of day-to-day operations.” In a June 2003 Diversity Action Plan instituted by U.S. Transportation Secretary Norman Mineta, it states: Data from the last few years reflect that women, minorities and people with disabilities are underrepresented in our workforce, particularly at managerial and executive levels. Much of the transportation industry mirrors this reality and federal transit is among that group. This research would serve the broader context of transportation in delivering a method for ensuring inclusion that could be used in other modes.

**Related Research:**
To be determined.

**Persons Developing the Problem:**
Julie Cunningham, President & CEO, Conference of Minority Transportation Officials
Judith A. Burrell, Principal, BURRELL PROJECT CONSULT

**Process Used to Develop Problem Statement:**
Conference of Minority Transportation Officials
TCRP Problem Statement

I. PROBLEM TITLE

Recruitment, Performance and Retention of Quality Paratransit Managers -- Skills, Qualifications, Needs, and Future Prospects

II. RESEARCH PROBLEM STATEMENT

In 2005, Easter Seals Project ACTION hosted a Consensus Conference to explore recruitment, training, retraining, and rewarding paratransit managers. The Conference was directed at the long-term goal of increasing the competency of paratransit managers, as well as the effectiveness of their training. TCRP Synthesis SF-12 was one noteworthy result, to document the current state of paratransit managers’ skills, qualifications, and needs. Further research is desirable, especially to gain greater insight into small and rural agency managers’ responsibilities and prospects, and to provide guidance to improve the future of the profession.

III. OBJECTIVE

As of a result of TCRP Synthesis SF-12, it became clear that it is important to identify additional information regarding paratransit managers as a professional category, and especially in light of Project F-13 regarding paratransit vehicle operators. The proposed research would provide that important “next step” to identify and quantify key information to improve recruitment, performance, and retention of paratransit managerial personnel.

The demographics of our aging Baby Boomer population make it clear that the professional category of Paratransit Manager needs particular enhancement, and sooner rather than later.

IV. RESEARCH PROPOSED

It is envisioned that there would be larger and more extensive surveys than is possible for a Synthesis project. These should be disaggregated between rural, suburban, and urban agencies, and agencies of different sizes. The research project should collect more details on how paratransit managers fit into their agency organizations and cultures and what specific training needs are necessary to ensure success. The project should also investigate how to attract
new entrants and how to improve job retention. Greater opportunities for local advisory committees’ input would also be helpful.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $350,000

**Research Period:** 18 months

VI. URGENCY AND PAYOFF POTENTIAL

Given the increasing demand for paratransit service in a variety of operating settings, this project becomes increasingly important to ensure that managers of these systems are appropriately selected, trained, and retained. It is also necessary to maintain parity with evolving research and knowledge about key employees for whom these managers are responsible (e.g., TCRP Project #F-13 currently underway).

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This project has direct opportunity to contribute to at least two of FTA’s strategic research goals:

(2) Improving Capital and Operating Efficiencies
(3) Improving Safety, Security and Emergency Preparedness

-- and to the extent that the results can, as anticipated, enhance performance of paratransit managers and systems, this project can also support two other FTA goals:

(1) Increasing Ridership
(4) Protecting the Environment and Promoting Energy Independence

The project also contributes to all five of TCRP’s strategic priorities:

I. Place the Transit Customer First
II. Enable Transit to Operate in a Technologically Advanced Society
III. Continuously Improve Public Transportation
IV. Flourish in the Multimodal Environment
V. Revitalize Transit Organizations

VIII. RELATED RESEARCH

This proposed project is a follow-up to the recently-completed TCRP Synthesis SF-12: *Paratransit Managers’ Skills Qualifications and Needs.*
It is also essential to keep pace with TCRP Project F-13: *Driver Recruitment, Retention and Performance in ADA Complementary Paratransit Operations* (currently underway).

**IX. PERSON(S) DEVELOPING THE PROBLEM**

This problem statement was developed with unanimous endorsement of the TCRP SF-12 Project Panel (J. Barry Barker, Chair) with the assistance of project consultants John Potts and Maxine Marshall of the DMP Group.

**X. PROCESS USED TO DEVELOP PROBLEM STATEMENT**

TCRP Synthesis Project #J-12 provided a useful “snapshot” of the current state of information regarding paratransit managers skills, qualifications, and needs. At the Oversight Panel’s review meeting for the Draft Report, it became clear that more information is needed regarding this critical job function. This resulted in the proposed Problem Statement.

This project statement has also been endorsed by the Community Transportation Association of America (CTAA) and by the APTA Access Committee. Although the idea was initiated too late for endorsement by the full TRB Committee on Rural & Intercity Bus Transportation (AP055), it has been endorsed by several members, including two former Chairs.

**XI. DATE AND SUBMITTED BY**

Submitted: June 15, 2007
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TCRP PROBLEM STATEMENT

I. PROBLEM TITLE

Advancing the Implementation of Maintenance Training Standards

II. RESEARCH PROBLEM STATEMENT

The transit industry is experiencing a period of resurgence and growth. As ridership continues to grow, transit agencies are deploying new technologies to serve passengers that expect highly responsive, environmentally appealing and safe transit services. As newer and more convenient transit systems are deployed, agencies are faced with the need to operate and maintain equipment that is becoming more complex. This calls for a workforce that is constantly being trained and retrained on new equipment, even at a time when many existing workers are fast approaching retirements and when the industry has to recruit new workers in highly competitive labor markets. These opportunities and challenges are made more complicated by the fact that many of today’s younger and less experienced workers have little understanding of the new technical requirements of transportation systems as few schools provide this type of training. As a result, transit agencies are finding that they must continuously train their maintenance mechanics and technicians to develop the needed skills.

Most recently, transit managers and labor representatives are working in partnerships to address the growing skills shortages affecting transit by identifying training requirements and developing national standards for bus and rail maintenance occupations. The Community Transportation Center (CTC) has served as a key facilitator for the labor-management partnerships in developing these standards. To date, working in concert with APTA, joint labor-management national training standards have been developed for 8 of the 11 key areas of bus maintenance corresponding to ASE testing for bus maintenance certification. Working closely with APTA and the major transit unions, the CTC is also facilitating the development of training standards for four transit rail maintenance occupations. Training modules for each of these areas are scheduled to be completed in late 2007 and throughout 2008.

This proposal is to take transit maintenance standards to the next level by developing activities that further the implementation of standards within the transit maintenance community. Each of the proposed activities is intended to foster the application of national maintenance training standards as examples of best practices.

III. OBJECTIVE

This current proposal is to further the utility of the emerging joint national training standards by developing activities which will complement the national training standards and increase their usefulness. Four deliverables are proposed to complement and implement national training standards that have recently been completed or are still in development:

1. In each of the four rail maintenance crafts (railcar, signals, elevator and escalator, and wayside power), the national training standards will be...
coordinated with the FTA’s State Safety Oversight process and APTA’s Manual of Standards and Recommended Best Practices to ensure that the national rail maintenance training standards fully incorporate State Safety Oversight requirements and APTA’s Standards and Recommended Best Practices.

2. To improve the acceptance and adoption of the national standards for transit maintenance training, a system of courseware evaluation and sharing will be developed and disseminated via the internet and other appropriate dissemination media.

3. An implementation plan for developing regional training centers for bus maintenance of electrical and electronic systems using existing agency resources. This will respond to the acute shortage of well trained and skilled technicians for bus electrical and electronic maintenance. These shortages are most acute in medium and small transit agencies that have very limited training capacities. The training modules used in this training will be the Bus Electrical and Electronics Maintenance Training Standards that were recently developed as part of the training standards development.

4. The CTC will work with transit agencies and trainers throughout the U.S. to take the national training standards and develop pilot maintenance training programs.

IV. RESEARCH PROPOSED

Task 1: APTA Standards, Federal and State Safety/Security Oversight Coordination with Rail Transit Maintenance Training Standards

Each of the rail maintenance training standards (signals, elevator and escalator, wayside power) is critical to the safety and security of rail transit. The training standards have implicitly integrated safety considerations. The maintenance training standards will be fully coordinated with state safety oversight agencies, APTA’s Standards and Recommended Best Practices for Rail Transit Maintenance and, the evolving New Starts and security requirements for rail transit that the Department of Homeland Security and FTA are coordinating. These considerations may result in enhancements to the maintenance training standards recommended by the transit industry labor-management subject matter experts. This process will be undertaken in close coordination with APTA and FTA to ensure the successful incorporation of relevant safety and security oversight considerations in the rail maintenance training standards.

Task 2: System of courseware evaluation for training standards consistency

Courseware, including instructional resources, training models and simulators, software, demonstrators, etc., is essential to successful technical training and instruction. In each of the areas where maintenance training standards are completed or under development there are courseware of various types and qualities. In this task, transit agencies will be requested to make available to the CTC their non-proprietary courseware. As this courseware is made available, subject matter experts from labor and management will be asked to review the courseware and to evaluate the consistency of the courseware with established training standards. The outcomes of this process will be included in a compendium of courseware compliant with the national training standards. This compendium will be disseminated to transit agencies and their trainers. This will assist trainers with identifying course resources for instruction and facilitate the development of courses of training consistent with the training standards.
Task 3: Develop a plan for a pilot program that would use larger agencies as regional centers to provide electrical and electronic (EE) training to maintenance personnel from smaller sized agencies using established training standards.

Buses have become increasingly complex with the majority of that complexity coming in the form of advanced electrical and electronic (EE) systems. The success of onboard bus electronics, especially Intelligent Transportation Systems (ITS), depends on skilled technicians to keep this sophisticated equipment operational. The vast majority of technicians, however, were trained in mechanical methods and lack essential EE skills. Although it is extremely difficult for smaller agencies with limited resources to provide the specialized training needed to impart these skills, larger agencies routinely deliver top-level EE training in classrooms with empty seats.

An evaluation study is proposed to determine if larger transit agencies would be willing to serve as a pilot program for establishing three to four Regional EE Training Centers throughout the country, and if smaller agencies would be willing to send personnel to these centers. The study would identify the issues associated with establishing regional EE training centers and the resources required to implement a pilot program. Included in the evaluation study would be a review of the EE curriculum offered by potential pilot agencies to determine if agency courses comply with established EE training standards and the ability of these courses to prepare students for ASE certification.

Task 4: Develop Curriculum Pilots for Rail Transit Maintenance Occupational Training

The larger transit agencies that operate heavy rail transit have well developed training departments. These agencies will be well positioned to incorporate the maintenance training standards into their training programs with appropriate contingencies based on the particulars of the agency’s equipment, practices and working conditions. For smaller rail operators, such as those with a limited number of rail corridors and equipment, the training standards will provide a baseline for the training of their rail maintainers. This is the case with many of the recent and new light rail agencies which are challenged with hiring and training maintenance personnel with limited training departments and budgets. The CTC will work with agencies to develop pilot programs to implement important parts of the rail maintenance training standards and evaluate their effectiveness in the training of new workforce entrants and the retraining of incumbent workers. The Center proposes to undertake three pilots to execute and evaluate the effectiveness of the rail training standards.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $250,000. CTC has spent $327,000 directly to support the work of these national labor-management training standards committees. The Center has spent more than three times the requested amount in its effort to assist in developing a system of national training standards and apprenticeship for transit maintenance. In addition, CTC is continuing to spend
several times the requested budget amount in building labor-management partnerships for training in local transit agencies and statewide transit labor-management partnerships for training. (When the Center with extensive industry input was finalizing its proposal to USDOL, Building Capacity for Transit Training and Apprenticeship, the industry had not yet implemented the national joint labor-management Bus Maintenance Training Subcommittee. With that very successful experience under the industry’s belt, it would be wasteful to pass up the opportunity to apply that same successful joint labor-management method to developing national training standards for the four rail maintenance occupations covered (along with bus maintenance) in the Building Capacity project.)

The investment on the part of transit agencies in participating in the labor-management partnerships and technical committees far exceeds the TCRP and Transport Center resources devoted to this project. It is estimated that the labor-management committee members will require a minimum of 2200 total person hours of meeting time in developing the training standards. This represents a very substantial investment of industry resources.

**Research Period:** It is estimated that this applied research will take 24 months to complete including the publication of a final report.

**VI. URGENCY AND PAYOFF POTENTIAL**

The APTA Standards and Recommended Best Practices for Transit Rail Systems were developed in 2004 and were substantially implemented in the industry by September 2006. The development of training for the four rail occupations covered by this labor-management cooperative effort will support the further implementation of the rail standards and best practices. This proposal was initiated and developed with the concurrence of APTA, ATU and key Locals of TWU and IBEW.

In addition to supporting the implementation of standards and best practices, the five bus and rail occupational categories included here are occupations that are subject to shortages of adequately trained employees. As rail transit systems have expanded and continue to expand and, as the related equipment and systems have become more complex and integrated, the need for training transit maintenance technicians has become more acute. This need is further accentuated by the aging existing workforce, with many of the older rail transit systems facing the pending retirement of existing signals, facilities and vehicles maintenance personnel. In the case of escalator maintainers, and to lesser degree elevator maintainers, there are very few training programs and training resources outside of those available from OEM's and escalator installation contractors. This project will be very critical in addressing the need for training for escalator technicians. The training provided through this process will help to increase the numbers of rail maintenance personnel with appropriate training and qualifications and will assist agencies in developing their internal training programs.

**VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES**

This research supports the FTA Strategic Research Plan and the goal of Improving Capital and Operating Efficiencies.
This research supports the following TCRP Strategic Priorities:

- Enable Transit to Operate in a Technologically Advanced Society
- Continuously Improve Public Transportation, and
- Revitalize Transit Organizations.

**VIII. RELATED RESEARCH**

This project is closely related to TCRP Project E-06 Transit Bus Mechanics Building for Success. In project E-06, certification requirements and tests are being developed for transit bus mechanics. In that project, transit unions insisted that training be available to prepare transit workers to successfully comply with certification related tests. This project is similar to E-06 but focuses developing training for four rail transit occupations subject to already developed APTA Standards and Best Practices.

This project is closely related to continuing work by the Community Transportation Center jointly with APTA, major transit labor unions and numerous transit agencies to develop national training standards for rail maintenance occupations under grants from the Federal Transit Administration and the U.S. Department of Labor.

Other related research includes:


IX. PERSON(S) DEVELOPING THE PROBLEM

The Community Transportation Center
American Public Transportation Association
Amalgamated Transport Union

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the result of the Community Transportation Center’s continuing activities with APTA, many transit agencies and the major transit unions to develop labor-management partnerships at the state and local levels; to develop and facilitate joint labor-management adoption of training standards for transit maintenance crafts; and to further the transit standards development.

XI. DATE AND SUBMITTED BY

Lewis P. Clopton
Community Transportation Center
June 15, 2007
Title: Assessment of Transit Industry Software Practices

Research Problem Statement:

The role of software technology in the transit industry has increased to the point where it is nearly impossible to procure any major equipment or build a transit system without it. From control centers to buses and rail cars to traction power systems to fire alarms and even elevators, software is everywhere. As software seems more and more pervasive throughout the industry, it is and has been this same software that gives us the most problems. In fact for the typical large infrastructure project where software makes up less than 1/2 of 1% of the total value of the project, software is often cited as one of the top 5 risks of not achieving an on time project delivery. While attempts have been made for years to specify “Off-the-shelf” software products in vain hope that the vendors have worked out all of the issues prior to purchase, it is frequently found that they have not done so for ‘our system’ and that adds cost, time and risk to projects.

Objective: the objective of this study is four fold:

1. Understand the role process plays in the acquisition and development of software intensive transit industry systems
2. Investigate and identify industry pitfalls associated with development acquisition process components
3. Determine the state of the industry with respect to proven industry standards for software development and acquisition
4. Evaluate potential transit industry benefits from emulating best practices from other industries such as Defense, which have proven effective.

Research Proposed:
We propose a comprehensive data gathering exercise and analysis along the following lines:

1. Perform several data gathering workshops with transit authorities, consultants, transit contractors/suppliers to:
   a. Determine empirically where the state of the industry is in software process/engineering/procurement
   b. Develop a comprehensive understanding of the needs of the industry
   c. Identify focus areas for further evaluation
   d. Select individual participants for in depth evaluation
2. Perform in depth evaluations, audits, appraisals on contractors, suppliers, agencies, and consultants using:
   a. Questionnaires
   b. Focus area audits/appraisals
c. Feed back sessions
3. Provide an overall study results and assessment of industry in aggregate along with recommendations

Estimate of the Problem Funding and Research Period

We estimate the project will take two/three FTE persons 6 months of research plus another month to write up the report. Total expected budget is anticipated at $250,000 plus an approximate $50,000 in travel and other expenses.

Urgency and Payoff Potential

Whether we like it or not, software is here to stay and will continue to increase in its importance to transit. Already many projects suffer from significant cost overruns, late starts, and loss of functionality due to poor implementation and acquisition processes. The sooner the industry can get a handle on a process that works the better.

We estimate that the payoff for this consists of several parts (1) establishing a baseline and recommended practices for the industry, (2) greater software project schedule adherence, (3) reduction of cost overruns, and (4) improved system functionality. The magnitude of savings will be on the order of $3-10 million annually across the industry.

Relationship to FTA Strategic Goals and Policy Initiatives and ACRP Strategic Priorities

Project fits into both the FTA’s and APTA’s strategic research goals of improving capital and operating efficiencies and the effectiveness of technology and capital projects.

Related Research

None that we are aware of.

Person(s) Developing the Problem

ATPA Communications Subcommittee
Chair: Jonathan McDonald, Principal Consultant - Communications,
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Phone: 206-398-5458, Fax: 206-689-3339

Process Used to Develop Problem Statement

Problem was developed by APTA’s Communications Subcommittee with input from APTA’s Research and Technology Committee.

Date and Submitted by:
Submitted by: Jonathan McDonald 6-7-07
A Proposal to TRB

From:

American Public Works Association/ National RTAP

And

Community Transportation Association of America

PROBLEM TITLE: Tribal Transit Service, Training and Funding Challenges

RESEARCH PROBLEM STATEMENT: The integral relationship between access to transportation and quality of life is well known. Yet many citizens across the country struggle with access to health care, education, jobs, businesses and entertainment. This is especially true of many Native American communities.

Although American Indians living in “Indian Country” (on or near Indian reservations or designated Indian statistical areas) experienced marked improvement in real per capita income growth during the decade of the 1990s relative to the rest of the U.S. population (33% vs. 11%), even as the American Indian population grew by more than 20%, this predominantly rural segment of the U.S. population lags substantially in economic resources behind mainstream America. While 79% of the U.S. population (2000 Census) is classified as urban, this statistic is reversed for Native American communities with about three-fourths of the population classified as rural. Even with the substantial improvements in Indian community economies since 1990 (e.g., poverty rate and unemployment improvements ten times higher than the U.S. as a whole), American Indians still fall into poverty and are unemployed at triple the rate of the U.S. population.

Even with improvement of their economy, Native American families often still do not have the luxury of personal automobiles. In these cases, public transportation can literally be a life line for Native Americans to their jobs, school, health care, and other important aspects that define “quality of life.” In fact, as their economies improve, public transportation becomes more vital as people now have jobs to go to, money to buy groceries, and schools to attend. In the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), Congress established a supplemental funding program to assist tribes in establishing and maintaining transit systems to address this issue. In order to provide sufficient levels of funding, training and technical assistance to tribal transit agencies and to tribes establishing transit agencies, it is necessary to have clear, in-depth and current information on the level of coverage and other statistics on tribal transit across the country. This need was also identified in a recent National Cooperative Highway Research Program (NCHRP) Synthesis Report 366 “Tribal Transportation Programs: A Synthesis of Highway Practice.” The report identified “operation and development of tribal transit services” as an area that needed further study. The time is ripe for an in-depth data collection and analysis of tribal transit statistics and characteristics.

OBJECTIVE: The proposed study will research and gather information from the 562 Federally Recognized American Indian Tribes and Alaskan Native Villages. The research will focus on
gathering much needed data on the different transit systems serving these tribes. Specifically tribes will be surveyed to determine the existence of tribal-owned and/or operated transit systems as well as other transportation services available to tribal members, the existence and extent of transportation planning in tribal transportation systems, in addition for those tribes with existing transit systems, statistics on the system (e.g., size, coverage area, etc.) will also be gathered. In addition, researchers will identify those tribes without access to a local public transit system and attempt to determine the reasons behind these transportation gaps. The end result will be a substantive and detailed report on the level of transportation coverage available to American Indian Tribes and Alaskan Native Villages across the country. This information will be useful for Federal and state governments (specifically departments of transportation) as well as national, regional, state and local transportation providers and associations as well as research, training and technical assistance providers and universities looking to serve tribal communities.

**RESEARCH PROPOSED:** Analysis will include an in-depth data collection of information on the existence of different levels of transit service available to tribes (with especial focus on tribal-ran systems), characteristics of identified tribal transit agencies and other systems serving tribes, coverage areas served, types of transit service provided, various funding sources for tribal transit agencies, existence and extent of transportation plans for tribes, and determination of areas with a lack of available transportation and reasons for said gaps in service. It is planned that this TRB Project (estimated cost of $400,000) will complete phase 2 of a three-part comprehensive research project on the overall status of tribal transit across the country. Phase 1 will be a TCRP Synthesis project on characteristics of federally-funded tribal transit programs. Phase 3 will be an American Association of State Highway and Transportation Officials – Standing Committee on Public Transportation research project to develop a toolkit for strategies for coordination between state and tribal governments on transit projects and planning. The information gathered in this phase 2 project will be crucial to establishing a foundation of research and credible on this historically overlooked topic.

**ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD:**

**Recommended Funding:** It is estimated that $400,000 will be needed to complete this project. Of this total, the data collection is estimated to cost $200,000; the convening of representatives of affected parties $100,000 and the analysis, preparation and distribution of the final report $100,000.

**Research Period:** Time needed to complete this project is estimated at two years.

**URGENCY AND PAYOFF POTENTIAL:** In the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), Congress established a supplemental funding program to assist tribes in establishing and maintaining transit systems to address this issue. In order to provide sufficient levels of funding, training and technical assistance to tribal transit agencies and to tribes establishing transit agencies, it is necessary to have clear, in-depth and current information on the level of coverage and other statistics on tribal transit across the country. This need was also identified in a recent National Cooperative Highway Research Program (NCHRP) Synthesis Report 366 “Tribal Transportation Programs: A Synthesis of Highway Practice.” The report identified “operation and development of tribal transit services” as an area that needed further study. This area is a historically overlooked topic for credible data. As the FTA Tribal Transit Grant program continues to fund tribal transit systems moving forward and national, regional, state and local systems and technical assistance providers are looked to assist a growing population of Tribal transit systems, it is imperative that a substantive data collection on
the current “state of tribal transit” occur to provide all stakeholders with credible data in which to pursue the mutual goals of increased transportation opportunities for all Americans, especially Native Americans.

RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES:

**Federal Transit Administration**

**Ridership Goal**—Understanding the current levels of tribal transit service will allow federal state and tribal transit agencies to improve service delivery, coordinate and expand programs and clear the way for expanded service and ridership.

**Security Readiness**—Understanding the levels of service currently available will identify existing resources that are currently underserved in security training and information dissemination. By identifying the current tribal transit systems, state and federal agencies can work to increase the security readiness for those systems.

**Project Planning and Oversight**—Identifying base service levels for tribal transit will allow service providers and state and federal agencies to coordinate programs and improve efficiency of operations.

**Strategic Management of Human Capital**—Gaining information on the different characteristics of current tribal transit systems will allow providers and funding and support agencies to identify training gaps, areas for coordination and strategies for management progress. This information will also provide a basis for increased training and technical assistance to tribal providers.

**Transit Cooperative Research Program**

**Place the Customer First**—Native American tribes are a historically underserved population. Often lacking basic resources and services that most citizens take for granted. In order to redress the balance and ensure that Native Americans have access to the same opportunities and quality of life, it is necessary that funding and support programs target programs to maximize the benefit to customers.

**Enable Transit to Operate in a Technologically Advanced Society**—As pointed out in the Urgency and Payoff discussion, there is no current source of information on levels of technology use by tribal transit agencies or on different examples of technology applicable to tribal transit programs.

**Continuously Improve Public Transportation**—The project would dramatically improve tribal transit programs by identifying the levels of service currently provided and the types of transit available to Native Americans. More importantly, this research will provide crucial data that will inform state and federal funding and support programs that will help to improve and expand existing services for Native Americans.

**Flourish in the Multimodal Environment**—This information will help identify levels of tribal service existing across the country. This information will be identified through a process including state and local practitioners to help identify areas for coordination. Additionally, a subsequent study is planned utilizing this data as a core to identify strategies to assist state and tribal transit coordination.

**Revitalize Transit Organizations**—By identifying different levels of service and characteristics of tribal transit agencies new and existing tribal transit programs will benefit from the increased flow of information. In addition state and federal funding and support programs will be able to utilize this information to continue and expand programs to support tribal transit across the country.

PERSONS DEVELOPING THE PROBLEM:
American Public Works Association
Peter B. King, Executive Director, APWA; pking@apwa.net
David Barr, Director, National RTAP, c/o APWA; dbarr@apwa.net
1401 K Street, NW, 11th Floor, Washington, DC 20005, 202-218-6722; fax 202-218-6723; and

Community Transportation Association of America
Dale Marsico, Executive Director, CTAA; Marsico@ctaa.org and
Charles Dickson, Associate Director, CTAA; Dickson@ctaa.org
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PROCESS USED TO DEVELOP PROBLEM STATEMENT: With FTA’s implementation of SAFETEA-LU provisions, RTAP was identified as the key technical assistance resource for tribes to access for Section 5311 and the Tribal Transit Programs. National RTAP established a relationship with the Tribal Technical Assistance Program to assist in providing training and technical assistance to tribes on transit issues. Through discussions between APWA-National RTAP, CTAA, FTA and TTAP it was identified that a key gap in information for training and technical assistance provision to tribes was the lack of current and clear data on tribal transit programs and service and training gaps. This discussion ended with an agreement that research and data collection on this issue was needed to develop the type of information needed in order for FTA, National RTAP and TTAP and other funding programs and training and technical assistance providers to interact and assist tribes in establishing, maintaining and expanding tribal transit service.

DATE AND SUBMITTED BY:

_6/8/07________________          __David Barr /e/_____________________
(date)      (name)
II. RESEARCH PROBLEM STATEMENT

The provision of parking spaces at or near transit boarding points evokes mixed feelings within the transit industry and the local communities that the industry serves. Some people believe that it would be better to operate common carrier feeder services to line-haul transit facilities, and to discourage access by private vehicles. Yet new rail transit stations or lines built without parking provision in medium density areas have often learned that, even with considerable feeder provision, providing parking is necessary to build rail ridership. And for some commuter rail systems, limited parking provision is seen as a major constraint on further ridership growth.

The objective of this research project would be to provide a primer for transit agencies on parking provision for transit. The Primer would include methods to evaluate the effect of parking on ridership, on traffic flow at stations, and on nearby neighborhoods. The primer would describe best practices in parking provision, communicating with the customer and in revenue management. It would also investigate the pros and cons, legality, and practicality of restricting use (or differentiating prices) at over-subscribed parking facilities.

III. OBJECTIVE

The objective of this research project would be to provide a primer for transit agencies on parking provision for transit. The primer would include methods to evaluate the effect of parking on ridership, on traffic flow at stations, and on nearby neighborhoods. The primer would describe best practices in parking provision, communicating with the customer and in revenue management. It would also explain the pros and cons, legality, and practicality of restricting use (or differentiating prices) at over-subscribed parking facilities.

IV. RESEARCH PROPOSED

Transit agencies face a wide variety of policy issues in connection with parking provision, including the following:
• **Whether or not to provide or encourage parking**
The level of parking provision and its influence on transit ridership, local traffic flows, and station choice behaviors. Methods of encouraging or discouraging parking provision.

• **Ownership/control aspects**
Direct ownership or leasing by the transit agency; direct ownership or leasing by local governments; transit agency management of publicly- or privately-owned facilities; totally private facilities.

• **Informational aspects**
Communicating to potential passengers the parking arrangements, both statically and in real time (e.g., current parking availability, diversions to other facilities). Signage.

• **Pricing aspects**
Integration of parking pricing and revenue management with transit pricing/revenue management.

• **Other rationing mechanisms**
The pros and cons, legality, and practicality of restricting use (or differentiating prices) at over-subscribed parking facilities to favor (say) residents of the local community, certain types of vehicle, HOV access, etc.

The research would investigate these issues through:

1) A review of the literature on parking and transit as well as parking provision in general.
2) Conduct a review of industry practices in parking provision, including parking ownership, management, pricing, and impact on transit ridership.
3) Conduct a review of industry practices and the legality of restricting parking use.
4) Conduct case studies of best practices of parking in transit and in related industries. Case studies of other industries need to provide lessons learned for the transit industry. Case studies should cover acquisition, construction, ownership, management, pricing and other relevant policies.
5) Investigate and provide a technical memorandum on the impact of parking provision and pricing on transit ridership. The memorandum should propose a model that transit agencies can use to estimate parking demand and the impact on ridership.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $200,000

**Research Period:** 18 month project

VI. URGENCY AND PAYOFF POTENTIAL
Parking is a difficult issue for transit agencies. Adequate parking, rather than bus feeder service, is considered necessary for rail or express bus services to reach their full potential. Successful intercity operators now count on park and ride facilities for their customers. Transit agencies need guidance on how to provide parking, the advantages and disadvantages of doing so, pricing for parking, parking facility design, parking facility management, and mitigating the effects on local communities. Little research has been done on this important aspect of transit service, and a parking project will provide the opportunity to make a real contribution to the transit industry.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This research will make a positive contribution in many of the FTA and TRB priority areas including:
1) Increasing ridership: many transit agencies view parking as critical for ridership growth for express services.
2) Security readiness: parking facilities need to be secure to attract customers, and transit agencies should be aware of best practices in parking security.
3) Placing the customer first: good parking makes transit accessible to a much larger audience than if there were no parking. Transit agencies need to understand how to provide information to customers on parking availability.
4) Multimodal environment: parking and transit represent the pairing of modes, and transit can play an important role in helping to provide parking for a community.

VIII. RELATED RESEARCH

There has been little related research from TCRP on parking policy.

IX. PERSON(S) DEVELOPING THE PROBLEM

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Phone: 617-425-3350 Fax: 617-425-3132 Email: mak@crai.com
Karla Karash, Vice President, TranSystems, 1 Cabot Road, Medford MA 02155, 781-396-7775 (p), 781-396-7757 Fax, khkarash@transystems.com

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement was developed by the AP030 Committee on Public Transportation Marketing and Fare Policy

XI. DATE AND SUBMITTED BY

June 15, 2004
Karla H. Karash
TCRP Problem Statement

I. PROBLEM TITLE
Public Transit Parking: Meeting Transit Agency Policies, Community Planning Goals and Neighborhood Concerns

II. RESEARCH PROBLEM STATEMENT
Transit agencies strive to maintain and increase ridership through a variety of marketing techniques and physical improvements. Key support elements in the expansion of transit ridership are the availability and amount of commuter parking (surface or structured lots), the parking policies of the transit agency (free, daily fee or monthly spaces) and the ability of users to easily access the station area and designated parking areas. Parking policies and development/design issues and the different perspectives of operating agencies and local governments often result in the potential for conflicts, controversy and implementation delay.

- Transit agency staff must often respond to negative reactions by local officials and residents (whether real or perceived) to new or expanded commuter parking facilities, in terms of off-site impacts (such as, induced neighborhood traffic and safety or nuisance concerns) and community aesthetics.
- At the same time, land use and community planners, transit agencies and the development community, often have conflicting goals for parking. One approach for the station area is to promote transit-oriented development and neo-traditional (New Urbanist) community design: creating a mixed use, walk-to environment that minimizes driving and extensive parking areas. The other may be to provide maximum commuter parking to support transit’s ridership and revenue goals or to fulfill the financing requirements of lending institutions.
- Related to these concerns are the issues of parking standards, development controls and parking facility design; which are evolving due to smaller cars, use of shared vehicles and greater community design sensitivity.

III. OBJECTIVE
Evaluate rail, bus and transit systems and stations in a sample of community settings to determine:
1) the role and impacts of commuter parking, in terms of traffic generation, transit access and transit ridership; and
2) the role and interactive effects of commuter parking on and by different community densities and development patterns.

IV. RESEARCH PROPOSED
The research would include:
- Phase 1 – Literature Review with Summary of Previous Studies and Best Practices, focusing on practice in the United States.
- Phase 2 – Evaluation of Commuter Parking Outcomes (both land use and travel behavior) of a sample of implemented commuter parking projects in urban, central business district, suburban and rural settings.
• Phase 3 – Assessment of Findings and Recommendations, including supportive policies, design features and actions that could enhance the potential land use and travel behavior benefits of commuter parking areas, in support of transit systems and as “good neighbors” in a community setting, including illustrative case studies.
• Phase 4 – Final Report with an Executive Summary suitable for use by local officials and the public.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding: $300,000.
Research Period: 24 months

VI. URGENCY AND PAYOFF POTENTIAL
A better understanding of the role and impacts of commuter parking in various community settings, and its integration with public transit services and transit-oriented development is critical to attain community receptivity and to promote the continued growth of transit ridership. Successful research will: increase the knowledge base of transit and land use planners; enhance prospects for implementation in local communities; and better enable planners and transit staff to respond to the questions and concerns raised by local officials and residents.

VII. RELATIONSHIP TO FTA RESEARCH PROGRAM AREAS and TCRP STRATEGIC PRIORITIES
The proposed research supports the Federal Transit Administration’s Strategic Goals and Policy Initiatives, Ridership, and the TCRP’s Strategic Priorities III and IV, Continuously Improve Public Transportation and Flourish in a Multi-Modal Environment.

VIII. RELATED RESEARCH
This study is intended to provide a current policy perspective, oriented to land use and transit planners, local officials and the development community. There have been previous commuter parking-related studies by TCRP, APTA, the ITE and others, but these have not been oriented to community planning, design and implementation issues. The Transit Design Manual developed through the TCRP program has limited coverage of the issues raised here.

IX. PERSON DEVELOPING THE PROBLEM
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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT
Committee Member (This is a slightly revised version of a statement submitted in 2003.)
XI. DATE and SUBMITTED BY
May 29, 2007: Edward A. Beimborn
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I. PROBLEM TITLE

New methods for collecting origin-destination and ridership data for proof-of-payment/open-fare transit systems

II. RESEARCH PROBLEM STATEMENT

The ability for transit operators to know how many riders they have and how their system is being used by these riders is a critical aspect for both operations planning as well as for future system planning. Having accurate up-to-date ridership and rider travel patterns allows transit agencies to understand how best to provide for their customers' needs. This understanding is critical for many reasons, including the fact that it is the basis for how FTA evaluates New Starts projects. Transit agencies are now required to show what is currently happening on their system to justify the need for federal funding to address system capacity constraints. However, transit systems with proof-of-payment or open-fare collection systems (typically commuter rail or light rail systems) must rely on manual methods or, in limited cases, APC systems to estimate ridership. Current APC systems do not provide data about customers' station-to-station origin and destination patterns.

Traditionally, ridership and origin-destination data are collected by origin-destination surveys and manual passenger counts. Surveys typically occur every five to ten years (or even longer), while counts are conducted more often (often to obtain federal NTD funding). While the survey and count data are of great value, they are cumbersome to collect and can be very costly. These data are also difficult to collect in a comprehensive way and it is usually only possible to collect such data for a limited time. Accurate and comprehensive automated data that is collected continuously and simultaneously can allow transit planners to understand the wide variety of ridership variation across days of week, time of day, and time of year. Continuous data collection also allows for the ability to understand various phenomena that are very hard to understand with manual data collection, such as ridership changes based on weather conditions or due to special events.

APC systems are not new and have been implemented on a variety of transit modes over the last 25 years. Many of these systems have established the benefits of improved data described above by providing accurate, continuous, and automated data collection. However, APC systems for open-fare transit systems where passengers board vehicles without passing through turnstiles have proven to be difficult to validate and operate. These systems are also costly. Furthermore, current APC systems are not able to determine a rider's boarding and alighting pattern, and only are able to provide unlinked boarding and alighting counts.

New technologies are now appearing which could improve the accuracy and the depth of ridership data using electronic data collection systems tied to fare collection systems, which is a different way to count riders than with traditional APCs. These new electronic data collection technologies have the promise of significantly improving data for the open-fare transit systems which need them the most, such as LRT and commuter rail systems. New technologies have the potential to increase the amount and quality of data on ridership and ridership patterns for these systems at costs that may approach the cost of conducting manual counts and surveys over a decade. These systems would be able to count continuously and therefore would provide much more extensive and current information to transit planners that could significantly improve day-to-day operations.

This research will review current APC technologies and data collection techniques for open-fare transit systems, on either commuter rail or light rail systems, to understand their strengths and limitations. The
research will then review a variety of new technologies and outline the strengths and weaknesses of using
these different technologies to use for collecting ridership data. The research team will select the most
favorable technology determined by the research and conduct a pilot study on an actual open-fare transit
system of either a commuter rail line or a light rail system using this most favorable technology. The pilot
study will be used to demonstrate the potential of such a system and to provide transit agencies guidance on
how to implement such a system and to define its costs.

III. OBJECTIVE

The goal of the work will be to provide guidance to transit operators about the potential benefits of
installing new technologies tied to their fare collection systems in order to significantly improve their
ridership data, particularly for open-fare transit systems (e.g., commuter rail and proof-of-payment
systems). The work will define the necessary technologies and institutional changes required to implement
such a system and will define the costs and benefits of integrating this system into a transit agency.

IV. RESEARCH PROPOSED

The research would include a literature review and interviews with selected transit operators and planners.
It will also include interviews with management of transit agencies developing or planning development of
fare collection systems and/or APC systems. The research will also provide a comprehensive review of
existing and potential automated ridership data technologies, a pilot test of the selected new technology on
an open fare system such as a commuter rail line or a light rail line, and a full development of appropriate
recommendations and implementation guidance.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $400,000 maximum.
Research Period: 18 months.

VI. URGENCY AND PAYOFF POTENTIAL

As noted earlier, the potential to collect accurate and comprehensive ridership and ridership pattern data
using next generation technologies appears extremely promising. Its urgency is high, as transit operators
and planners can use these data to improve their system operations, obtain funding for future system
enhancements, and to potentially save money based on more effective operations planning.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP
STRATEGIC PRIORITIES

This relates directly to FTA funding requirements that transit agencies must show a strong understanding of
current ridership and ridership patterns occurring on their system. Data from automated ridership data
collection systems can also be used as direct inputs into ridership models which will be used by FTA to
evaluate the benefits derived from New Starts applications.

VIII. RELATED RESEARCH

TCRP has conducted research on APCs in the past, recently for TCRP REPORT 113: Using Archived AVL-
APC Data to Improve Transit Performance and Management. There has also been research on the accuracy
of APC data in a variety of modal contexts. However, there has been little research on how new
technologies could be used to collect ridership data in lieu of or in addition to traditional APCs. The fact
that there is significant research on improving the data coming out of APCs shows the need that such
research is necessary and important.

IX. PERSON(S) DEVELOPING THE PROBLEM
X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Above draft written by Greg Spitz.

XI. DATE AND SUBMITTED BY

6/15/07 by Kathryn Coffel on behalf of the Public Transportation Marketing and Fare Policy Committee.

Submit to: Christopher W. Jenks, Director
TCRP
Transportation Research Board
500 Fifth Street, N.W.
Washington, D.C. 20001
202/334-3089
FAX 202/334-2006
I. PROBLEM TITLE

Relationship of Major Transit Investments to Transit Supportive Market Segments

II. RESEARCH PROBLEM STATEMENT

Urban planners have long known of the important relationship between urban growth and the transportation network. Transit-oriented developments (TODs) that are centered around major transit investments, such as rail stations, are beginning to take advantage of that relationship. The transit research conducted to date measures this success by looking at the relationship between service and amenities, and the impact on ridership. These studies make a broad assumption that providing more amenities and services to the general public, whether through regular bus service, bus rapid transit (BRT), light rail (LRT) or commuter rail, will result in measurable impacts on ridership. In fact, a TCRP project is underway (TCRP Project H-37) to estimate those impacts in order to develop more accurate transit ridership prediction models. The element that is not accounted for in these studies is the general beliefs and attitudes of the population being served. Behavioral science has long known that persons have differing beliefs that lead to different outcomes of a decision-making process. The large marketing and market research industry in the U.S. has capitalized on this, creating consumer models that allow consumer goods and services companies to carefully target their markets to maximize sales (i.e., market share). The transit industry has only begun to look at how segmentation could be used to improve market share. (See VIII. Related Research, below.)

Experience and research related to LRT have shown that major transit investments can change usage patterns and development patterns in a region. There is a need to understand the dynamics of these populations beyond demographics in order to measure and project the changes and benefits to a region resulting from large transit investments.

This project aims to build on the formative work done by TCRP and TriMet, to demonstrate how market segmentation of this type can be used to understand a regional population, which areas are supportive of transit services, and the impact of major investments on both the transit usage levels of the market segments and persons' overall location decisions.

III. OBJECTIVE

Understand the potential long-term economic benefits of transit investment programs and improve the ability to project the future impacts of the investments by:
1. Determining the market segments in a geographic region that are the most supportive of transit in order to determine the most effective areas for new and improved service;
2. Determine how the introduction of significant service improvements can influence the total percentage of transit-supportive residents and their location decisions; and
3. Determine if nationally available lifestyle market segmentation data can be used for this type of analysis in place of individually conducted market segmentation studies.

IV. RESEARCH PROPOSED

Following is a draft outline of how the project could be accomplished. It is suggested that the project be separated into two phases, with Phase 1 being the initial segmentation work and applicability to transit operations. Phase 2 would be conducted after the implementation of major service improvements to track the changes in market segments as a result of those improvements.

Phase 1
Task 1: Literature review of existing work on attitudinal or psychographic segmentation as it relates to transportation, transit, and/or land use decisions. This would include published reports plus contacting transit districts known to have done segmentation research.
Task 2: Identify potential transit districts and regions for conducting the case study and a control city. Candidate cities should have a major transit investment under development, including transit oriented development, which can be used for a “before and after” analysis.

Task 3: “Before” Survey
a) Design and implement an in-depth survey designed to capture data on transit usage, attitudes towards transit and transportation options, messages and channels for message delivery, demographics, and other pertinent data.
b) Link this survey to an existing standard “lifestyle” database used in the marketing industry, such as Cohorts® or PRISM®, to determine if and how these data can be used in place of primary data collection.

Task 4: Data analysis
a) Conduct a standard analysis of the data collected in the “before” survey for immediate use in messaging and target marketing.
b) Conduct segmentation (using cluster analysis and factor analysis) to develop market segments with distinct attitudes towards public transit. Provide geographic analysis and mapping of the results to show the relationship between the market segments and the transit service/infrastructure.
c) Analyze national lifestyle market segments against the “before” survey market segments to determine the strength of relationship between the two. If a strong relationship exists, transit districts may be able to use nationally available data instead of conducting their own segmentation study.
d) A comparison would be made between the target and control cities for both data sources (“before” survey and national lifestyle data), to establish a baseline against which the “after” analysis will be conducted.

Task 5: Phase 1 Report, summarizing and documenting Tasks 1-4.

Phase 2
Task 1: “After” Survey
a) Replicate the “before” survey after the implementation of the major service investment in both the target and control cities.
b) Using the same methodology as in Phase I, link this survey to an existing standard “lifestyle” database used in the marketing industry.

Task 2: Data Analysis
a) Using the same segmentation methodology as in Phase I, conduct an attitudinal segmentation. Note changes in the size and geographic concentrations of segments in relation to transit service investments and transit-oriented developments. Provide geographic analysis and mapping of the results to show the relationship between the market segments and the transit service/infrastructure.
b) Analyze national lifestyle market segments against the “after” survey market segments to determine the strength of relationship between the two. If the same changes are seen in the national data as in the segmentation data, this further supports the potential of using national data for transit market analysis.
c) A comparison would be made between the target and control cities for both data sources (“after” survey and national lifestyle data).

Task 3: Conclusions and recommendations. Evaluate the results from Phase 1 and Phase 2, in light of the project objectives.


V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: Phase 1: 300,000; Phase 2: $200,000. This includes the cost of the attitudinal segmentation surveying and the purchase of national lifestyle data and survey rights.

Research Period: Phase 1: 21 months; Phase 2: 18 months.

VI. URGENCY AND PAYOFF POTENTIAL

Across the US, transit districts and local and regional governments are combining resources to create strong economic development packages around transit. These projects are being developed in order to reduce reliance on single occupant cars, reduce congestion, spur economic development and preserve the quality of life in cities. Yet little is known about the dynamics of the populations these projects are meant to serve, when it comes to positive support, work and home location decisions, and overall usage. Some projects have initial support and then crumble. This could be seen in Portland Oregon when public support for the south rail line dried up in 1998. Initial work has been done on transit supportive market
segments; tremendous research is available through the market research industry. With the implementation of many large transit investment and economic development projects underway, now is the time to put these elements together. The result will be an understanding of market and transit investment forces that can be used by others to strengthen their transit investment programs.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

Increasing Ridership and Improving Capital and Operating Efficiencies: This project makes efficient use of transit resources (both capital and operating) by identifying populations that are most supportive of transit so transit investments can be made where they will have the most impact. Alternatively, it will show the areas of a region that are the least supportive and where alternative or longer term strategies may be needed. For example, some areas have poorly utilized service. The expectation is that there is a silver bullet that will draw that public to transit, when in fact, due to the lack of support for transit from the surrounding population the service may have little hope of becoming better utilized until there is a dramatic shift in that population (e.g. gentrification). Knowing this will allow transit districts to understand which markets will respond to additional services providing a strong return on the investment, and where the additional services will be a poor investment. This type of market research can be conducted by special surveys, however it can be expensive. The project also determines whether relatively inexpensive nationally available data can be purchased and used to achieve the same results.

Protecting the Environment and Promoting Energy Independence. This project identifies those populations who share the vision of transit as a means to reduce reliance on SOVs and to protect the environment and our quality of life. It is designed to support TOD development and target transit investments to where they will be most effective.

The TCRP strategic priorities:

Place the Transit Customer First. This project provides a tool for transit districts to understand their customers the way the successful businesses do, through detailed market segmentation. By understanding these specific markets transit districts can tailor services to their specific needs, instead of using the Spam approach. This results in higher satisfaction and higher sales.

Continuously Improve Public Transportation. Understanding the market needs allows transit districts to prioritize and continuously build and refine the product they offer the public. Especially if the outcomes can be tied to existing national market segmentation data, continuous updates are available that allow for on-going monitoring and adjustment to meet market demands.

Flourish in the Multimodal Environment. This project works hand in hand with understanding transportation decisions, regardless of the mode. In fact, the multi-modal nature of major investments with TOD, walking, biking and even park and ride lots, provides the connection that makes this more than just a transit project, but a regional transportation development project.

VIII. RELATED RESEARCH

TCRP B-9, A Handbook: Using Market Segmentation to Increase Transit Ridership. This report introduced the topic of market segmentation to the transit industry and outlined various segmentation techniques along with their benefits and limitations. That research included an overview of the work done at TriMet, as of 1997. Since that time, TriMet instituted several major service improvements, including three additional light rail segments, significant increased bus service, and a branding campaign. Segmentation completed in 2004 indicated significant changes in the attitudinal segments and overall support for transit, that didn’t occur between the 1993 and 1997 research outlined in the TCRP B-09 work. This would build on that research conducted by TriMet.

TCRP H-27A, Ensuring Full Potential Ridership from Transit-Oriented Development (active). This project examines the factors that make a successful TOD. This research focuses on the supply end of the equation: what can be supplied in a TOD to help encourage ridership. The proposed research would be complementary in that it looks at the demand end – which customers are supportive markets, in order to determine which locations already are prime candidates for TOD and other major transit investments, and which areas have existing markets that may not lead to the expected success.
TCRP H-31, Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation (active). This research focuses on learning theory and the benefits from a more in-depth understanding of the conditions under which travel preferences are learned. The proposed research segments the market based on existing levels of support for public transit. This would complement the research from H-31 by developing and identifying the markets with the most potential, which can then be targeted using the learning theory approach explored in TCRP H-31.

TCRP H-37, Characteristics of Premium Transit Services that Affect Choice of Mode (RFP released). This project focuses on the aspects of premium transit services (e.g. light rail, Bus Rapid Transit) and how those impacts on ridership can be included in standard transit forecasting models. This research problem statement focuses on individuals and their underlying propensity to use transit.

‘Complacent Car Addicts’ or ‘Aspiring Environmentalists’? Identifying travel behaviour segments using attitude theory is an article by Jillian Anable available in Transport Policy, available online, January 2005. In her research, she uses the Theory of Planned Behavior, taken from psychology theory, to explain mode choice decisions. As was found at TriMet, socio-demographic variables had little relationship to decisions, yet this is the basis for most travel modeling. The research found that “Cluster analysis is rarely used in studies of travel behaviour but this study demonstrates its utility in providing a way of extracting naturally occurring, relatively homogenous and meaningful groups to be used in designing targeted hard and ‘soft’ transport policies.

Joe Cortright, Impresa Consulting. The Young and the Restless is research that analyzes the factors that make a city attractive to young, educated workers. Focus groups associated with this research identified a strong transit system as a element that made a city attractive to this highly educated, but highly mobile population. In follow-on research sponsored by CEO’s for Cities, Mr. Cortright has developed “City Vitals” which identifies four dimensions of success for a City. A strong public transit system that connects everyone in the city is identified as an element of a “Connected City”, one of the four dimensions of success.

IX. PERSON(S) DEVELOPING THE PROBLEM

Submitted by:

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Developed and reviewed with:

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XI. DATE AND SUBMITTED BY:
Kathryn Coffel
June 14, 2007
I. PROBLEM TITLE
Update and Expand Passenger Flow Capacity Analysis for Station Facilities

II. RESEARCH PROBLEM STATEMENT
Data on the passenger flow capacity of various station elements is both outdated and incomplete. New and expanded data is needed on the capacities of stairs, escalators, moving walkways, various fare control systems, ramps, and other elements found in passenger stations and other transit environments. Original studies of passenger capacity were undertaken by John Fruin in the early 1970s. Others have conducted localized studies of pedestrian capacity on an ad-hoc basis since then. However, these studies have not been coordinated or conducted following consistent procedures. There is a strong need to update the available data, to expand its geographic basis, to include elements from different types of stations, and to expand the depth of the data to explore new issues. Shortcomings in available data and consistent standards have been identified both during preparation of the Second Edition of the Transit Capacity and Quality of Service Manual and on various projects. New and improved data will contribute to the next edition of the TCQSM.

One area requiring new data is the evaluation of stairway capacity in terms of walking “lanes” rather than stair width. The notion of walking lanes on stairs was introduced by J. Fruin in Pedestrian Planning and Design, was applied in the 1998 edition of the NFPA 130 evacuation standard, and is preferred by some analysts. However, evaluation based on stairway width remains the most common approach even though there is some evidence that that this method produces less accurate results.

Other elements for which additional understanding is needed include moving walkways and fare control gates. Manufacturers of moving walkways often state unrealistic capacities and few moving walkways ever experience capacity volumes in normal operating conditions. The capacity of fare control gates and systems varies considerably and is dependent not only on the physical characteristics of the gates or devices, but also on the fare system and other factors. Recently, the effect on pedestrian capacity of bollards and other security measures has also taken on increased importance.

Other changes in the transit industry also suggest further investigation of capacities. For example, the growth of light rail transit and bus rapid transit and the move from high floor to low floor vehicles calls for additional studies of boarding and station capacity in those environments. The growth of travel by the disabled on transit systems arising from the provisions of the Americans with Disabilities Act also results in new capacity-related considerations.

III. OBJECTIVE
The research will produce a set of definitive measures of the practical capacity of various station elements. To the extent possible, the measures should indicate geographic differences and distinctions associated with the location of selected elements. For example, an escalator in a rapid transit system may have a different practical capacity than an escalator in a commuter rail terminal due to differences in crowd behavior.

In addition to basic tabular data and recommended planning guidelines, the study should produce a narrative explaining the use of the data and identifying those factors that affect capacity.

IV. RESEARCH PROPOSED
The research would include the following tasks:
1) Collect and review available data and standards on passenger capacity for key station elements. This would include published and non-published data as available from transit agencies and industry professionals both in the U.S. and abroad.

2) Devise consistent data collection methods and execute data collection. Most data collection would be under normal operating conditions, though arrangements might be made to simulate maximum loading conditions at locations where they don’t normally occur. Both manual counting and video recording techniques may be employed.


V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: The required level of funding will depend on the extent of the data to be collected, particularly in terms of the geographic diversity of test cases and the variety of facilities to be studied. In order to insure consistency of methods, the Chief Investigator should expect to perform or supervise data collection at a number of locations. A budget of $350,000 is estimated.

Research Period: The study should be completed within approximately 12 months, including revisions.

VI. URGENCY AND PAYOFF POTENTIAL

The planning, design, and analysis of transit facilities are ongoing exercises affecting both passenger comfort and substantial capital expenditures. Better understanding of passenger capacities will have immediate benefits by improving the design of facilities and in some cases offering cost savings. No specific barriers to the research are expected. It is anticipated that various transit agencies will cooperate with the research since it will directly benefit them.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This proposal most directly addresses the FTA strategic goal to improve capital and operating efficiencies. It also addresses the goals of improving safety, security, and emergency preparedness and increasing ridership by expanding the technical information available to project planners, allowing them to address transportation needs in the most efficient and effective manner possible.

The proposal supports the TCRP Strategic Priorities to “place the transit customer first” and to “continuously improve public transportation.” The study will provide supporting data and analysis to improve existing passenger facilities and build new ones that better serve passengers in a cost-effective manner.

VIII. RELATED RESEARCH

Transit agencies and industry professionals conduct related studies on an ongoing basis, but the methods are often inconsistent and their results are not broadly disseminated or summarized. Part of the research effort will be to identify and summarize available data, then expand upon it.

IX. PERSON(S) DEVELOPING THE PROBLEM

This Problem Statement was prepared by Mark C. Walker, AICP. Mark is a member of TRB Committee AP045 Intermodal Transfer Facilities and the Subcommittee on Stops, Stations, and Terminals AP015(4). Mark was the chief author of Part 7 on Stop, Station, and Terminal Capacity in the second edition of the Transit Capacity and Quality of Service Manual.

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT
This problem statement was prepared by Mark C. Walker. The proposal arose in part from Mr. Walker’s role as chief author of revisions to Part 7: Stops, Stations, and Terminals in the Second Edition of the Transit Capacity and Quality of Service Manual. A draft of the statement was distributed to members of TRB Committee APO45 who offered suggestions and expressed support for the proposal. At both the 2005 and 2007 Annual Meetings, the committee endorsed resubmission of the problem statement for fiscal years 2006 and 2008. This work remains of vital interest to the Committee.

XI. DATE AND SUBMITTED BY
Developing Guidelines for Incorporating Mode Split in the Application of ITE Trip Generation Tables

ITE Trip Generation Tables have become the “bible” for many traffic engineers and planners in determining the impact new development will have on traffic conditions. Decisions regarding both infill and greenfield development for projects ranging in scope from as small as a stand-alone day care center to billion dollar mixed use developments often hinge on the predictive nature of these tables. Trip generation tables are frequently used by local governments and financing entities to develop conditions of approval for development. However, for many years the focus of these trip tables has been on the amount of vehicle traffic that is generated and not necessarily the amount of pedestrian, bicycle or transit trips that would be generated. While planning agencies now require accommodations for pedestrians, bicyclists and transit users with greater frequency, it is often unclear as to how effective these conditions will be in influencing mode split. It is not uncommon for local agencies to require a developer to mitigate based on the assumption that 100% of the trips generated by the development will be auto trips and then provide accommodations for other modes on top of this. This “double mitigation” not only unnecessarily adds cost to the development, but creates incentives to use the private auto (e.g. ample free parking) or disincentives to use other modes (e.g. wide, pedestrian unfriendly streets, long walking distances from transit stops to building entrances). The latest edition of the ITE Trip Generation Handbook provides some information on the effect of travel demand management and transit usage on trip generation. However, the auto orientation of the predictive travel tables and the inability of most practitioners to accurately assess when conditions are ripe for, or what mitigations would produce mode shifts, inhibits developers, local governments and financial institutions from taking significant actions to encourage or allow for the shift of some trips from single occupant autos to other modes. In other words the benefit of accommodating transit is not obvious to developers, municipalities or financial institutions. This weakens the persuasive power that transit providers have on the development process, and tends to limit transit and other alternative modes to an insignificant status.

Establish guidelines for determining the impact on mode split that can be engendered by different strategies in transit service design and pricing; and the physical layout, design and locational context of proposed developments within the region. Create a matrix of the interactive nature of these strategies. Alternatively develop a sketch planning technique to help determine the level of transit benefit. Going beyond work already contained in ITE Handbooks, further develop guidelines, methodologies and criteria for incorporating better mode split assessment in standard tables predicting trip generation and parking demand.
RESEARCH PROPOSED

Identify factors influencing mode split and review existing research to identify the likely impact each strategy has on mode split. Include various “cocktail” approaches (where the impact of a combination of strategies may be more than the sum of each strategy). Provide additional research and or identify research needs for strategies that do not have sufficient data sampling to accurately reflect the likely impact on travel choices. Using this data synthesis, develop guidelines, methodologies and criteria for modifying trip generation and parking demand tables to confidently assess how physical design and transit service and pricing strategies may affect mode split under various conditions. Identify and work with the appropriate committees from ITE, AIA, ASCE, NACO and NLC to encourage further research and application of these guidelines.

Research should include the development of a sketch planning technique that can identify the level of transit benefit that could be particularly useful for developers seeking to receive credit for accommodating transit.

ESTIMATED FUNDING AND RESEARCH TIME

$300,000; 18 months

URGENCY AND PAYOFF POTENTIAL

Urban form (physical design of major developments) has a significant impact on transit use and its growth potential. Trip generation tables play a significant role in shaping that urban form. Therefore, the more that trip tables can reflect the effect of good design and transit service on mode choice, the better armed decision makers will be to succeed in mitigating adverse traffic impacts by utilizing other modes. Virtually all development projects large and small -- both those within existing developed areas and those developed on raw land -- will be impacted by any revision to how trip tables are used and applied. The potential for arming developers, local communities and financial lenders with accurate assessments of strategies to encourage trips via alternative modes is significant.

Green building is rapidly becoming a major force in construction as more and more developers are seeking LEED certification for their structures. This has given birth to LEED-ND certification which focuses on the qualities of green neighborhoods and communities. This effort can be supportive of developments seeking LEED-ND or other similar certification.

RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

FTA Strategic Goals and policy Initiatives:

Ridership. This effort will enable predictive travel and parking demand tables to become useful tools for shaping land use decisions, physical design of developments and urban form; and in the application of development mitigations that will encourage greater transit use.
Improving Capital and Operating Efficiencies. This effort will enable predictive travel and parking demand tables to become useful tools in fashioning new development in a manner that enhances the overall efficiency and effectiveness of transit service delivery.

Protecting the Environment and Promoting Energy Independence. The improved guidance in the use of tables can help in the creation of local land use policies that support a sustainable transportation network.

TCRP priorities:

Place the customer first. This effort is designed to offset the impact that existing tables have on creating transit unfriendly environments and conditions that limit travel choices or opportunities available to individuals.

Continuously improve public transportation. Increasing transit ridership will also improve productivity.

RELATED RESEARCH

PERSON DEVELOPING THE PROBLEM

American Public Transportation Association
Systems Management/Operations Planning Subcommittee
1666 K Street NW
Washington DC 20006
Phone: 202-496-4800
FAX: 202-496-4321

PROCESS USED TO DEVELOP PROBLEM STATEMENT

Developed by American Public Transportation Association
Systems Management/Operations Planning Subcommittee

DATE AND SUBMITTED BY

June 15, 2007

American Public Transportation Association
Systems Management/Operations Planning Subcommittee
1666 K Street NW
Washington DC 20006
Phone: 202-496-4800
FAX: 202-496-4321
I. PROBLEM TITLE

Data Collection for Transit Ridership Forecasting Models

II. RESEARCH PROBLEM STATEMENT

Fixed guideway transit projects (“New Starts”) are evaluated by local and federal funding agencies according to (a) the likely ridership that the project will attract and (b) the potential transportation system user benefits (similar to travel time savings) that will accrue to riders as a result of project implementation. Estimates of both ridership and user benefits are products of transit forecasting models which, over the past 20 years, have not demonstrated the capability to generate reliable projections of the demand for new transit services. A key factor contributing to this deficiency is that data on existing conditions are often insufficient to fully calibrate the models so that they properly represent either the supply or demand for transit services. Key data required to improving model calibration include:

1. **Transportation supply** including observed highway and transit (particularly bus) travel times and costs stratified by time period, geographic location, and facility type. Such data can be supplemented by data on travel time variability or reliability and the degree to which travelers receive subsidies or discounts.

2. **Transit ridership patterns** including linked transit trips, stratified by production/attraction location, time-of-day, trip purpose, socioeconomic class, transit submode, access mode, egress mode, and number of transfers.

3. **Non-transit travel patterns** including non-transit trips stratified by production/attraction location, time-of-day, trip purpose, socioeconomic class, and mode of travel.

Frequently, collection of these types of information is inhibited by the considerable effort and expense required to assemble a comprehensive database. Documentation of best practices in transportation supply and travel pattern data collection could help reduce expense and improve reliability by disseminating information on the most the effective and efficient techniques for collecting this data.

III. OBJECTIVE

The objective of this project is to research best practices in data collection to support transit ridership forecasting model development and validation. This research will identify the data required to support model development and validation, review approaches used to gather information in various cities across the United States, and
assess the effectiveness of these approaches in collecting accurate data that support the
development and validation of ridership forecasting models.

IV. RESEARCH PROPOSED
The following research is proposed:

1. Prepare a white paper identifying the data needed to properly develop and validate
   transit ridership forecasting models. Such data should include information on the
   transportation supply, transit trip characteristics (e.g., origin-destination and trip
   purpose), and transit and non-transit traveler characteristics.
2. Conduct a telephone survey of up to 20 metropolitan area transit authorities and
   metropolitan planning authorities on recent experience in collecting data to
   support transit ridership model development and validation. Information to be
   gathered should include the nature of data collection efforts, dates of data
   collection, sample survey instruments, and (where possible) actual data. The
   survey will also ask respondents to assess the quality of the data, the cost-
   effectiveness of the data-collection techniques, and any “lessons learned.”
3. Review data obtained through the telephone survey to determine the extent of
   missing data and the usefulness of the data to support transit ridership forecasting
   model development and validation.
4. Prepare a report documenting examples of successful data collection for each
   metropolitan area.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH STATEMENT

Recommended Funding: $100,000
Research Period: 12 months

VI. URGENCY AND PAYOFF POTENTIAL
Each year, the Federal Transit Administration reviews and prepares funding
recommendations for transit New Starts projects costing many billions of dollars. A key
determining factor is the cost-effectiveness of the project—the annualized incremental
cost of the project divided by the person hours of transportation system user benefits.
Estimates of user benefits depend on accurate forecasts of transit ridership. FTA
experience suggests that transit forecasting models can be improved by collecting
comprehensive information on existing transit ridership patterns and using such data
during model development and validation to more accurately represent the conditions
where travelers elect to use transit services.

The availability and quality of transit ridership data must be dramatically improved so
that local and FTA decision-making can be informed by the highest quality information
possible.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVE AND TCRP STRATEGIC PRIORITIES
FTA’s first “Strategic Goal” and TCRP’s first “Strategic Priority” are related to designing and delivering an integrated portfolio of products and services to increase the average number of transit boardings. This research supports that goal by providing improved information to decision makers on the number and characteristics of likely transit riders attracted to new fixed guideway transit facilities. This information will allow project sponsors and FTA to make informed investment decisions that will lead to the development of projects with the highest likelihood of attracting additional riders to the regional transit systems.

VIII. RELATED RESEARCH
Proposed research on Model Analysis, Reporting, and Validation Techniques

IX. PERSON(S) DEVELOPING THE PROBLEM
TCRP J-06/Task 68 Working Group
William A. Woodford, President AECOM Consult, Inc.

X. PROCESS USING TO DEVELOP PROBLEM STATEMENT
TCRP J-06/Task 68 Working Group Conference call reviewing white paper on “Opportunities for Improving the State of the Practice of Ridership Estimates for Major Public Transportation Projects” and subsequent discussion on research priorities.

XI. DATE AND SUBMITTED BY
TCRP Problem Statement

I. PROBLEM TITLE

Transit Model Analysis, Reporting, and Validation Techniques

II. RESEARCH PROBLEM STATEMENT

Fixed guideway transit projects (“New Starts”) are evaluated by local and federal funding agencies according to (a) the likely ridership that the project will attract and (b) the potential transportation system user benefits (similar to travel time savings) that will accrue to riders as a result of project implementation. Estimates of both ridership and user benefits are products of transit forecasting models which, over the past 20 years, have not demonstrated the capability to generate reliable projections of the demand for new transit services. One reason for this problem is that models are not always developed and validated with a view to fully representing the characteristics of the transit or highway systems, the geographic and socioeconomic characteristics of total travel, or the travel patterns associated with transit use.

Unfortunately, it is not always easy to query the model data bases in a way that allows analysts to compare modeled travel characteristics to the real world. One way to remedy this problem is to develop improved reporting tools that effectively depict the inner workings of the travel forecasting model in a way that allows model developers, planners, and decision makers understand and evaluate model outcomes. This research effort is intended to address improve model reporting and calibration by describing techniques successfully used for reporting transit forecast results and then using these reporting protocols to test each stage of the travel forecasting model for effectiveness.

Improving reporting of transit ridership model results should provide a more complete understanding of model results beyond the total number of riders. At a minimum, reported ridership needs to be disaggregated by origin/destination location, access/egress mode, and traveler socioeconomic class.

With this type of reporting available, more detailed tests can be applied during model development and validation that include:

- Comparison of observed and modeled highway zone-to-zone travel times;
- Comparison of estimated transit bus running times to scheduled and/or observed bus running times to modeled running times;
- Testing of transit network processing procedures by assigning a survey-derived transit trip table to the transit network. (Results will be assessed by comparing modeled (assigned) boardings to observed (counted) boardings);
- Comparison of trip distribution outputs by purpose to observed district-to-district summary flows from survey and/or Census data;
• Comparison of modeled transit ridership patterns to observed travel by trip purpose, geographic area, socioeconomic class, and transit path;
• Comparison of modeled transit boardings and alightings to observed boardings and alightings by station, route, access mode, and egress mode;
• Analysis of model sensitivity to changed inputs, including backcasting to simulate conditions before recent infrastructure changes, changed fare policy, and other likely policy changes.

Improved reporting and model development/validation procedures will enhance the quality of transit ridership forecasts by better representing the factors that influence the choice to use transit.

III. OBJECTIVE
The objective of this project is to assemble examples of best practices in transit ridership model reporting and validation so as to guide to practitioners on practical and effective techniques available to improve transit forecasting models and communicate results.

IV. RESEARCH PROPOSED
The following research is proposed:

1. Conduct a telephone survey of the top 20 metropolitan area transit authorities and metropolitan planning authorities on recent experience in conducting detailed transit model validation and reporting. Wherever possible, sample validation and results reports will be obtained together with an agency assessment of the effectiveness of each approach.
2. Prepare a White Paper documenting examples of successful transit ridership model reporting procedures designed to provide insights into forecasted transit ridership.
3. Prepare a White Paper documenting examples of successful transit model validation protocols that emphasize input data quality control, reasonableness of intermediate model outcomes, and appropriateness of final ridership results stratified by geographic area, purpose, socioeconomic characteristics, and access/egress mode.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH STATEMENT

Recommended Funding: $100,000
Research Period: 12 months

VI. URGENCY AND PAYOFF POTENTIAL
Each year, the Federal Transit Administration reviews and prepares funding recommendations for transit New Starts projects costing many billions of dollars. A key determining factor the cost-effectiveness of the project—the annualized incremental cost
of the project divided by the person hours of transportation system user benefits. Estimates of user benefits depend on accurate forecasts of transit ridership. FTA experience suggests that forecasting models can be made much more accurate thorough validation of transit models which confirm their ability to replicate observed ridership patterns. Experience shows that matching total transit ridership is not, in itself, sufficient to represent the true market for transit services. Models must also be checked to confirm that they represent transit demand for different submarkets as well.

Advanced transit reporting and validation techniques must be adopted by the industry as soon as possible so that local and FTA decision-making can be informed by the highest quality information possible.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVE AND TCRP STRATEGIC PRIORITIES
FTA’s first “Strategic Goal” and TCRP’s first “Strategic Priority” are related to designing and delivering an integrated portfolio of products and services to increase the average number of transit boardings. This research supports that goal by providing improved information to decision makers on the number and characteristics of likely transit riders attracted to new fixed guideway transit facilities. This information will allow project sponsors and FTA to make informed investment decisions that will lead to the development of projects with the highest likelihood of attracting additional riders to the regional transit systems.

VIII. RELATED RESEARCH
Proposed research on Data Collection for Transit Forecasting Models.

IX. PERSON(S) DEVELOPING THE PROBLEM
TCRP J-06/Task 68 Working Group
William A. Woodford, President AECOM Consult, Inc.

X. PROCESS USING TO DEVELOP PROBLEM STATEMENT
TCRP J-06/Task 68 Working Group Conference call reviewing White Paper on “Opportunities for Improving the State of the Practice of Ridership Estimates for Major Public Transportation Projects” and subsequent discussion on research priorities.

XI. DATE AND SUBMITTED BY
I. PROBLEM TITLE

Trip Distribution Techniques to Improve the Quality of Transit Ridership Forecasts

II. RESEARCH PROBLEM STATEMENT

Fixed guideway transit projects (“New Starts”) are evaluated by local and federal funding agencies according to (a) the likely ridership that the project will attract and (b) the potential transportation system user benefits (similar to travel time savings) that will accrue to riders as a result of project implementation. Estimates of both ridership and user benefits are products of transit forecasting models which, over the past 20 years, have not demonstrated the capability to generate reliable estimates of the demand for new transit services. One key reason for this problem is that the element of the forecasting models that relates trip origins and destinations to one another (i.e., the trip distribution model) seldom represents travel patterns throughout an entire metropolitan area at an adequate level of precision. Errors in trip distribution directly translate to errors in estimates of transit trip making.

Over the past fifty years, trip distribution has been based on the “Gravity” model in which trip making between any pair of zones is proportional to the trips produced and attracted in those zones and inversely proportional to a measure of the travel impedance (“friction”) between those zones. After this calculation is repeated for every zone-pair combination in the region, the total forecasted trip productions and attractions for each zone are balanced to match trip productions and attractions estimated by the trip generation model. In recent years, the Gravity model formulation in some model sets has been replaced by destination choice procedures that have many mathematical similarities to gravity models but allows more flexibility in the techniques used to represent travel impedances and zone size.

The Distribution component of transit ridership forecasting models are typically calibrated with a view toward matching trip length frequency distributions with some adjustments to represent major geographic biases (e.g., river crossings) that may not be fully represented in the other model factors. Survey information for more detailed calibration and validation is seldom available to support more detailed assessments of the quality of trip tables generated by trip distribution models. As a consequence, significant inaccuracies in trip distribution may be undetected and can contribute to significant error in the resulting transit ridership forecasts.

This research effort is intended to address this deficiency by investigating and assessing the effectiveness of different techniques in trip distribution modeling. Key areas will include:

• Collecting information on person travel patterns to support detailed model calibration and validation
• Assessment of whether existing gravity or destination choice models can be structured to improve their suitability for transit ridership forecasting by refining existing practices. Examples include (a) stratification by income or other socioeconomic group, (b) utilization of transit in the impedance function, and (c) use of destination choice in lieu of gravity formulations

• Assessment of whether non-traditional techniques for forecasting origin-destination linkages (e.g., urban simulation systems that jointly forecast work and residential locations) result in improved distribution results.

III. OBJECTIVE
The objective of this project is to review trip distribution models from the perspective of transit ridership forecasting and recommend steps that can be taken to generate improved person trip tables.

IV. RESEARCH PROPOSED
The following research is proposed:

1. Conduct a literature review documenting the state of the practice and advanced practice trip distribution models.

2. Conduct a telephone survey of 20 metropolitan area transit authorities and metropolitan planning authorities on current trip distribution methods. Wherever possible, survey and trip distribution results will be obtained together with an agency assessment of the effectiveness of the trip distribution models.

3. Compare model and survey outputs to assess the effectiveness of trip distribution models in representing observed travel patterns. Where feasible, test alternative techniques for improving trip distribution performance. Potential enhancements include replacing gravity models with destination choice formulations, adding transit impedance to the overall friction computations, adding socioeconomic stratification to the model procedures, and implementing adjustment factors.

4. Select one or more data sets for testing advanced practice techniques, such as urban simulation, which simultaneously represent an individual’s workplace and residential location.

5. Prepare a research report documenting results of research including specific recommendations of techniques that can be employed within the existing state-of-the-practice for substantially improving forecasted trip distribution results.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH STATEMENT
Recommended Funding: $200,000
Research Period: 24 months

VI. URGENCY AND PAYOFF POTENTIAL
Each year, the Federal Transit Administration reviews and prepares funding recommendations for transit New Starts projects costing many billions of dollars. A key determining factor is the cost-effectiveness of the project—the annualized incremental
cost of the project divided by the person hours of transportation system user benefits. Estimates of user benefits depend on accurate forecasts of transit ridership.

Trip distribution results are a significant source of error with the current process. In many cases, the errors introduced by the trip distribution process require “correction” factors elsewhere in the model chain that provide substantial bias to fixed guideway transit. These biases can affect ridership forecasts for future transit investments by overstating the benefits provided by the project. These overstated benefits may lead to forecasts of ridership that are not achievable. This critical model shortcomings should be mitigated as soon as possible so that local and FTA decision-making can be informed by the highest quality information possible.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVE AND TCRP STRATEGIC PRIORITIES
FTA’s first “Strategic Goal” and TCRP’s first “Strategic Priority” are related to designing and delivering an integrated portfolio of products and services to increase the average number of transit boardings. This research supports that goal by providing improved information to decision makers on the number and characteristics of likely transit riders attracted to new fixed guideway transit facilities. This information will allow project sponsors and FTA to make informed investment decisions that will lead to the development of projects with the highest likelihood of attracting additional riders to the regional transit systems.

VIII. RELATED RESEARCH
None

IX. PERSON(S) DEVELOPING THE PROBLEM
TCRP J-06/Task 68 Working Group
William A. Woodford, President AECOM Consult, Inc.

X. PROCESS USING TO DEVELOP PROBLEM STATEMENT
TCRP J-06/Task 68 Working Group Conference call reviewing White Paper on “Opportunities for Improving the State of the Practice of Ridership Estimates for Major Public Transportation Projects” and subsequent discussion on research priorities.

XI. DATE AND SUBMITTED BY
TCRP Problem Statement

I. PROBLEM TITLE

Techniques for Improving Transit Networks

II. RESEARCH PROBLEM STATEMENT

Fixed guideway transit projects (“New Starts”) are evaluated by local and federal funding agencies according to (a) the likely ridership that the project will attract and (b) the potential transportation system user benefits (similar to travel time savings) that will accrue to riders as a result of project implementation. Estimates of both ridership and user benefits are products of transit forecasting models which, over the past 20 years, have not demonstrated the capability to generate reliable projections of the demand for new transit services. One key reason for this problem is that the network representations of transit supply do not fully represent the travel time and cost associated with bus or fixed guideway transit services. This problem can result in an exaggeration of the benefits offered by proposed transit services, leading to forecasts that overstate potential ridership on these services.

Transit ridership forecasts could be substantially improved by rigorous transit network coding and improved testing procedures. Research into these techniques should include:

- Network level of detail, including understanding the desirable specificity, related to route cutbacks/deviations or skip-stop operation of individual trains;
- Accuracy of information related to transit running times. In particular, the structural form of procedures used to estimate bus running time as a function of highway running time and the comparability of these estimates to observed or scheduled bus running times.
- Station representations that incorporate the additional impedance (time) associated with entering and exiting a station while also representing the value of station amenities in providing a relatively comfortable waiting location.
- Procedures used to represent walking to, from, and between transit stations and stops. Typically these procedures use a combination of direct zone-station and station-station walk links together with a representation of downtown sidewalk links. Advanced practice might include region-wide sidewalk links (in areas where sidewalks exist) to fully represent walk-to-transit opportunities.
- Procedures used to represent park-and-ride and kiss-and-ride access to transit. Modeling procedures should account for differences in the availability of park-and-ride and kiss-and-ride opportunities, and trade-offs between short and long drives versus quality of service and availability of parking.
- Path building procedures. Procedures used to build shortest paths must be defined that adequately represent observed path-finding behavior while also maintaining consistency with implied factors in other model components.
• Network testing procedures. Prior to use in travel forecasting models, transit networks should be tested by generating and reviewing sample test paths throughout the region. Where available, networks and procedures should be tested by assigning survey-developed transit trip tables to the network and confirming that assigned boardings by sub-mode, route, and station match observed values.

This research effort is intended to improve the quality of networks by providing guidance into best practices for transit network development and testing.

III. OBJECTIVE
The objective of this project is to review best practices in transit network development and provide a protocol for testing transit networks and network processing techniques. When implemented, these recommendations should increase confidence in the ability of transit networks to properly represent the mobility benefits associated with fixed guideway transit and lead to improved ridership forecasts.

IV. RESEARCH PROPOSED
The following research is proposed:

1. Conduct a telephone survey of 20 metropolitan area transit authorities and metropolitan planning authorities on transit network development and validation methods. Wherever possible, current-year transit networks, network processing procedures, and onboard survey data will be obtained together with an agency assessment of the effectiveness of the transit networks and procedures.
2. Review transit networks and procedures obtained from participating agencies to understand and document the coding practices related to transit running time, fares, waiting times, network specificity, walk access/egress, and park-and-ride/kiss-and-ride access.
3. Test assign onboard survey information to determine whether route-level and station-level assigned ridership matches observed volumes. As needed, adjust network processing procedures to improve assignment fidelity.
4. Prepare a report documenting the research, including recommended practices for improved transit network coding.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH STATEMENT
Recommended Funding: $150,000
Research Period: 18 months

VI. URGENCY AND PAYOFF POTENTIAL
Each year, the Federal Transit Administration reviews and prepares funding recommendations for transit New Starts projects costing many billions of dollars. A key
determining factor is the cost-effectiveness of the project—the annualized incremental cost of the project divided by the person hours of transportation system user benefits. Estimates of user benefits depend on accurate forecasts of transit ridership.

User benefits are a direct function of the time savings for the build system as compared with a no-build or baseline scenario. As a consequence, inaccuracies in the representation of transit supply are incorporated in the estimate of user benefits. A precise, realistic assessment of transit network characteristics for both bus and rail is essential for an accurate determination of the value of a new fixed guideway transit line.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVE AND TCRP STRATEGIC PRIORITIES
FTA’s first “Strategic Goal” and TCRP’s first “Strategic Priority” are related to designing and delivering an integrated portfolio of products and services to increase the average number of transit boardings. This research supports that goal by providing improved information to decision makers on the number and characteristics of likely transit riders attracted to new fixed guideway transit facilities. This information will allow project sponsors and FTA to make informed investment decisions that will lead to the development of projects with the highest likelihood of attracting additional riders to the regional transit systems.

VIII. RELATED RESEARCH
None

IX. PERSON(S) DEVELOPING THE PROBLEM
TCRP J-06/Task 68 Working Group
William A. Woodford, President AECOM Consult, Inc.

X. PROCESS USING TO DEVELOP PROBLEM STATEMENT
TCRP J-06/Task 68 Working Group Conference call reviewing White Paper on “Opportunities for Improving the State of the Practice of Ridership Estimates for Major Public Transportation Projects” and subsequent discussion on research priorities.

XI. DATE AND SUBMITTED BY