I. PROBLEM TITLE

Transit Ridership-Server Architecture for a Real-Time Traffic Information System on the Internet

II. RESEARCH PROBLEM STATEMENT

The Intelligent Transport Systems (ITS) movement represents a revolutionary new perspective on a fundamental activity of our society-transport. We prize the mobility afforded by the extensive transport network used by private and public vehicles. Furthermore, we also prize the environment, our natural resources, our physical safety, and our leisure time, all of which are being adversely affected by increases time times. The increasing complexity of automobile design, highway design projects, increasing competition in transport industry, increasing competition in transport industry, increasing clients and public demand for cost effectiveness with consequent adverse effects on the reputation of the transport industry are all factors which necessitate the need for fresh approaches to procuring and delivery of Intelligent Transport Systems. ITS is a revolutionary new perspective on a fundamental activity of our society-transport.

Overall, the importance of ITS in our future transport needs cannot be understated. The United States Federal Highways Administration estimates that, by 2011, traffic congestion could be reduced by as much as 20% in cities that adapt ITS technologies. ITS activities will not only benefit city dwellers. Linking the physical transport infrastructure with the communications infrastructure can help to effectively address issues of rural road safety and efficiency.

III. OBJECTIVE

To develop an enhanced transit-rider server architecture for an advanced traffic information system (ATIS) that can be used to provide travelers with real-time information on the internet and to describe strategies for implementation.

IV. RESEARCH PROPOSED

We are planning to use two ITS services, World Wide Web (WWW) and Geographical Information System (GIS). The tentative tasks to be performed for the purpose of achieving the stated objectives in section III are:

Task1: Review of literature.
Task2: Create an integrated and geo-coded real-time traffic information and road inventory database
Task3: Graphical interface and ridership-based map of the road network.
Task4: Determine the type of personalized traffic information to be disseminated and how best to present them to the users on the internet
Task5: Evaluate the Internet mapping software an the market and identify one that is suitable for the project
Task6: Design web pages to provide effective user interfaces
Task 7: Implement, test, and refine the design of web pages and the presentation of transit-ride information on a computer server.

Task 8: Prepare a report summarizing key research results and findings.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
$350,000 - $400,000

VI. URGENCY AND PAYOFF POTENTIAL
Accurate traveler information allows transportation users to make decisions based on the attributes of the alternatives. The implementation of such a system has the potential to minimize roadway traffic congestion, reduce pollution and improve transit efficiency.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
FTA Strategic initiative -
TCRP Strategic priorities -

VIII. RELATED RESEARCH
Research completed:
Research in progress or pending:
1. Rural transit $180,000
2. Impact of rural public transportation $170,000

IX. PERSON(S) DEVELOPING THE PROBLEM
JO Oluwoye, PhD
Director
Transportation Research Institute
Department of Community Planning and Urban Studies

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

XI. DATE AND SUBMITTED BY
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

II. RESEARCH PROBLEM STATEMENT
Written policies 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:

- Conduct a review of pertinent documentation and resources to identify available or adaptive materials and/or methodologies.
- Identify and invite bus transit professionals to participate in this project. They will represent a geographically diverse and representative sample.
- Design, field, and evaluate a survey instrument for transit systems that captures representative opinion on format, substance and application of a polices guidebook.
- 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.
- Develop a product dissemination mechanism that can include a hard-copy document, and/or computer based software to adapt the materials.
- 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>
</tr>
</thead>
<tbody>
<tr>
<td>- Resource identification/review.</td>
<td>1 month</td>
<td>15,000</td>
</tr>
<tr>
<td>- Expert panel convened.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase II: Project Development</td>
<td>4 months</td>
<td>20,000</td>
</tr>
<tr>
<td>- Design, field, evaluate survey instrument.</td>
<td>6 months</td>
<td>80,000</td>
</tr>
<tr>
<td>- Preparation of policy handbook.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Development of product dissemination mechanism.</td>
<td>2 months</td>
<td>10,000</td>
</tr>
<tr>
<td>Phase III: Project Completion</td>
<td>4 months</td>
<td>30,000</td>
</tr>
<tr>
<td>- Final draft report/revisions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Time and Cost</td>
<td>16 months</td>
<td>$165,000</td>
</tr>
</tbody>
</table>

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:

- A guidebook of pertinent policies for public bus transportation.
- A computer based format that provides adaptable policy templates.
- 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
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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
TCRP PROBLEM STATEMENT

I. Development of System–Specific spare bus ratios.

II. As suggested in TCRP Synthesis 11 “further research on … alternative methodologies to more accurately determine appropriate spare requirements for each agency, including the possibility of establishing a percentage range for various agencies” is needed. A maximum spare ratio as a specific percentage of the fleet may not be appropriate for all agencies to apply equally. It may make more sense to determine appropriate spare ratios by examining such factors as average miles put on the fleet each year; miles between planned maintenance; size of the fleet; fleet make up, run specific special equipment configurations, etc.

III. A report should be provided that identifies those factors that best predict an effective spare ratio for various fleets’ make up. As a minimum, spare ratios should be recommended for fleets with these differing factors: size, age, annual mileage, interval between planned maintenance, diversity of coach manufacturers and run specific special equipment configurations.

IV. The researcher should examine various aspects of fleet make up to determine what are the best predictors of an effective spare ratio.

V. Funding for the project is estimated at $300,000 which should be possible to complete in six to nine months.

VI. If the spare ratio is inappropriately constrained customer service may be impacted by missed trips due to lack of vehicle availability, or planned maintenance may be missed. If the spare ratio is too high then capital funds are wasted on purchasing vehicles that may not be used efficiently and fleet maintenance costs are increased. Agencies have been operating under spare ratio constraints that were developed decades ago. The equipment and operational realities have changed significantly. A contemporary evaluation of vehicle requirements is necessary to ensure appropriate performance and efficiencies.

VII. This project relates to a number of the FTA Strategic Research Goals and TCRP Strategic Priorities.
   A. Ridership is adversely impacted if trips are missed due to bus availability. (FTA 1 & TCRP I)
   B. Capital resources are wasted if excess buses are procured. (FTA 2)
   C. Safety is not enhanced if planned maintenance is delayed due to the need of buses to be kept in service. (FTA 3 & TCRP III)

VIII. TCRP Synthesis 11

IX. A. Joy Munkers, Director of Planning and Development, 425-348-7133
B. Dave Richards, Director of Maintenance, 425-348-2346
C. Fred Worthen, Director of Transportation, 425-348-2373
D. Jim Turpie, Chief Operating Officer, 425-348-7105

X. Discussion among the executive team of the agency while trying to address missed trips due to coach shortages.

TCRP PROBLEM STATEMENT

I. PROBLEM TITLE
Ready Reserve Contingency Fleet Planning Requirements

II. RESEARCH PROBLEM STATEMENT

In the mid to late 1970s, the United States faced an oil shortage. More recently, California was beset by availability and pricing issues with electricity. The current situation in the Middle East has caused an increase in the price of oil, and, given the political unrest, supply issues as well. Natural disasters, such as Hurricane Katrina, also place demands on the local transit provider.

While older strategies developed to cope with this issue may remain valid, some of the fundamental practices advocated 20-plus years ago may be less relevant or potentially at odds with current FTA mandates, particularly with regard to a mothballed fleet and vehicle spare ratios. Institutional memory for individual transit properties that faced an energy crisis may also be non-existent. Additionally, the growth in light rail and alternative fuel vehicles may require the rethinking of older plans. Communication programs (television, radio, print) developed in the late 1970s, while still appropriate, may need to be updated for more current technologies including the Internet and cell phones. Accessibility issues would also need to be addressed.

In sum, in the event of an energy crisis or natural disaster, public transit may in a market-enviable position to retain and attract new ridership, but unable to capitalize on the prospect without a viable plan in place.

III. OBJECTIVE

The proposed research should achieve the following objectives:

- Document historical and existing practices for energy contingencies and natural disasters.
- Outline existing federal regulations and other guidelines that need to be considered in preparing a contingency plan.
- Develop a planning template that incorporates the requisite elements (staffing, communications, purchasing, legal, fare policy, new routings, etc.) for implementation that a transit property may utilize to develop their own specific plan.
- Test the planning template by working with a small (less than 100 vehicles), mid-sized (200-600 vehicles) and large (in excess of 1,000 vehicles) property to develop a viable plan. This should be done in coordination with the American Public Transportation Association, and preference should be given to multimodal properties.
IV. RESEARCH PROPOSED

The product of the research is anticipatory: How does one react in the face of a crisis? While the end product specifically relates to transportation, the template models may be more appropriately be drawn from epidemiologic interventions. Moreover, the experience in transit is to deal with a short term service interruption (aftermath of a hurricane, snow storm, civil disruption, etc.); there is little industry experience dealing with a longer term shortage of critical material.

The first task of the research, a documentation and exposition of applicable regulations, will be assistance to most transit properties. This will also be of value to regulators, particularly if an existing rule might have the unintended consequence of restricting performance in the face of a mobility crisis.

Another effort within the first task should be a survey of transit properties to determine the availability of existing tactical plans to deal with an energy crisis.

The second task would be to collect past examples of prior plans and to assess their value in the context of the current political and economic climate. Costs to obtain a “near readiness condition” should also be defined. Consideration should be given to other crisis-related models.

One concept deserving in-depth study is the central stockpiling of vehicles that have exceeded their useful lives, but may be suitable for service in the event of an emergency. The study should address facility, equipment, parts (storage and availability), fuel, and security issues.

The third task would be to develop a working model/template that a transit property could utilize for developing a basic tactical plan. It would be advisable to engage three transit properties of varying size to validate the working assumptions of the model, and to revise where appropriate.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

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

VI. URGENCY AND PAYOFF POTENTIAL

The current political and economic conditions indicate that an energy contingency plan is imperative, and should already be in place.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This proposed project aligns with the FTA research plan in that it directly relates to safety, security and emergency preparedness, as well as bolstering transit ridership. This project also aligns with the TCRP strategic priority of protecting the interests of the customer.

VIII. RELATED RESEARCH

*Energy contingency planning became a non-issue in the early 1980s and research/preparations stalled, hence while there may be planning documents available, they may be significantly outdated.*

*Effective models may potentially be derived from epidemiologic crises and military interventions.*

IX. PERSON(S) DEVELOPING THE PROBLEM

Steven Silkunas  
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Philadelphia, PA 19107  
215 580 7797  
ssilkunas@septa.org

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Individual

XI. DATE AND SUBMITTED BY

SEPTA  
June 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.

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
Problem Statement

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

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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
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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

Guidelines on Influencing Bus Reliability

II. RESEARCH PROBLEM STATEMENT

The reliability of bus transit service is of interest to bus passengers and transit agencies alike. Reliability is a quality-of-service issue for customers, as unreliable service results in longer overall travel times for passengers, who must allow extra time for their trip to make sure of arriving at their destination by a particular time. When unreliability results in bus bunching, uneven passenger loads result, creating a second service issue. For transit agencies, poor reliability may inhibit ridership, and many agencies set reliability service standards in recognition of this. In addition, the more variable a route’s travel time is, the greater the amount of schedule recovery time an agency must provide as an allowance to ensure an on-time departure for the next trip. If recovery time could be reduced, buses could be used more efficiently, and—in a best-case scenario—a bus could be removed from a route while maintaining the scheduled headway, thus reducing costs.

A number of studies have identified sources of unreliability. TCRP Report 100: Transit Capacity and Quality of Service Manual, 2nd Edition (TCQSM), for example, lists the following factors as influencing reliability for better or for worse: traffic conditions and road construction, vehicle and maintenance quality, vehicle and staff availability, transit preferential treatments, schedule achievability, evenness of passenger demand, variations in bus operator experience, wheelchair lift and ramp usage, route length and the number of stops, and operations control strategies. However, there is very little documentation on the magnitude of these factors’ impact on reliability, and there is little guidance to help agencies prioritize actions that would improve reliability.

Research is needed to quantify the impact of these factors on bus reliability so that transit operators and/or roadway agencies can identify cost-effective techniques for improving bus reliability, and thereby help improve ridership and provide more cost-efficient bus service.

III. OBJECTIVE

The objective of this research is to produce a guidebook to assist transit agencies in prioritizing actions to improve bus reliability. To the extent possible, the guidebook should quantify the impact of different actions a transit agency might take to improve reliability and the corresponding implementation costs.

IV. RESEARCH PROPOSED

The proposed research would involve the following tasks:

Task 1—Literature Review. Critically review and summarize existing North American and international (particularly the U.K.) literature on the causes of bus unreliability; the impacts of unreliability on transit operations, costs, and ridership; methods of measuring reliability; and service standards relating to reliability. The research agency should endeavor to obtain unpublished before-and-after studies and/or performance monitoring reports that document reliability improvements and other related impacts resulting from agency actions taken to address reliability problems.

Task 2—Measures of Reliability. Evaluate existing performance measures used to measure reliability (e.g., on-time performance, travel time variation, headway variation, excess wait time, punctuality), including ease of data collection, typical applications, and typical agency service standards. Prepare a working paper discussing which measure(s) appear most appropriate for quantifying the impacts of actions or treatments on reliability.

Task 3—Causes of Unreliability. Based on the results of Task 1, document the primary causes of bus unreliability and identify potential actions or treatments that could be used to address each cause.
Prioritize potential actions or treatments based on the documented or likely magnitudes of their impacts on reliability, cost, ease of implementation, and similar factors. Prepare a working paper recommending a set of promising actions/treatments to test during Task 5.

**Task 4—Interim Report.** Develop a detailed work plan for the Task 5 work, including identifying the proposed actions/treatments to be studied and identifying any agencies proposed to be used for case study efforts. Prepare an initial outline of the guidebook to be developed during Task 6. Summarize the results of Tasks 1-4 in a draft interim report. A panel meeting with the research agency will be held at the conclusion of this task.

**Task 5—Execute Work Plan.** Revise the interim report and Phase 2 work plan based upon panel comments. The details of the work effort will be determined during Phase 1; however, it is anticipated that this work will include both case studies (in the field or simulated, as appropriate for the particular action/treatment being evaluated) of promising techniques to address particular causes of unreliability, and the development of quantitative and/or qualitative methods to estimate the impact of a particular action or inaction on reliability. The case studies should include studies relevant to daily bus operations, bus service planning and scheduling, and allocation of roadway right-of-way and traffic signal timing. Prepare a working paper describing the case study effort, results, and implications for guidance.

**Task 6—Guidebook.** Prepare a guidebook describing causes of unreliability, strategies for addressing those causes, and the costs and benefits of those strategies. The potential audience for the guidebook includes transit agency staff, public works/highway department staff, and consultants.

**Task 7—Draft and Final Reports.** Prepare a draft final report describing the process that led to the development of the Guidebook. Following panel review and comment, make revisions and issue a final version of the report.

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

**Recommended Funding:** $350,000

**Research Period:** 24 months.

**VI. URGENCY AND PAYOFF POTENTIAL**

Although some limited work has been done in this area (see Section VIII for particulars), there is no single source of information agencies can turn to when seeking to improve reliability. As discussed in Section VII, reliability is a significant customer satisfaction issue for passengers. Some agencies, such as the San Francisco MUNI, have voter-mandated reliability goals (e.g., on-time performance, service hours delivered, % of scheduled vehicles beginning service at the scheduled time, actual vs. scheduled headways, and miles between roadcalls), while others report on-time performance to the public on a quarterly or annual basis. Existing reference documents, such as the TCQSM, identify the importance of reliability to passengers, but acknowledge the lack of available techniques to quantify how reliability may improve given a particular action. As discussed in Section VII, improving reliability can result in increased ridership and more efficient bus service. It is expected that the Guidelines document that would be a product of this research would identify potential challenges to implementing particular actions or treatments, but that it would also identify a range of potential techniques, so that if one action is infeasible for a particular agency, another may still provide benefit.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

FTA Strategic Goals

(1) Increasing Ridership: Improving reliability can attract more ridership, both through improved passenger perceptions that the published schedule may be trusted (TCRP Report 95, Chapter 9) and through decreases in the overall journey time, as passengers don’t need to allow as much extra time for their trip if they need to be at a particular destination by a particular time (NCHRP 3-70 Phase 2 Interim Report). Reduced incidences of crowding resulting from bus bunching can also improve ridership (TRL Report 593, “The demand for transport: a practical guide”).

(2) Improving Capital and Operating Efficiencies: Improving reliability allows agencies to reduce the amount of recovery time built into the schedule at the end of each trip. In a best-case scenario, for routes with frequent service, the recovery time savings (potentially in combination with speed-related improvements) will exceed one headway, allowing an agency to save a bus on the route. The saved bus can either be used to increase service on another route (helping to increase ridership at the same operating cost), or can be used to reduce operating costs (helping to maintain ridership at a lower operating cost). Either outcome results in operating efficiencies. Even if a bus cannot be saved, the schedule recovery time saved postpones the day when a bus will need to be added to the route to maintain headways, thus postponing future capital and operating costs.

TCRP Strategic Priorities

(1) Place the Customer First: Customer satisfaction surveying reported in the literature (e.g., TCRP Report 95, Chapter 9 and NCHRP 3-70 Phase 2 Interim Report) frequently identifies reliability as among the most important stated satisfaction factors for customers. The TCQSM presents reliability as an important passenger quality-of-service factor, with levels of service provided for assessing both on-time performance and bus bunching.

(2) Enable Transit to Operate in a Technologically Advanced Society: One reason for the lack of prior research on reliability has been the difficulty of obtaining data in a cost-effective manner. The growing adoption of Automatic Vehicle Location (AVL) equipment by transit agencies, however, is overcoming this obstacle. A series of studies conducted by Portland State University using TriMet’s warehouse of AVL data has illustrated some of the potential.

(3) Continuously Improve Public Transportation: Improving reliability involves day-to-day operations decisions, longer-term planning decisions, and continuous monitoring, with the potential payoff of improved ridership and more efficient operations.

(4) Flourish in the Multimodal Environment: Some of the factors that influence bus reliability are not under the control of transit agencies, but can be influenced by the owners and operators of roadway facilities, particularly with regard to decisions on right-of-way allocation to various modes and traffic signal timing decisions. Better information on how these external factors influence reliability can help transit agencies make better cases for the funding of roadway capital improvements that have the potential to save transit operating costs. The multimodal urban street level-of-service (LOS) measure being proposed for the Highway Capacity Manual by the NCHRP 3-70 project includes transit reliability (excess wait time) as a component of transit LOS on urban streets.

VIII. RELATED RESEARCH


• University of Wisconsin, Madison, “Use of AVL Technology to Optimize Transit Service Restoration Strategies.” (ongoing research)

• TCRP Report 100: Transit Capacity and Quality of Service Manual, 2nd Edition (TRB, 2003) identifies on-time performance and headway adherence as passenger quality-of-service measures, but is unable to provide techniques to forecast future performance given changes to current conditions.

• TCRP Report 95, Chapter 9: Traveler Response to Transportation System Changes: Transit Scheduling and Frequency (TRB, 2004) provides a few examples of observed ridership changes resulting from reliability changes.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is a product of TRB Committee AP015, Transit Capacity and Quality of Service. Mr. Danaher is the chair of the committee; Mr. Ryus is the chair of the committee’s Quality of Service subcommittee.

XI. DATE AND SUBMITTED BY

Submitted by Alan Danaher (see Section IX for contact details) on June 14, 2007.
I. PROBLEM TITLE
Inefficiencies and Safety Concerns with Current Rail System

II. RESEARCH PROBLEM STATEMENT
Today’s rail transportation system utilizes older technologies that do not take advantage of many recent advances in propulsion, speed, suspension, traction, tunneling, and energy reduction, distribution, storage, and regeneration. As a result, the railway transportation system is needlessly expensive to operate due to inefficient energy consumption, unnecessary maintenance, and under-optimized throughput; is dependent on foreign oil due to large consumption of diesel fuels; is putting unnecessary strains on our eco-system due to carbon emissions and noise pollution; is unsafe at crossings and city-centers; and is not competitive with the speed and convenience of alternate transportation solutions, leading to unnecessary congestion on highways, airports, and shipping ports.

Most of the innovative approaches being studied today, such as traditional MagLev and high-speed light rail, require expensive capital funding for infrastructure build-up and are not cross-compatible between freight and passenger transportation. There has not been a comprehensive study to assess the available technologies and techniques across various industries that could be used to retro-fit and enhance today’s transit system without the need for major overhauls or construction of costly new infrastructure.

III. OBJECTIVE
The objective of this research is to produce a wide assessment of promising technologies and associated strategies and partnerships to reduce overall energy consumption, dependence on foreign oil, maintenance cost, and emitted pollutants as well as increase throughput, speed, convenience, eco-compatibility, and safety of the transit system. The research will be confined to promising solutions that require minimal investments or overhauls to existing infrastructure. This assessment should provide a useful reference to government agencies, businesses, and organizations for further research, adaptation, and implementation of surveyed topics.

IV. RESEARCH PROPOSED
The proposed research approach would involve five components:
1) An extensive survey of available technologies and techniques in use and development across multiple business areas, geographical divisions, and disciplines. As stated in Section III, the goal of identified technologies and techniques is the potential to increase the effectiveness of the transportation system as applicable to the nine attributes mentioned: energy consumption, dependence on foreign oil, emitted pollutants, operating costs, throughput, speed, convenience, eco-compatibility, and safety.
2) An analysis and rating of identified candidates along five separate dimensions: potential, maturity, readiness, reliability, risks, costs, and barriers to implementation.
3) An exploration of efficiencies and effectiveness gained by using select candidates in combination from a total system perspective.
4) An investigation into alternative and innovative approaches to funding and implementation crossing public and private resources.
5) A proposed timeline and, if possible, estimated budgetary needs for suggested implementation strategies, with contingencies.

V. ESTIMATE OF THE PROBLEM FUNDING & RESEARCH PERIOD

It estimated that this project will take two years to complete at $200,000-$250,000/year over a two-year period, for a total of $400,000-$500,000, depending on the desired scope.

VI. URGENCY AND PAYOFF POTENTIAL

The urgency of research to enhance existing transit rail can be assessed by simply opening a newspaper, turning on the television, or logging onto the internet. In national news media, global warming and dependence on fossil fuels have grabbed the public’s attention not only in the US, but world-wide. In more subtle news, railways operators such as Amtrak continue to operate in the red while facing congressional budget cuts, while the US remains orders of magnitudes behind the usage of European and Asian nations while falling further behind. Shipping ports, airports, and highways continue to get more congested because there is no other alternative for fast, reliable, point-to-point transportation. Despite this, innovations in technology, funding, and partnerships that hold promises of up to 50-80% reduction in energy consumption and pollution, 300-500% increases in speed and throughput, and quantum leaps in public safety and eco-friendliness are not being explored for the existing rail transit system.

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

This research proposal is directly applicable to all or part of each stated FTA strategic goal: (1) Increasing Ridership (2) Improving Capital and Operating Efficiencies (3) Improving Safety (4) Protecting the Environment and Promoting Energy Independence. The proposal will also be directly applicable to three of the five stated TCRP Strategic Priorities: (II) Enable Transit to Operate in a Technologically Advanced Society (III) Continuously Improve Public Transportation (IV) Flourish in the Multimodal Environment, and potentially to the other two: (I) Place the Transit Customer First (V) Revitalize Transit Organization. It is also believed that the results of this research initiative could spawn several more future TCRP research problem statements and/or TRB IDEA demonstrations with a sharper focus on individual solutions and implementation techniques.

VIII. RELATED RESEARCH

Ongoing ITSC/SCTS areas of preliminary investigation and/or current research:
- MagRail Investigation: A newly patented technology that has a promising application in allowing frictionless suspension and propulsion of rolling stock on existing railway lines.
- Standard Rail Linear Induction Motor (LIM): Utilizing LIM technology on standard rail lines to efficiently propel rolling stock and re-coup energy from breaking.
- Tunneling & Land Sale Proposition: Utilizing new and inexpensive tunneling techniques to relocate urban railways underground while re-couping costs with the resale of land.
- Downhill railroad electricity generation: Strategic placement of LIM technology on high throughput corridors to generate power for local business/residential use.
- Inductive Charging Stations: New technology that safely allows electrical re-charging of transit vehicles at select stations without physical contact.


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

This problem statement was generated by two individuals representing a strategic partnership between Southern California Transportation Solutions Foundation For Education, a 501C(3) Non-profit organization dedicated to implementing the best technologies and practices for improving the mobility of goods and people throughout the Southern California Region, and Innovative Transportation Systems Corporation, a for-profit venture implementing innovative means to solve our nation’s transportation problems.

XI. DATE AND SUBMITTED BY

Date: 14-JUNE-2007

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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

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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
TCRP PROBLEM STATEMENT

I. PROBLEM TITLE

II. RESEARCH PROBLEM STATEMENT
Transit systems, particularly those serving highly populated areas, are not only impacted by day-to-day crime, but are also vulnerable to large-scale man-made and natural disasters including but not limited to terrorism. Fortunately, Geographic Information Systems (GIS) offer transit agencies extremely effective methods to use geospatially enabled data, applications and technology to support safety and security operations. GIS systems that are utilized by state and local governments across the United States are particularly noted for their ability to support risk management, emergency response (E-911) and crime analysis (CompStat). However, despite these successes, many transit systems do not utilize GIS in a safety and security capacity. Additionally, many transit organizations view GIS as an expensive technology whose costs and staff requirements far outweigh perceived benefits.

Through research, little reference could be found in available literature on the use of geospatial data and systems to support transit safety and security. To remedy this, we propose that an effort be made to identify existing transit GIS best practices as they relate to safety and security, analyzing not only domestic transit systems, but also those selected foreign transit systems which have already been the target of terrorism. Transit GIS systems should be examined within their local and regional contexts including their relationship to municipal and state geospatial systems. Additionally, this study should focus on how security and safety oriented transit GIS systems – which require the “mapping” of critical transit infrastructure - can also be used to support a variety of maintenance and management functions with similar infrastructure data and feature needs, including facility management, work order management, risk management, and power, communications and signal maintenance.

In the past, the geospatial community as a whole has experienced difficulty quantifying the return on investment (ROI) of GIS systems. More recently however, the Geospatial Information and Technology Association (GITA), the Federal Geographic Data Committee (FGDC), the National Aeronautics and Space Administration (NASA) and the Public Technology Institute (PTI) have provided important new and more rigorous methods for GIS ROI analysis. Based on these new methods we also propose that an analysis be conducted of the financial, productivity, safety and security benefits associated with transit GIS systems as they relate to both security and maintenance operations.
III. OBJECTIVE
To identify current and potential uses of transit GIS systems for safety, security and maintenance operations, and to demonstrate that the multiple uses of such enterprise systems can provide significant ROI and other benefits to a transit agency.

IV. RESEARCH PROPOSED
The research proposed will include these main items:

- An analysis of the GIS role in safety, security and facilities management applications currently utilized by ten selected rail transit systems serving the top UASI urban areas, including the Metropolitan Transportation Authority’s (MTA) NYC Transit Authority, Long Island Rail Road (LIRR) and Metro-North Railroad (MNRR); New Jersey Transit (NJT), Bay Area Rapid Transit (BART), Chicago Transit Authority (CTA), Los Angeles County Metropolitan Transportation Authority (LA CMTA), Dallas Area Rapid Transit (DART), Massachusetts Bay Transportation Authority (MBTA), Southeast Philadelphia Transit Authority (SEPTA) and the Washington Metro Area Transit Authority (WMATA). In the analysis, there should be a focus on the transit strategic infrastructure elements most commonly cited as of great security value by the Department of Homeland Security (DHS), the National Geospatial-Intelligence Agency (NGA), Northcom and other Federal agencies that deal with national security.

- A review of the ways the NYC Transit Authority utilized geospatial systems following 9/11 and an assessment of the on-going project to map transit stations and infrastructure initiated in 2004 to support security for the Republican National Convention (RNC) held at Madison Square Garden. (Alan Leidner, one of this study proposal’s authors directed the Emergency Mapping and Data Center – EMDC – for the NYC Office of Emergency Management, which served thousands of 9/11 responders in the three months following the terrorist attack. Mr. Leidner also helped to initiate the RNC subway mapping project through a grant from NGA.)


- The identification of best practices found nationally and internationally for the use of geospatial data and applications for safety and security.
A gap analysis of current practices to identify areas where improvement and innovation make sense.

A review of maintenance and management applications in use by major transit agencies; a review of the use of geospatial data and tools; an analysis of data and feature elements needed by both security and maintenance systems; and an assessment of the productivity and cost saving returns from automated asset management and maintenance systems.

The estimated ROI from increased safety and improved productivity benefits that can be achieved by use of a common transit enterprise GIS to support both security and facility management operations.

An assessment of whether DHS related grants can be used to support the capture of transit infrastructure elements and the development of geospatially enabled security and safety applications.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
Funding: $500,000
Research period: 24 months

VI. URGENCY AND PAYOFF POTENTIAL
Transit systems are acknowledged targets of terrorists as evidenced by a number of deadly attacks that have already taken place on worldwide transit systems. Geospatial systems, especially when utilized as an extension of enterprise IT to geo-enable, organize, analyze and “operationalize” data, has proven to be effective at all stages of disaster preparedness, response and recovery as demonstrated by the extensive use of GIS capabilities following 9/11 and in the aftermath of Hurricane Katrina. However, most transit systems are yet to take full advantage of geospatially enabled applications to support security and safety operations. This study proposal, if approved and funded, would make it possible to document the most effective uses of geospatial systems for improving transit safety and security. The study would also provide a strong rationale for funding and implementing transit geospatial systems, by linking their development to ROI yielding improvements in day-to-day management and maintenance operations.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP PRIORITIES
This initiative is fully aligned with the strategic goals and policies of the FTA and TCRP.
FTA’s Strategic Research Goals

- **Increasing ridership:** A safer and more secure transit environment that is also better maintained will inspire confidence and attract new customers.
- **Improving capital and operating efficiencies:** This project would assess the potential of geo-enabled data and technology to improve system maintenance and increase work crew productivity.
- **Improving safety, security and emergency preparedness:** This project would examine past, current and potential uses of geospatial systems to increase safety and security through better intelligence analysis, and improved situation awareness. This project would also examine methods for reducing transit crime and for reducing accidents.

TCRP Strategic Priorities

- **Place the transit customer first:** This proposal has, as a primary focus, the uses of geospatial systems to improve customer safety.
- **Enable transit to operate in a technologically advanced society:** This project would examine a variety of ways in which transit geospatial systems and technologies can be integrated with similar GIS systems to be found in surrounding jurisdictions to create new synergies and greater benefits.
- **Flourish in the multimodal environment:** Transit geospatial data and feature layers when combined with similar data and features from other transportation systems including highways, bridges, tunnels, ports and airports, can be related to one another through a shared geospatial framework. Such a framework provides many opportunities to examine multimodal travel patterns, analyze how intersecting transportation systems interact, and assess the relationship of transportation facilities to their surrounding communities.
- **Revitalize transit organizations:** The use of geospatially enabled data, applications and technologies affords transit organizations many opportunities to safeguard their riders, reduce operating costs and provide insightful intelligence to support executive decision making.

VIII. RELATED RESEARCH


Green, R.W., Confronting Catastrophe, A GIS Handbook,” ESRI Press, Redlands, California, 2002


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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT
Collaboration between a team of Booz Allen consultants working in the New Jersey and New York region.

XI. DATE AND SUBMITTED BY
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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

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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 AND SUBMITTED BY

June 15, 2007, same as IX above.

Submit to:

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

Bus Rapid Transit (BRT) Planning Tool

II. RESEARCH PROBLEM STATEMENT

Intelligent transportation systems (ITS) and other bus technologies have been applied to BRT, however, not always in a fully integrated manner. Non-integrated approaches to add-on technologies can contribute to added costs, system complexity that can impact system reliability, and constraints on data sharing among different systems. The problems associated with the deployment phasing of bus rapid transit systems over time have only begun to be addressed by the development of a prototype visual web-based tool that was designed as part of earlier research.

III. OBJECTIVE

This will address transit challenges and the steps necessary to lead to eventual deployment of a given product, service, or system. The present vision for BRT is the incremental deployment of various levels of new technologies including advanced infrastructure-transit vehicle cooperative systems with the potential of creating a system of automated transit vehicles on transit lanes.

IV. RESEARCH PROPOSED

Institutional issues and their linkages and tradeoffs with the technical and operational aspects of the implementation of intelligent transportation systems play a very important role in the overall picture of ITS deployment. Thus, an inquiry into these institutional issues is essential to gain a more complete understanding of the potential barriers and obstacles in the path of deployment for BRT. The core questions to be answered during this project include the following:

- What are the relevant institutional issues arising out of a proposed application of bus rapid transit, both in general and with respect to specific case study site scenarios?
- What is their relative level of importance?
- What is the likelihood of them occurring?
- What recommendations can be made for resolving them?

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $200,000

Research Period: 24 months

VI. URGENCY AND PAYOFF POTENTIAL

To show the relationships among commonly used BRT elements and major dimensions along which deployment decisions are made, significant work is required to bring the tool to its full functional potential. This will allow decision makers to fully understand tradeoffs involved in the BRT deployment where synergies might exist, and guide decision makers through the extensive relationships among BRT elements.

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

This research will assist in advancing all of FTA’s strategic goals (1) increasing public transportation ridership; (2) improving safety, security, and emergency preparedness; (3) improving capital and operating
efficiencies; and (4) protecting the environment and energy independence. The research supports TCRP’s strategic priorities I, II, III, and IV.

VIII. RELATED RESEARCH

Research has been conducted in the US and internationally that will benefit this project.

California Department of Transportation (Caltrans) Research:
- Research Technical Agreement 18365 Bus Rapid Transit Development and Deployment Framework
- Task Order 4401 Cooperative Vehicle-Highway Automation Systems (CVHAS) Pooled Fund Study Project Case Study Analyses
- Task Order 5603 Development of Deployment Strategy for an Integrated Bus Rapid Transit System
- Task Order 5602 Development of Bus Rapid Transit (BRT) Information Clearinghouse
- Research Technical Agreement 20829 An Assessment of Bus Rapid Transit Opportunities in the San Francisco Bay Area

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

California Department of Transportation (Caltrans)
Division of Research and Innovation
Strategic Research Process

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June 15, 2007
I. PROBLEM TITLE

Bus Rapid Transit (BRT) Toolbox

II. RESEARCH PROBLEM STATEMENT

In 2007, the California Department of Transportation (Caltrans) recently adopted a policy supporting the implementation of Bus Rapid Transit (BRT). For the past several years, Caltrans has been researching Transit Signal Prioritization, locally and nationally. There is a national trend for local agencies to implement or want to implement BRT and find state agencies, such as Caltrans, an obstacle to this implementation. Engineers and practitioners don’t have the tools and appropriate language in their current manuals to help them say “yes” to BRT and assist locals in its implementation.

Faced with this policy, Caltrans engineers, as other national engineers, worry about a perceived impact of BRT on vehicle throughput (rather than passenger throughput) due to the use of Transit Signalization Priority (TSP), how to make drop down ramps work in existing facilities, how to safely collect and board passengers along the State Highway System, durability of paving materials experiencing frequent bus traffic, among other real world implementation issues.

III. OBJECTIVE

Provide planners, design and traffic operations engineers with proven options (at the detail level needed) for addressing state agencies concerns and needs. Provide a decision procedure to help agencies identify the costs, benefits (expressed in passenger throughput), and timing of various BRT solutions in various settings.

IV. RESEARCH PROPOSED

Develop a BRT Toolbox to include recommended language changes to current manuals. Additionally, the research will provide planners and engineers with a decision procedure to decide the role of BRT as an integral part of existing/future transportation systems. Toolbox should include Planning Guidelines, HOV Guidelines, Project Development Procedures Manual, etc., as well as a Decision Procedure.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $100,000

Research Period: unknown

VI. URGENCY AND PAYOFF POTENTIAL

This research is urgent as many state agencies are in need of developing design criteria for BRT concepts for street re-alignments, geometric considerations, right-of-way acquisition, signal preemption, dedicated/shared bus ways on major state arterials, and integrating BRT into existing and future managed lanes (HOT/HOV). The joint partnership with transit agencies and other private/public partnerships will help state agencies in developing, identifying, and evaluating the analysis tools and methodologies required to plan BRT. Integrating BRT into existing and future management lanes will be instrumental in planning and designing case studies. By maximizing transportation system performance outputs and increasing accessibility will result in increases in transit ridership and improved air quality.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
This research will assist in advancing of the FTA’s strategic goal (2) Improving Capital and Operating Efficiencies, as well as the TCRP’s strategic priorities (1) Place the Transit Customer First (2) Enable Transit to Operate in a Technologically Advanced Society (4) Flourish in the Multimodal Environment and (5) Revitalize Transit Organizations.

VIII. RELATED RESEARCH

- Advanced Transit Signal Priority Project (Caltrans)
- Lane-Assist and Precision Docking Project (Caltrans)
- Lane-Assist and Pavement Durability (Bradley to get correct name) (Caltrans)
- Transit Bus Collision Avoidance Warning System Project (Caltrans)
- Bus Rapid Transit System Deployment Project (Caltrans)
- TCRP 90 – Implementation Guidelines
- TxDOT Project 0-5668 – Comprehensive Planning and Design Guidelines for Incorporating a Bus Rapid Transit Scenario to the Analysis of Texas Highway Corridors (start 9/06, end 8/08)

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

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June 15, 2007
TCRP PROBLEM STATEMENT

I. PROBLEM TITLE

Complete Streets Projects – Project Procedures Uniform Guidelines for Implementation

II. RESEARCH PROBLEM STATEMENT

The California Department of Transportation (Caltrans) has developed an Active Transportation and Livable Communities (ATLC) Advisory Committee to help it incorporate the issues of "Complete Streets" into its plans, designs and projects. Like many other states, Caltrans is revising policy to reflect the concept of "complete streets" -- streets designed and operated to enable safe access for all users where pedestrians, bicyclists, transit users, and motorists of all ages and abilities are able to safely move along and across a complete street. Planners and engineers are in need of guidelines to help them make decisions about what, where, when and how to incorporating Complete Streets elements into their plans, designs, and projects.

III. OBJECTIVE

Increase ridership and reliability of Bus Rapid Transit (BRT) systems across the country by way of a project guidelines approach.

IV. RESEARCH PROPOSED

Increase ridership of bus transit through increased safety, comfort and convenience. Increase the use of non-motorized travel methods through increased safety, comfort and convenience.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $300,000

**Research Period:** 24-months

VI. URGENCY AND PAYOFF POTENTIAL

There is a need to decrease our reliance on the Single Occupant Vehicle, and offer safe and convenient modal choices including walking, biking, and transit alternatives which will decrease our reliance on fossil fuels and improve air quality. By fully considering the needs of all non-motorized travelers (pedestrians, bicyclists, and persons with disabilities) early in the life of a project, the costs associated with including facilities for these travelers are minimized.”

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

This project supports FTA Strategic Goals 1, 2, and 4, as well as TCRP Strategic Priorities I, II, III, IV, and V.

VIII. RELATED RESEARCH


IX. PERSON(S) DEVELOPING THE PROBLEM

Judith Mac Brine, Chief
X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

California Department of Transportation (Caltrans)
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June 15, 2007
I. PROBLEM TITLE
Multimodal Traveler Information

II. RESEARCH PROBLEM STATEMENT
Traveler information services and trip planners, such as 511, require users to choose their modes of travel prior to learning about their options and respective pros and cons (e.g., trip duration, reliability, cost). Transportation users are unlikely to be familiar with the variety of transportation choices available along their travel corridor and default to use of the car, usually a single occupant vehicle (SOV).

III. OBJECTIVE
Development of a national multimodal traveler information prototype which can be easily read and understood by all users of the system.

IV. RESEARCH PROPOSED
Develop a prototype multimodal travel information system / trip planner. Test the prototype with the traveling public and enhance design accordingly. Provide performance specifications.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $280,000

**Research Period:** 24 months

VI. URGENCY AND PAYOFF POTENTIAL
The development of a multimodal traveler information prototype will provide consistent and uniform traveler information to the traveling public across the nation.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
This project supports FTA Strategic Goals 1, 2, 3, 4, as well as TCRP Strategic Priorities I, II, III, IV.

VIII. RELATED RESEARCH

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June 15, 2007
I. PROBLEM TITLE

Public Transit/Passenger Information Interface

II. RESEARCH PROBLEM STATEMENT

Route, schedule, and fare information and transactions are the first place the riders interface with the transit system. With well over 100 separate entities providing transit information in California, like other states, there is no consensus on industry standards or “best practices” for providing this information to customers. First time users can be overwhelmed when trying to plan a trip from Point A to Point B successfully. This is especially true for travelers using multiple transit modes or providers. As a result, would-be transit users are discouraged from using transit at their first opportunity because it is difficult to navigate through a maze of uncertain choices and contingencies.

III. OBJECTIVE

Increase transit ridership by improving communication to potential users for routes, schedules, fares, etc.

IV. RESEARCH PROPOSED

The study will address the legal and institutional challenges of developing a universal system for conveying multi-modal transit information to the traveling public.

- Summarize methods for presenting route, schedule, and fare information and fare transactions.
- Test the ease of understanding information and performing transactions.
- Format presentation and materials for transportation engineers and planners: “Best Practices” for communicating user-friendly route, schedule, and fare information for traveling public.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $300,000
Research Period: 24 months

VI. URGENCY AND PAYOFF POTENTIAL

Reduce single-occupancy vehicle dependence; increase transit ridership; support congestion management and mitigate SOV vehicle emissions.

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

This research will assist in advancing all of FTA’s strategic goals (1) increasing public transportation ridership; (2) improving safety, security, and emergency preparedness; (3) improving capital and operating efficiencies; and (4) sustaining the environment and energy independence. The research supports TCRP’s strategic priorities I, II, III, IV and V.

VIII. RELATED RESEARCH

Small scale project related research has been done locally in California, and both nationally and internationally.
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June 15, 2007
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
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PROCESS USED TO DEVELOP PROBLEM STATEMENT


DATE AND SUBMITTED BY

June 15, 2007

American Public Transportation Association
Systems Management/Operations Planning Subcommittee
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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
TCRP Problem Statement

I. Improving Safety of Shared-use Corridors by Implementation of ATC Processes

II. Research Problem Statement
Shared-use of existing freight corridors by passenger trains is a cost-effective, quick way to provide exclusive right-of-way (XOR) transit service to older, densely-developed areas.

A major impediment to creating more of this service is the existing FRA regulatory structure, which generally prohibits the use of non-compliant rollingstock on freight railways with freight operations. Where those regulations do permit shared use, the requirements for temporal separation of on mode from the other limit the headways to the point that the service is not effective.

Automatic Train Control systems, such as Communications Based Train Control (CBTC) and other advanced software-based improvements, have the potential to improve performance and reduce separation on shared-use tracks, but to date, little has been done in this area.

III. Objective
The objective of the research program would be to identify the potential for software-based improvements shared-use operations.

IV. Research Proposed
The first step would be a survey and compilation of the FRA regulations that pertain to shared-use and of any recent studies on similar issues. A second, parallel survey of software applications that have applicability to the temporal separation issue should be part of this step.

At a minimum, the next step should be an assessment of the potential of the currently available software/ATC systems vis-à-vis the relevant FRA requirements for shared-use. As these systems were not developed with shared-use as an objective, major shortcomings in their applicability to the problem will likely manifest themselves.

The final step in the process should be recommendations for a program to develop the necessary software/hardware system to enable safe, efficient temporal separation on shared-use corridors. The program should include schedule and budget information for the development process of the recommended system(s).
V. Estimate of the Problem Funding and Research Period

Recommended Funding: Two professionals for a full-time equivalent of nine months plus a half-time administrative assistant is the approximate level of effort. Dollar cost should be in the $350,000 to $400,000 range.

Recommended Period: Each step (as described in section IV) should take about three months for a total of nine months. Add three months for review and revision for a total of twelve months to complete the project.

VI. Urgency and Payoff Potential

The urgency of starting this research and subsequent systems development is two-fold. Ninety-percent of the energy used for transportation in this country comes from refined petroleum, and the USA imports more of than half of the petroleum it uses. Much of this is from an increasingly unstable region, so disruptions are inevitable.

The second urgent aspect to implementation is the phenomenon of global warning. Decreasing fossil fuel use is essential if this problem is to be mitigated.

A third, more specific reason for urgency of implementing shared-use improvements is increasing traffic on freight railways. As freight railroads move more trains over their tracks, the window of opportunity for testing and installing new systems will close.

Institutional barriers do exist to shared-use, as mentioned in the reference to FRA regulations in the Research Problem Statement above. Part of the objective of the study would be identify the relevant regulations and specify software that would obviate the need for those regulations.

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

This research relates to the four FTA Strategic Goals as follows:

1. Shared-use of freightways would increase ridership by providing exclusive right-of-way operation built-out, high-density areas.
2. Shared-use of freightways would be an efficient use of capital in that the ROW already exists – property acquisition problems and costs are minimal. The software to be developed has the goal of making operations viable.
3. The software developed as an ultimate result of this research would increase safety of shared-use operations. That would be a primary goal, that is, to decrease temporal separation while maintaining safe operations.
4. Shared-use would provide high-quality, attractive rail service in the near-term. It would provide commuters with a viable alternative to automobile use which achieves the goals of protecting the environment and promoting energy independence.
This research relates to the TCRP’s Five Strategic Priorities as follows:

I. By providing improved rail service at low capital cost and in a relatively short time (two to three years as opposed to eight to ten years for other new rail starts), passenger needs are met more quickly and at a lower cost.

II. Integrating software-based solutions to replace inefficient temporal train separation requirements will require integration of state-of-the-art information technology into a new application.

III. Increasing and improving shared-use of freightways a major improvement to public transportation.

IV. Shared-use of freightways is by definition multi-modal, and it also lends itself to coordination with bus and light rail service.

V. A tenet of improved and expanded shared-use is “work better – cost less”.

VIII. Related Research
Cannot comment – don’t know.

IX. Person Developing the Problem
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X. Process Used to Develop Problem Statement
Brian J. Larkin developed this problem statement as an individual acting alone.

XI. Date and Submitted By
Brian J. Larkin submitted this problem statement on July 6, 2007 – better late than never. A Larkin transit-specific resume will come under separate cover.
I. Problem Title
Factors Contributing to the Success or Failure of CBD Shuttles

II. Research Problem Statement
CBD Shuttles have been implemented or are under consideration in many cities throughout the U.S. Examples include a wide range of central business districts, including many small and medium-sized cities. The common theme to the shuttles is that something other than the existing transit service is needed to re-vitalize these districts. Civic, business, and transit leaders may have visited other cities and seen shuttles operated with special vehicles (including trolley replicas or colorful wraps) and distinct marketing identities (including a catchy name for the service).

When the idea of a shuttle is proposed for a CBD, many questions soon arise about how to replicate the success of other cities’ shuttle services. Is it the special vehicles, the slick marketing, the frequency of service, the support of the businesses, or some combination of all of these? In some cases, a city will commission a study to look at the idea or simply try it and see what happens. Unfortunately, it seems that many attempts to implement CBD shuttles have resulted in disappointing ridership levels, wasted resources, and perhaps even the abandonment of the idea.

It would be very useful to have a comprehensive look at what has contributed to the success and to the failure of CBD shuttles. That way, cities considering new shuttles (or trying to salvage existing shuttles) would have a resource to help them understand what is required for success. At the same time, those cities that do not have the needed elements to have a successful shuttle can ascertain that much earlier in the process and avoid the expenses associated with a failed shuttle.

III. Objective
The primary objective is to produce a report which summarizes the factors that are in place for all successful CBD shuttle systems and catalogs the missing elements in CBD shuttles that have failed.

IV. Research Proposed
The research would consist of a general survey of all cities to ascertain the number that have existing CBD shuttles or have attempted a shuttle in the past. This survey would gather statistics on the characteristics of the shuttles (what is being linked, hours/frequency of service, route length, number of stops, ridership, operating cost, capital cost, marketing materials, etc.). The researcher would supplement the survey with available data from the Census, NTD, and other sources on the characteristics of the CBD and transit systems. These data would be combined to produce a summary report of indicators of success and failure.

Based on the general data, a second part of the research would choose several representative cities as successes and failures for more detailed case studies. The case studies would serve to
solidify or modify the conclusions of the general survey report, to result in a final set of contributing factors.

V. Estimate of Problem Funding and Research Period
The research should be pretty standard and at the low end of the typical scale – perhaps $250,000. It should be possible to complete this in one year, including the 3-months for review and revision prior to the final report.

VI. Urgency and Payoff Potential
This research is only urgent in the sense that resources are being wasted by not having this information available. The waste includes not only operating and capital funds, but also the loss of goodwill between transit and the local community leaders that accompanies a local study (“foot-dragging”) or a failed implementation.

VII. Relationship to FTA Strategic Goals and TCRP Strategic Priorities
This research relates directly to the first two FTA Strategic Goals (1. Increasing Ridership and 2. Improving Capital and Operating Efficiencies) because it will lead to shuttle services that attract higher ridership and that use capital and operating funds more efficiently. The research also serves several of the TCRP Strategic Priorities. By developing services that meet customers needs and providing a basis for a successful relationship between the transit system, city, and business leaders, this research addresses 1. Place the customer first, 3. Continuously improve public transportation, 4. Flourish in a multi-modal environment, and 5. Revitalize transit organizations.

VIII. Related Research
TCRP Report 116: Guidebook for Evaluating, Selecting, and Implementing Suburban Transit Services looked at shuttle services but in a suburban environment, not a CBD. Other TCRP reports (TCRP Report 22: The Role of Transit in Creating Livable Metropolitan Communities; TCRP Report 51: A Guidebook for Marketing Transit Services to Businesses) discussed aspects of shuttles serving businesses, but without a detailed assessment of the formula for their success.

IX. Person Developing the Problem Statement
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X. Process Used to Develop Problem Statement
Individual

XI. Date and Submitted by
Submitted by Anthony Palmere, ajpalmere@ucdavis.edu, May 1, 2007.
I. PROBLEM TITLE

Increasing Public Transit Ridership on Public Lands

II. RESEARCH PROBLEM STATEMENT

America's public lands (such as National Parks and National Forests) contain natural and recreational resources of national, and increasingly, international significance. Given the significance of this resource base, public demand to see and experience these areas is great. Data on visitation dramatically support this premise: the National Park System receives nearly 300 million visits annually and the National Forests accommodate over 200 million visits annually. A vast majority of visitors to public lands arrive and experience these places in personal vehicles. Moreover, use of public lands is often highly concentrated both spatially (i.e., on a limited network of roads) and temporally (i.e., June-August) (Manning, 1999; Hammitt & Cole, 1998).

The popularity of public lands and the personal vehicles used to access them presents substantial challenges for managers. Too many vehicles can cause unacceptable impacts to fragile natural resources, and may also cause congestion and other social impacts that degrade the quality of the visitor experience in these places. Public transit systems implemented on some public lands have begun to mitigate impacts associated with having too many vehicles on roads. However, relatively few visitors willingly leave their personal vehicles to ride a bus or other form of public transportation while visiting these lands. This has resulted in an urgent need to increase ridership of public transit on public lands so that both natural resources and the experience of visiting these areas are protected.

Influences of external and internal factors on general public transit ridership have been researched. External factors such as job growth and wages are highly correlated with increases in ridership, but these factors are largely beyond the control of public land managers (Taylor, Haas, Boyd, Hess, Iseki, & Yoh, 2002). Internal factors like pricing, service information, and service frequency are more manageable. Also, internal factors related to service quality have been found to be influential in attracting riders to public transit (Cervero, 1990; Syed & Khan, 2000). A recent nation-wide review of transit agencies found that the foremost factor in increasing ridership was a transit system that was tailored to meet the needs of its customers (Taylor et. al, 2002). These findings suggest that increased ridership may be best promoted by providing high quality service specifically tailored to individual groups of transit users. This is particularly relevant to the problem of increasing ridership of public transit on public lands. Recreational visitors to public lands represent a large, distinct group of potential transit users. The motivations, attitudes, and needs of these visitors must be better understood in order to effectively encourage a transition from personal vehicles to transit systems on public lands.

III. OBJECTIVE

The objectives of this research are to (1) determine context-sensitive, experiential indicators (i.e., measures of effectiveness) that affect perceived quality of public transit on public lands, (2) determine customer-based standards (i.e., performance measures) for the primary indicators that influence ridership in these places, and (3) evaluate existing and potential strategies for increasing ridership of public transit on public lands by improving the quality of riders’ experiences. A primary product of this research will be a guidebook of indicators, standards, and strategies that can be used by transit managers to increase ridership of public transportation on public lands.

IV. RESEARCH PROPOSED

Two primary, but closely related, conceptual frameworks are relevant to the proposed research objectives. First, the Highway Capacity Manual (HCM) uses the concept of “levels of service” (LOS) for
planning and managing the quality of transit service (Transportation Research Board [TRB], 2000).

Empirical research suggests that public transit can operate under a range of conditions from good to poor. These conditions are categorized into six levels labeled “A” through “F” based on a given performance measure. LOS for transit is based on four service measures: service frequency, hours of service, passenger loads, and reliability. For example, LOS A for urban, scheduled bus transit is defined by a service frequency with less than 10 minutes between bus arrivals, between 18 and 24 hours of service operation per day, a passenger load greater than 12.9 ft²/person, and an on-time reliability between 97.5 and 100% (TRB, 2000).

The research proposed here will integrate these two conceptual frameworks to address the problem of increasing public transit ridership on public lands. It will focus on developing transit-related indicators and standards to better understand the transit needs of public land visitors. Indicators and standards obtained in this research will then be used to develop context-sensitive LOS guidelines for increasing ridership by promoting quality public transit on public lands. Moreover, these indicators and standards will inform an evaluation of existing or potential management strategies for increasing ridership.

The research proposed here will be conducted in three phases over the course of three years. Phase I (2008) will focus on identifying indicators for public transit on public lands. This work will employ literature review, quantitative and qualitative surveys of public land users, focus groups, and stated choice modeling. Phase II (2009) will focus on developing standards for the most important indicators identified in the first phase of research and on evaluating existing and potential management strategies for increasing ridership of public transit on public lands. Quantitative surveys of public land users will be conducted to identify preferred and minimally acceptable conditions of indicator variables. This work will utilize normative research methods derived from sociology and applied in many fields of study, including tourism/recreation and public land management (Manning, 1999; Vaske and Whittaker, 2004; Manning, 2007). Visual research methods will be incorporated where applicable to realistically represent and enable evaluation of a range of transit-related attributes (Manning and Freimund, 2004). Quantitative surveys and interviews with public land transit managers will be used as the primary methods to evaluate management strategies for increasing ridership.

Phase III (2010) will integrate study findings – indicators, standards, and best practices for increasing ridership – into a guidebook that can be used to address the problem of increasing public transit ridership on public lands. Recommendations will be analogous to the LOS guidelines for transit contained in the HCM, but they will be more holistic in that they will incorporate experiential variables and be tailored to meet the needs of public land visitors.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: A total of $375,000 will be necessary to accomplish the research described above. This estimate includes funding for salary contributions (for 2 principal investigators and 2 graduate students), travel and expenses for field-research, equipment/supplies, and project administration.

Research Period: The estimated time period to complete this research (including 3 months for review and revision of a draft final report) is 3 years.

VI. URGENCY AND PAYOFF POTENTIAL
Visitor and personal vehicle use on public lands is high, and this use results in impacts to both the natural and experiential resources of these areas. For example, on an average summer day in Yosemite National Park, thousands of personal vehicles are driven through Yosemite Valley and this can create severe traffic congestion. Public transit is available to Yosemite’s visitors but, like in many national parks, ridership levels are relatively low. Results of this research have the potential to reduce the hundreds of millions of personal vehicles that drive annually on public lands. Furthermore, the methods and results of this research may be used as a basis for examining how ridership of public transit in other contexts could be increased by improving the quality of riders’ experiences. No institutional, political, or socio-economic barriers are expected in implementing the anticipated research products of this proposal.

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

This problem statement directly addresses the FTA’s strategic research goal of increasing ridership. More specifically, the research described above will be used to determine how to relieve traffic congestion on public lands by determining indicators (i.e., measure of effectiveness) and management strategies to increase ridership. Also, the problem statement directly relates to the TCRP strategic priorities of placing the transit customer first and continuously improving public transportation. These priorities will be addressed by developing indicators, standards, and strategies for increasing transit ridership on public lands using a multidisciplinary, customer-based approach.

VIII. RELATED RESEARCH

Research conducted by the project principal investigators has been used to identify a number of indicators for visitor use on public lands (e.g., density of use, trail and campsite impacts, litter, and level of facility development) and to formulate minimum acceptable standards for these indicator variables. In several parks, this work has addressed transportation-related indicators. For example, studies at Blue Ridge Parkway and Acadia National Park identified vehicle use levels on park roads as important determinants of the quality of the park experience (Valliere & Manning, 2004; Hallo, Manning, & Valliere, 2005; Manning, 2007).

A second example illustrates the ways in which the transportation guidelines contained in the HCM must be tested and will often need to be re-registered in the context of public lands. Research at Muir Woods National Monument identified the number of visitors on trails and walkways as an important indicator for the park (Manning et al., 2004). The HCM includes guidelines (in the form of LOS) for density of pedestrian use on walkways. These guidelines were used to prepare a series of six study photographs illustrating the six LOS specified in the HCM along a generic section of walkway within the park. These study photographs were incorporated into a visitor survey, and findings suggest that only LOS A and B are acceptable in the context of Muir Woods. In contrast, traditional applications of the LOS concept consider levels C and D to be acceptable. Clearly, indicators and standards are needed that specifically address transportation in the context of public lands.

In addition to these examples, the project principal investigators are using the conceptual frameworks described above to examine transportation issues on several other public land areas. The issues include roadway capacity analysis at Denali and Acadia National Parks, management of vehicle-dependent recreation at Cape Cod National Seashore and Lake Umbagog National Wildlife Refuge, and sustainable transportation planning for tourism on public lands in the New England region.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is based on the experience and past research of both principal investigators. Development of this problem statement was informed by discussions with managers at several national parks who are seeking to increase ridership of public transit to mitigate impacts related to vehicle congestion.

XI. DATE AND SUBMITTED BY

This problem statement was submitted via email by Jeffrey Hallo (contact information above) on May 25, 2007.
I. PROBLEM TITLE
Transit Marketing for New Residents

II. RESEARCH PROBLEM STATEMENT

New residents are a target market for transit. Ideally, the new residents should be aware of transit prior to their move into a community or very shortly thereafter. Most current methods for initiating contact are inadequate. Mailing lists, at best, are dated, even when they are developed from public sources. The increasing penetration of cell phones particularly among the young further complicates the task. While it is difficult to identify new homeowners, it is even more difficult to identify renters.

FTA has documented some success with its individual marketing approach. For many transportation agencies this is a labor intensive program with a relatively high cost per new rider. Transit agencies, particularly those with limited staff and resources could benefit from a template approach to developing new resident awareness of transit.

III. OBJECTIVE

The proposed research should achieve the following objectives:

- Establish existing methods for identifying new residents, and the programs and incentives employed.
- Identify parallel programs in commercial sales that can be transferred to transit applications.
- Identify possible lead sources (e.g., motor voter, cable subscription, utility sign-up and real estate closings) that can be used to drill down to new residents.
- Identify legal parameters that might limit contact or sharing of information.
- Develop a template that can be used by variously sized transit agencies for marketing and follow-up.
- Propose a sample web based effort.
- Design a program to determine the longitudinal success of the effort.

IV. RESEARCH PROPOSED

The product of the research is “marketing program in a box.” To clarify, marketers in transit agencies could benefit from a standardized approach, while understanding the particulars that are agency specific. To this end, the final product will be a series of
templates. Of significant importance is that the report will include guidelines for tracking the success of various efforts over time.

The first task of the research is to survey transit agencies for existing methods, and to determine if possible the relative success of each method. The survey may yield innovations that may be unknown to the larger community of transit marketers.

The second task is to identify parallels in the private sector, and develop a list of possible alternatives. A charrette may be a useful approach.

The third task would be to assemble a method for developing leads, including mail lists, and utility applications. A subset of this task would be to identify possible legal restrictions that would preclude the use of non-public sources of information.

The forth task would be to collect past examples of prior plans and to assess their value in the context of the current political and economic climate. Costs to obtain a “near readiness condition” should also be defined. Consideration should be given to other crisis-related models.

The fifth task would be to develop a template that can be used by transit agencies of varying sizes. This template should include recommendations for marketing collateral. A subset of this task is to develop a template for a web-based marketing approach.

The final task is to develop a method for measuring the historical success of the program over a three-year period.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

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

VI. URGENCY AND PAYOFF POTENTIAL

The development and expansion of the customer base is directly related to the long-term viability of transit.

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

This proposed project deals directly with the FTA research plan to increase transit ridership.
VIII. RELATED RESEARCH

There are a number of previous TCRP projects that have dealt with marketing issues, and these reports can provide general guidance. The secular field of marketing and direct mail may offer additional guidance.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Individual

XI. DATE AND SUBMITTED BY

SEPTA
June 2007
I. PROBLEM TITLE

A Model Functional Assessment Protocol for Determining ADA Paratransit Eligibility

II. RESEARCH PROBLEM STATEMENT

The demographic imperative: As our population ages and more people survive severe and disabling illnesses and accidents, there will be a greater demand for alternatives to the personal vehicle. There will also be greater demand on public transportation agencies’ efforts to meet The American’s with Disabilities Act (ADA) mandate that public transportation entities provide alternative transportation services to persons with disabling conditions that prevent them from using a fixed-route system. In addition, these demographic forces provide challenges to decision-makers to establish fair and reasonable public policy.

Impact on the ADA eligibility assessment process: Currently, while there are reasonably clear standards for who is eligible for paratransit services, there are few objective assessments for determining such eligibility. Many of the assessment procedures being used are highly variable and subjective. Methods of determining eligibility, in general, include: 1) Application (with professional verification) only, 2) Application and interview conducted by a transportation agency employee, and 3) Application and interview including performance-based assessments. In most cases these interviews and assessments are conducted by transportation agency employees who are trained to perform the interviews and available assessments, but do not have formal training related to disabling conditions and environmental conditions that affect an individuals’ ability to access and ride fixed-route services. These evaluators are often unaware of how a given disabling condition and the environment affect a person’s function or how the potential variability of disabling conditions (for example, some worsen over time, others have variable impact on a person’s function, etc.) is important when assessing an individual’s capacity for accessing and riding fixed-route public transportation systems.

Impact on local, state, and national planning: With the growing number of older adults and people with disabilities in the United States and the high cost of paratransit services, it has become fiscally prudent for public transportation agencies to accurately and fairly identify those who are appropriate for ADA paratransit services. It is equally important for public policy makers to have reliable information about the disabling conditions of paratransit applicants and riders and the environmental conditions and barriers that prevent individuals who otherwise could use the fixed-route public transportation systems, from using the more cost effective fixed-route systems. We lack large databases of information about personal and environmental factors that impact accessibility to a fixed-route transportation system, and thus lack information needed to make good local, state, and national planning decisions.

III. OBJECTIVE

Development and dissemination of a model functional assessment protocol for determining ADA Paratransit eligibility. This objective assumes that while there exists a paucity of valid and reliable measures to directly assess people’s ability to ride fixed-route services, there are likely measures of cognitive function, physical function, psychosocial function, and sensory functions that have been applied to other activities and can be applied to navigating, boarding, riding, and disembarking fixed-route systems.

This model assessment protocol would likely include between one and three brief measures for each of the functional domains of cognitive, physical, psychosocial, and sensory functions used in navigating, boarding, riding, and disembarking fixed-route systems.

1. Use of the protocol would provide a more efficient and effective assessment procedure in that it would help transportation officials: a) Choose an appropriate measure or group of measures that best fit an applicant’s disabling condition, and b) Gather objective information for predicting, within reasonable limits, whether people have the cognitive, physical, psychosocial, and sensory capacity to navigate, board, ride, and disembark fixed-route systems.
2. This protocol would be useful in local, state, and national planning because: a) Transportation agencies using the protocol would collect similar data, b) This would afford the comparison of large numbers of data about paratransit applicant and rider demographics, functional characteristics, and environmental conditions which could prove critical in transportation agency planning, local community and state planning, and nation planning and policy decisions.

The results of the study would be disseminated through professional and trade publications and national and international professional association forums. In addition, the protocol would be published in a booklet and DVD that explained how to use the protocol. We would seek an appropriate organization such as Easter Seals Project ACTION to fund ongoing production of the booklet and DVD to maximize national use of the protocol.

IV. RESEARCH PROPOSED

Methodology for developing this model assessment protocol includes:

1. Systematic review of the literature related to cognitive, physical, psychosocial, and sensory functional domains necessary to navigate, board, ride, and disembark fixed-route systems.

2. Using the most statically significant (valid) measures found through the literature review, develop a model assessment protocol prototype. This prototype would likely include between one and three brief measures for each of the functional domains of cognitive, physical, psychosocial, and sensory used in navigating, boarding, riding, and disembarking from fixed-route systems.

3. Test and refine the prototype using participants from the Indianapolis Public Transportation Corporation paratransit applicants.

4. Use three other sites to implement and test the revised assessment protocol.

It is important to note that an alternative to this methodology would be the development of new measures of cognitive, physical, psychosocial, and sensory functional domains necessary to navigate, board, ride, and disembark fixed-route systems. However, this would be a very expensive and time-consuming proposition. This research supports strategic priorities II in that it will identify the current state-of-the-science in ADA eligibility assessment and will make available nationally a model assessment protocol for determining ADA paratransit eligibility and III in that this assessment protocol would improve public transportation in general by maximizing cost effective paratransit services.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $427,000. This includes an estimate of the funds necessary to produce a booklet and DVD to accomplish the objectives stated in Section III.

Research Period: This project would take three years including 3 months for review and revision of a draft final report.

VI. URGENCY AND PAYOFF POTENTIAL

According to American Public Transportation Association figures, while paratransit trips only account for approximately 20% of public transportation miles, a trip-by-trip comparison indicates that paratransit costs can exceed a fixed route cost by a factor of ten. Current estimates of paratransit operating expenses in the United States are over $2.5 billion annually. While costs to deliver paratransit services are increasing, many mass transit organizations must make due with smaller budgets.

The direct fiscal benefit of using the Functional Assessment Protocol for Determining ADA Paratransit Eligibility is not known. However, given the ADA mandate that public transportation entities provide alternative transportation services to persons with disabling conditions that prevent them from using a fixed-route system, using the Functional Assessment Protocol could help reduce the number of paratransit riders who, for lack of objective, reliable, and valid measures, use paratransit services when they could safely and independently use fixed-route services.

Use of the Functional Assessment Protocol by transportation agencies would be voluntary. Therefore, initially, the protocol may not be used as widely as hoped. However, the protocol booklet and DVD could be made widely available through an organization such as Easter Seals Project ACTION to maximize public transportation officials’ awareness and use of the protocol.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
This problem fits within the FTA strategic initiative number (1) to increase ridership in that this research effort will help to coordinate and improve the ADA eligibility assessment technologies or methods to ensure that the transportation benefits available to seniors and disadvantaged populations are fully utilized.

This problem fits within the TCRP Strategic Priority III. Continuously Improve Public Transportation in that by improving the ADA eligibility assessment process and outcomes, public transportation agencies will be able to make appropriate decisions about those eligible to ride fixed-route systems and if not realize reduced costs in providing paratransit services at least maximize the chance of meeting the spirit and letter of The American’s with Disabilities Act.

VIII. RELATED RESEARCH

Little research is available related the efficacy of ADA eligibility assessments. Easter Seals Project ACTION funded the development of the Functional Assessment of Cognitive Transit Skills (FACTS) which was tested for reliability and validity. However this assessment was tested on individuals with cognitive disabilities secondary to developmental disabilities and therefore is appropriate for a limited number of potential riders. In addition, Project ACTION has developed a guide for conducting physical functional assessments, but this guide, to our knowledge, has never undergone rigorous psychometric testing. Virtually no research, to our knowledge, has been done to explore the full range of cognitive, physical, psychosocial, and sensory functions necessary to navigate, board, ride, and disembark fixed-route systems.

Pilot data from our research at the Community Mobility and Social Participation (COMPAS) housed jointly at the Indianapolis Public Transportation Corporation, Indianapolis, Indiana and Indiana University – Purdue University of Indianapolis suggests that recommendations base on use of the guide for conducting physical functional assessments published by Project ACTION are no more valid than those recommendations based on professional observations of evaluators who have health care backgrounds and an understanding of the nuances of disabling conditions related to riding fixed-route systems. In addition, early indications of a review of over 1800 articles and reports related to aging, disability, and public transportation, suggests that other than the measures mentioned above, no specific measures have been developed to assess people’s ability to ride fixed-route systems. What our research is most like to find are measures of cognitive function, physical function, psychosocial function, and sensory functions that have been applied to other activities and can be applied to navigating, boarding, riding, and disembarking from fixed-route systems.

IX. PERSON(S) DEVELOPING THE PROBLEM

Drs. Jeffrey L. Crabtree and Michael D. Justiss developed this research problem statement. Both investigators have presented paratransit and transportation alternatives research in both national and international conference settings.

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the product of the two developers, above, in conjunction with formal and informal discussions among officials at the Indianapolis Public Transportation Corporation, other community members, and researchers in the COMPAS Lab (Dr. Crabtree, PI).

XI. DATE AND SUBMITTED BY

This research problem was submitted June 3, 2007 by:
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Michael D. Justiss, PhD, OTR, Co-Invesigator
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I. PROBLEM TITLE

New Markets for Car-Sharing: Strategies, Impacts, and Transit Linkages

II. RESEARCH PROBLEM STATEMENT

In the past seven years, transit agencies from Seattle to Washington, DC have partnered with car-sharing operators with the goals of improving station access, increasing ridership, and providing wider mobility options for customers. TCRP Report 108, Car-Sharing: Where and How it Succeeds provided a comprehensive overview of the development of car-sharing, the geographic and demographic markets where it succeeds, and the impacts on vehicle ownership and travel behavior. It has proved valuable not only to transit agency staff but also to other partners such as local governments, universities, and developers.

While the report concluded that car-sharing overall has a strong role in reducing vehicle travel and boosting transit ridership, it provided little data on the mobility impacts of key submarkets where transit planners need specific information. For example, agency staff often needs to know the impacts of car-sharing on access mode share, on parking demand in joint development projects, and on travel behavior for welfare-to-work recipients.

Since TCRP Report 108 was published in 2005, competition between car-sharing operators has intensified. Before, head-to-head competition only existed in the Washington, DC region. Now, three operators compete in the San Francisco Bay Area, and two in several other cities such as Minneapolis, Philadelphia, Chicago, and Toronto. Transit agencies have little guidance on how to handle these issues – in particular, when to issue an RFP, and how to treat operators equitably without raising legal concerns. In addition, transit agencies have expressed interest in helping extend the sharing concept to bicycles and low-speed electric vehicles (for example, to improve mobility for seniors).

III. OBJECTIVE

Anticipated products would include:

- A website to provide a “clearing house” for car-sharing impacts data (the need for which was documented in TCRP Report 108);
- Guidance on how to estimate car-sharing impacts for specific submarkets
  - business members
  - car-sharing vehicles at transit stations
  - car-sharing vehicles incorporated into development projects
  - welfare-to-work recipients; and
- Guidance on car-sharing procurement when multiple operators wish to provide service.

IV. RESEARCH PROPOSED

The first set of tasks will serve to update the research documented in TCRP Report 108, providing the baseline data on the number of operators, etc. This will set the stage for the following tasks.

Update TCRP Report 108 Findings

1. Update literature review. TCRP Report 108 included a comprehensive annotated bibliography of car-sharing literature. The contractor will update this resource to include more recent research.

2. Update inventory of car-sharing operators and partner transit agencies. TCRP Report 108 listed car-sharing operators and described partnership arrangements with transit agencies. To design the surveys in subsequent tasks, this
baseline data will need to be updated. This task should also discuss experience with new technologies and markets such as pre-paid car-sharing and lease sharing, including European examples, and other "sharing" concepts such as bicycle sharing.

Car-Sharing Impacts

3. **Design clearing house.** The contractor will design and implement a web-based clearinghouse to facilitate the sharing of car-sharing impact studies. This will allow operators and partners to conduct their own surveys according to a common methodology. For example, Arlington County (Virginia), BART District (San Francisco Bay Area), SANDAG (San Diego) and King County Metro (Washington) have all designed independent studies to measure the impacts of car-sharing in isolation. This means that not only are potential synergies lost but also that agencies find it difficult to benchmark their performance against peer systems. The following tasks will provide an opportunity to field-test the clearinghouse in practice. If possible, the clearinghouse should be designed to allow non-US operators and partners to share their data.

4. **Neighborhood car-sharing.** The contractor will assess the impacts of car-sharing in primarily residential and mixed-use neighborhoods, including impacts on transit ridership, vehicle ownership, and travel.

5. **Car-sharing at transit stations.** The contractor will assess the impacts of car-sharing at rail stations and other transit nodes. This will include the extent to which car-sharing is being used as an access/egress mode when the final destination is beyond walking distance. The impacts on transit ridership and revenue are of most interest, along with more general information on changes in vehicle ownership and travel.

6. **Business car-sharing.** Almost all studies of car-sharing impacts to date have focused on residency-based car-sharing or included all car-sharing members without disaggregating the results. While car-sharing at the workplace can also be expected to reduce travel, as employees no longer need to drive to work to have a car available during the day, the impacts may not be comparable to the residential market. The contractor will assess the impacts of business car-sharing, focusing on vehicle travel and transit ridership, and the extent to which employers have reduced or eliminated vehicle fleets. Data will be collected from participating members and companies, where available. Where possible, the results should segment impacts from car-sharing as part of a transportation demand management program and car-sharing as a fleet replacement mechanism.

7. **Car-sharing in new developments.** Cities have often approved lower parking requirements for residential and mixed-use projects that incorporate car-sharing, in some cases as part of transit-oriented developments or planned communities. This is important for transit agencies, as such developments reinforce the use of alternative transportation modes among residents by providing fewer parking spaces. Other cities, such as San Francisco, have mandated the inclusion of car-sharing through zoning codes. Overall, each car-sharing vehicle takes up to 15 private cars off the road, but it is difficult to translate this into decisions on parking and car-sharing vehicle provision, not least because actual adoption rates of car-sharing among residents is uncertain. The contractor will provide guidance on estimating parking reductions and vehicle needs in new development projects.

8. **Low-income members.** Car-sharing is being targeted at low-income residents as part of Job Access Reverse Commute programs in King County, WA and the San Francisco Bay Area. The contractor will assess the impacts of these and similar programs, focusing on overall travel behavior including transit ridership. The contractor will also assess barriers to serving this market, such as lack of Internet access, credit cards, or drivers' licenses and provide any case studies of where and how these are being overcome.

Procurement and Integration

9. **Car-sharing procurement.** The contractor will review strategies for transit agencies and other partner organizations in procuring car-sharing, focusing on instances where there are competing operators.

10. **Parking integration.** The contractor will review experiences integrating car-sharing with parking management strategies, including Parking Benefit Districts and similar programs.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
Estimated funding: $300,000  
Research period: 24 months

VI. URGENCY AND PAYOFF POTENTIAL

Two for-profit car-sharing operators recently received major injections of venture capital funding and have ambitious expansion plans to new markets. The Revolution investment firm became the majority shareholder in Flexcar, while Zipcar received $10 million in new venture capital funding from Benchmark Capital. Denver, Pittsburgh, Austin, and Atlanta are just some of the new potential markets, while established markets can expect to see more competition. Transit agencies urgently need guidance to harness this expansion to best achieve their goals.

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

This project links to the following FTA Strategic Goals and TCRP Strategic Priorities:

- **Increase transit ridership.** Nearly 40% of survey respondents in the previous TCRP research stated that they used transit more often because of their involvement with car-sharing. Partly, this is due to car-sharing’s use as an access/egress mode for the “last mile,” allowing transit to serve destinations that are outside of walking distance. Partly, it is due to car-sharing’s overall impact on reducing vehicle travel.

- **Enable transit to operate in a technologically advanced society.** Car-sharing is a technologically advanced mode of transportation that uses automated web-reservations and self-serve smartcard access.

- **Flourish in the multimodal environment.** Car-sharing helps transit agencies fulfill their role as mobility managers, taking responsibility for multi-modal alternatives to the private auto.

VIII. RELATED RESEARCH

TCRP Report 108 summarizes the relevant completed research. To the best of our knowledge, there is no closely relevant research in progress or pending.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement has been developed by the TRB Subcommittee on Car-Sharing and Station Cars (AP020 (1)), together with Nelson Nygaard Consulting Associates (the contractor for TCRP Report 108).

XI. DATE AND SUBMITTED BY

Submitted on June 11, 2007 by:

Adam Millard-Ball  
Dr. Susan Shaheen  
Chair, TRB Committee AP020, New Public Transportation Systems and Technology
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
Jeff Becker
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 of 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.

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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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Problem Statement

Impact of Universal Pass and Car Sharing on Transit Ridership

Universal transit passes, commonly marketed as Eco passes, and car sharing have been two very successful strategies for increasing transit ridership. Their success where applied implicates the possibility of significantly increasing ridership nationally. Although these two strategies seem unrelated; one is totally under the control of the transit agency while the other is generally operated by private profit or non profit entities and may or may not involve the local transit agency involvement. Rarely are the two strategies used in concurrence, however with more communities seeking to develop transit oriented or transit supportive developments that are dense and vibrant 24/7 communities; a conflict arises between concerns about providing adequate parking and devoting too much land for parking thereby which is contrary to the ambiance desired. In addition to being strategies for increasing transit ridership, they can also be urban development tools that reduce the demand for parking and enable a more transit supportive urban form.

OBJECTIVE

Identify based on the growing body of evidence the elements and strategies necessary for successful universal pass and car sharing programs and the benefits to transit agencies. Also determine the outcomes of implementing both strategies concurrently. The intent of this project is to identify where these strategies should be implemented and the benefits to transit agencies. It is not the intent of this project to provide intelligence to car sharing companies. As a general rule they have defined the market conditions needed to make car sharing work and that information will be needed to complete this project. The intention of this project is to provide information that transit agencies can use to identify opportunities for ridership growth.

RESEARCH PROPOSED

Identify successful applications of the use of universal passes in employment, residential and college settings; determine the elements critical for success and develop an simple model that transit agencies can use to anticipate impacts on ridership, revenues, costs and parking demand.

Identify successful applications of the use of car sharing, identify the role transit agencies can play to facilitate implementation and develop a simple model that transit agencies can use to anticipate impacts on ridership, revenues, costs and parking demand.

Identify the impact in terms of transit ridership and parking demand of implementing both strategies concurrently and the conditions necessary for doing so successfully.
ESTIMATED FUNDING AND RESEARCH TIME

$200,000; 18 months

URGENCY AND PAYOFF POTENTIAL

The success of both strategies indicates that greater application of one or both concepts could significantly increase transit ridership and reduce demand for parking. As more communities are opting for denser mixed use development that is pedestrian and transit friendly, the need for these concepts to facilitate this development pattern is growing daily. Providing a better understanding for transit agencies of the potential as well as tools that transit agencies can apply to assist in decision making will have tremendous and immediate impact on the transit industry.

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

FTA Strategic Goals: Increasing Ridership. These two concepts have demonstrated the potential for increasing transit ridership. Better information that can be used to facilitate more applications can have a significant impact on transit ridership.

TCRP priorities: Place the customer first. The aim if this study is to better address customer needs.

Flourish in the Multimodal Environment. This study could result in a better balance of the use of urban ground transportation modes.

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
1666 K Street NW
Washington DC 20006
Phone: 202-496-4800
FAX: 202-496-4321
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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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

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. TCRP Project B-11, also completed in 1998 and published as *TCRP Report No. 47*, "A Handbook for Measuring Customer Satisfaction and Service Quality,” focused on how to measure customer satisfaction and develop transit agency performance measures.
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

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
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:

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. TITLE: Using Private Carriers to Meet Needs of Transportation-Deprived Individuals

II. RESEARCH PROBLEM STATEMENT or need: In no more than three paragraphs, provide a general description of the problem or need.

Accessible and affordable transportation has consistently been one of the highest priorities in a list of unmet needs as reported by individuals with disabilities in general and also score high on a similar list emerging from the Joint Agency Meetings on Disability conducted by the Nebraska Independent Living Council, the Nebraska Department of Vocational Rehabilitation, and the Nebraska Commission for the Blind and Visually Impaired. Input from the Commission’s Advisory Committee bares this out, as does the increasing demand for the subsidized taxi programs in Lincoln and Omaha. Additionally, recent White House and Governors’ Conferences on Aging studies have also identified the lack of transportation and access to services for elderly and disabled individuals as a serious problem in rural areas across the country. Research conducted by the American Council of the Blind of Nebraska and Project Helping Hand found that while 71.5% of the visually impaired population responding to a transit needs questionnaire thought that intra-city transit services were adequate in Lincoln and Omaha, 82.3% of the respondents specifically cited the lack of evening services and intra-city transit services as a major problem. Furthermore, 97.4% indicated inter-city transportation as a major problem in the state as a whole.

Regarding Inter-city ground transportation: Omaha is important to all Nebraskans, as it is the primary metropolitan base for the state. It is the sole provider of many of Nebraska’s specialized medical services, holds a wide variety of jobs and industry, cultural opportunities, as well as being the primary gateway for air travel to and from the state with 17 airlines servicing its airport (Eppley Airfield). The Lincoln Airport offers only two regional airlines that service the city. This forces Nebraskans to utilize ground transportation travel to Omaha in order to fly out of Eppley Airfield. Compounding this problem, Lincoln recently lost its Greyhound service, which linked it with Omaha and ground service to the western part of the state.

Major differences exist in how federal Americans with Disabilities Act guidelines regarding paratransit services are applied and implemented. There are: inconsistent eligibility and service guidelines within the same service delivery system and across service areas by different ground transportation providers (same service, different rules on who can ride); limitations on times that fixed-route and paratransit services are available; limitations on geographic area served by paratransit services; and the Nebraska Department of Aging senior van system is restricted, fragmented and lacks coordination; which magnifies gaps in the delivery of transportation services at all levels.

III. OBJECTIVE Include a clear, concise statement of the objectives (anticipated products) that are expected to be met by this particular research.

Using our community-based approach to address the problem of inadequate accessible transportation will mean the private sector will fund private carriers to plug service gaps. At the same time, we will work with the formal transit delivery system to bring about improvements, such as a higher level of service coordination and agency networking; elimination of service duplication and the fragmentation inherent in the present system and an increase in ridership. All of this will result in a more integrated portfolio of transit products. Establishing and systematically testing a private funding mechanism to subsidize the cost of private carriers and networking with funders and public and private sector transit providers to address unmet transportation needs and share the cost of transportation for the disabled and elderly will enhance the number of affordable transit options available so riders can more readily and independently carry out daily living activities. A community-based approach educates transit providers, service agencies, riders, potential funders, private business and the general public as to the unmet transit needs of transportation-deprived persons and involves these groups in finding solutions to the problem, rather than assuming the “government” will magically address the issue. The approach provides tax savings for local and state governments. Additionally, private carriers are already licensed and insured, unlike volunteers and specialized transit providers, such as hospitals and nursing homes who do not wish to broaden their services due to higher insurance cost and risk factors.
We will research and document the interaction between system barriers to transportation services (high price set by the Public Service Commission and the cost of vehicle modification and provider insurance), unmet consumer needs, potential funding sources, and provider resources and fleet capabilities at the local level. We will determine the current level of service coordination and test the feasibility and effectiveness of different voucher systems. We will develop a manual that includes a step-by-step guide to establishing community-based transportation models and provide interested communities with hands-on assistance in establishing transit voucher programs. Clearly, this research has the potential for the development of a national model that can be used by other communities.

IV. RESEARCH PROPOSED

Provide a statement of the specific research proposed, how it relates to the general problem statement in Section II and, if possible, the research approach and the tasks envisioned.

We propose to set up and test several subsidized transportation program models. Each model choice would be dictated by the type of community (urban, rural, semi-urban, semi-rural) and the information gained within each community. We will:
1. Identify and review existing pertinent literature.
2. Carry out research to determine unmet community transit needs and the resources available within a particular community.
3. Identify the barriers encountered and work with others to remove the barriers.
4. Set up and test the subsidized voucher programs.
5. Test each model for a prescribed period of time.
6. Analyze the effectiveness of each model.
7. Make any necessary adjustments.
8. Write the manual.
9. Write the final report.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** Include an estimate of the funds necessary to accomplish the objectives stated in Section III. As a general guideline, the present cost for research usually averages approximately $150,000-$250,000 per professional staff-year. TCRP projects typically are in the $300,000-$500,000 range. A detailed budget is not necessary.

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set up 3 pilot programs and off-set transit costs</td>
<td>$150,000.00</td>
</tr>
<tr>
<td>Conduct and analyze research and write reports</td>
<td>$ 75,000.00</td>
</tr>
<tr>
<td>Administration and staff costs</td>
<td>$  56,000.00</td>
</tr>
<tr>
<td>Total</td>
<td>$281,000.00</td>
</tr>
</tbody>
</table>

**Research Period:** Provide an estimate of the period of time needed to complete the research, including 3 months for review and revision of a draft final report.

Two years.

VI. URGENCY AND PAYOFF POTENTIAL

Include a statement concerning the urgency of this particular research. Identify and, if possible, quantify the potential and magnitude of payoff from the achievement of the project objectives. Any institutional, political, or socio-economic barriers to implementation of the anticipated research products should also be identified.

Testing this community-based model is extremely urgent and the payoff potential great as thousands of transportation-deprived persons are, presently, virtually stranded in their communities in this mostly semi-urban and rural state. Additionally, regulatory guidelines set by the Public Service Commission prohibit private carriers from offering any direct discounts, making the use of private transit services cost-prohibitive for the target populations and many service agencies. Furthermore, Lincoln’s mass-transit provider, Star Tran, has distorted the facts regarding their portal-to-portal handi-van service by telling local officials the Americans With Disabilities Act (ADA) guidelines restrict their activities. In fact, ADA guidelines are just that, guidelines. Star Tran could follow the spirit, rather than the letter of the law and broaden their service beyond the minimal standards they have chosen.

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

Categorize this problem statement using the FTA strategic initiatives and the TCRP Strategic Priorities.
The FTA Strategic Priority and research goal under which this problem statement best fits is “Increase Ridership”. The goals of our research are to prove that:

1. affordable, accessible, reliable and efficient transportation will increase ridership; and

2. the use of private carriers, to meet unmet needs of transportation-deprived persons, will work.

The problem statement also best fits into the following TCRP strategic priorities.

1. Place the Transit Customer First: As evidenced by the statement above -- Lincoln’s mass-transit provider, StarTran has distorted the facts regarding their portal-to-portal handi-van service by telling local officials the Americans With Disabilities Act (ADA) guidelines restrict their activities – very often, this provider (and others) does not put the customer first. Our research will prove that doing so will better meet the needs of transportation-deprived persons.

2. Continuously Improve Public Transportation: We will work to improve both Lincoln and Omaha’s handi-van services and in the meantime, we will show that private carriers can, in fact, meet the unmet needs of transportation-deprived persons.

VIII. RELATED RESEARCH If available, provide information on other research—completed, in progress, or pending—that is closely relevant to the proposed problem.

Research conducted by the American Council of the Blind of Nebraska and Project Helping Hand found that while 71.5% of the visually impaired population responding to a transit needs questionnaire thought that intra-city transit services were adequate in Lincoln and Omaha, 82.3% of the respondents specifically cited the lack of evening services and intra-city transit services as a major problem. Furthermore, 97.4% indicated inter-city transportation as a major problem in the state as a whole.

IX. PERSON(S) DEVELOPING THE PROBLEM Provide the specifics (i.e., name, title, address, telephone, and fax numbers) for the person(s) who developed the problem.

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT State whether this problem statement is the product of an individual, a formal committee, or another group.

The problem statement was primarily developed and based upon the transportation research conducted by the American Council of the Blind of Nebraska and Project Helping Hand. The Nebraska Developmental Disabilities Council and Robert Doulas’ involvement in the Governor’s Task Force on Transportation provided additional input.

XI. DATE AND SUBMITTED BY Provide the specifics (see Section IX) of the person(s) who submitted the problem and the date of submission.

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Date of submission:  June 15, 2007

Submit to:

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Transportation Research Board
500 Fifth Street. N.W.
Washington, D.C. 20001
202/334-3089
FAX 202/334-2006
I. PROBLEM TITLE

Maximizing transit performance for sprawled low-density urban areas.

II. RESEARCH PROBLEM STATEMENT

Urban and suburban sprawling is one of the most obvious phenomena occurring in the last few decades. Cities and suburbs expand following a dispersed and decentralized model in order to accommodate the increasing population. This pattern can clearly be observed within the whole range of social classes: from the upscale, rich and exclusive neighborhoods of major cities (like Los Angeles, Houston, etc…) to the underdeveloped realities of low income communities, such as the numerous “Colonias” along the U.S. border with Mexico.

One of the typical characteristics of sprawling areas is the relatively low population density which does not facilitate the development of traditional transportation infrastructures and transit services, creating “car dependent” communities. This problem becomes especially significant within disadvantaged communities, where cars can not be easily afforded and most people basically have no means of transportation.

Recently, innovative and flexible concepts in transit (such as “demand responsive connectors”, “route deviation”, “point deviation”, “zone route”, among others) have been considered by practitioners to respond to the transportation needs of relatively low density areas. However, they have received limited attention from researchers and never considered for large-scale implementations.

III. OBJECTIVE

The overall objective of this research is to maximize the performance and productivity of transit services for low population density areas, for a smarter development of these new/existing communities. We will provide administrators, transit planners and decision makers with tools and guidelines which will help them in the design/revamp of such systems, allowing them to perform tradeoffs between operating costs and service quality much more efficiently.

IV. RESEARCH PROPOSED

The questions answered will be: when and under what circumstances is more efficient to implement what type of transit service?

The proposed research will consist of the following key points:

- Identify, categorize and model the configurations (geometrical shapes, road networks, demand distribution, fluctuation and level, etc…) of the low density areas. A few representative scenarios ranging from “small” to “medium” to “large” service areas will be considered.
- Review on transit performance measures, defined as a combination of operating costs and quality of service provided to customers. A particular attention will be devoted to the definition of transit service quality, which can be a function of several variable and factors.
• Analyze the above mentioned flexible transit services to quantify and compare their productivity among each other and vs. traditional fixed-route services for each considered scenario. A systemic approach to the analysis will also be adopted, considering combinations of connected services whenever appropriate and suggested by the considered configuration.
• Develop handy decision tools which will help in identifying the most appropriate transit configuration depending on the scenario to maximize the overall performance of the system.

The research will be conducted with extensive simulation and regression analyses, with the use of optimization tools whenever appropriate and with an extensive data collection from existing transit systems and practice and past studies.

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

The most crucial phase in determining the success or failure of any project is its design. Transit planners often struggle when having to decide what type of service to put in place in a given area and they often incur in designing errors which are hard, long and costly to fix, establishing systems with poor service quality and/or high operating costs.

The link between the rapidly expanding urban sprawl phenomenon and its inadequacy for the implementation of traditional transit services calls for an immediate attention. Researchers and practitioners need to look for alternative transit solution which would allow for a sustainable development of the communities in terms of their transportation infrastructures and services.

This research will help in identifying solutions to the transit problem in low-density sprawled areas, suggesting the most appropriate services for different scenarios. The current inadequacy of transportation services in most of these areas indicates that there is a lot of room for improvement and therefore a high payoff potential.

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:

• Increasing Ridership: One of the objectives of this research is to maximize the overall performance of transit systems by improving its service quality, which will naturally lead to an increase in transit ridership. The current inadequacy of transit services in sprawled areas is mostly due to the missing connection from the closest stop to the actual customers’ origin/destination point. This is perceived by customers as poor service quality, which will lead most of them to rely on private cars for their mobility needs. The flexibility of many transit services mentioned above can address the problem and improve the service quality. We will investigate the cost-effectiveness of this feature in its different forms.
• Improving Capital and Operating Efficiencies: The product of this research will be a set of decision tools which will contribute to a better decision-making in the planning and design of transit services for low density areas. This will not only quicken the decision process, but also reduce the risk of the investment.
• Place the Transit Customer First: This research will particularly focus on properly defining transit customer service, as the base to characterize transit performance.
Enable Transit to Operate in a Technologically Advanced Society: While this research does not directly focus on technology, we would like to emphasize that a major implementation of flexible transit services would certainly call for an extensive use of new technological tools (such as GPS systems, scheduling algorithms, web-based booking systems, etc...).

VIII. RELATED RESEARCH

SWUTC – FTA: “Performance assessment and comparison between fixed and flexible transit services for different urban settings and demand distributions” – in progress (P.I.: Luca Quadrifoglio)

TCRP B-25: “Guidelines for Evaluating, Selecting, and Implementing Suburban Transit Services” – completed (P.I.: Marlene Connor)


TCRP B-35: “A Guide for Planning and Operating Flexible Public Transportation Services” - pending

IX. PERSON(S) DEVELOPING THE PROBLEM

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Linda K. Cherrington
Research Scientist
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(409)740-4734

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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Tel: 979-458-4171/Fax: 979-845-6481
Submitted on June 15th, 2007

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

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
Research Scientist
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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

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Submitted on June 15th, 2007

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
Methods of Multi-lingual Customer Communications Efforts

II. RESEARCH PROBLEM STATEMENT
Continued population growth in non-English-speaking people groups has resulted in an increased need for a multi-lingual communication strategy on the part of many transit properties. The historic bent toward a single language communication strategy is insufficient to attract new riders whose primary or secondary language is one other than English.

A “best practices” industry-wide study would allow an exchange of ideas that have successfully demonstrated a customer-oriented focus by expanding their communication strategy beyond the normal single language strategy.

III. OBJECTIVE
The objective of this effort would be to develop a “best practices” industry-wide synthesis to supplement efforts at transit properties currently engaged in a multi-lingual communications strategy and provide a basis for efforts in multi-lingual communications strategies at transit properties that currently lack sufficient components of said strategies to address both short- and long-range demographic shifts. The research would include an industry-wide overview of the current practices, case studies on successful and unsuccessful components as well as ideas for future implementation possibilities.
IV. RESEARCH PROPOSED
Survey of 30 – 50 transit properties regarding multi-lingual communications efforts including collection of examples of communications and results (change in ridership, customer satisfaction, etc.). Case studies of successful multi-lingual communications efforts (3 – 5). Documentation of “things to be avoided” as well as barriers overcome and recommendations on corrective actions taken would be included.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
Recommended Funding: $300,000
Research Period: 18 – 24 months

VI. URGENCY AND PAYOFF POTENTIAL
As an increased number of non-English-speakers utilize transit there is an urgency to effectively communicate with these customers. Insufficient communication has the potential to deter non-English-speaking customers from utilizing transit. A better understanding of customers has the potential for effective communication between non-English-speaking groups. The payoff potential can lead to increased transit ridership. While TCRP Synthesis 68 Methods Of Rider Communication provided information on methods of rider communication, its respondent group, case studies and focus were primarily on communications with English-speaking groups. Few of the references included discussions of communications with non-English-speaking groups. The result is a gap in the overall communications research that can be filled by this study.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
Identification of “best practices” methods of multi-lingual customer communications efforts would allow the transit industry as a whole the opportunity to increase ridership through improved information dissemination and reduced barriers to ridership adoption, improve operating efficiencies through maximizing ridership for service allocated and improve safety and emergency preparedness especially with a customer base that is not ideally informed and/or communicated with at present. Improved multi-lingual customer communications would renew emphasis on “placing the customer first” and continue to improve transit as an option in today’s multi-modal society. Improved multi-lingual communications could provide additional opportunities for partnerships in the communities in which transit operates. Increased use of transit by multi-lingual customers in response to improved multi-lingual customer communications would reduce overall vehicle emissions thereby protecting the environment. This type of leadership effort would support not only local but national goals.
VIII. RELATED RESEARCH
Previous studies have concluded that effective communication has the potential to increase transit ridership and maintain existing riders (e.g. TCRP Synthesis 68: Methods of Rider Communication). A more thorough literature review may yield additional findings supportive of this position.

IX. PERSON(S) DEVELOPING THE PROBLEM
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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT
The problem statement is the product of individuals. The problem statement was developed following examination of the multi-lingual ridership on several bus routes and the difficulty in communicating information regarding fare, route and schedule changes as well as other information to these individuals. A review of the existing literature turned up little information that provided immediate assistance. Since this is an issue that many transit properties are facing or will face in an increasingly multi-lingual culture, the problem statement was developed for consideration.

XI. DATE AND SUBMITTED BY
Jim Archer and Jamaal Schoby
June 15, 2007
TCRP Problem Statement

Effective Coordination of BRT and Local Transit Service on Arterial Corridors

Research Problem Statement and Research Proposed

A number of communities are contemplating the introduction of Bus Rapid Transit Systems on arterial corridors along which there is already existing local and/or limited stop and/or express bus service. This strategy can be very effective since there is already a built-in transit service market in such corridors and there is considerable value in increasing the quality of service to existing transit customers. However, an “overlay” BRT system introduces a number of fare collection, service level, marketing, scheduling and operating challenges. For example, a customer waiting for a bus on a short trip is likely to choose the next bus to stop at the stop, regardless of whether it is a BRT vehicle or local vehicles.

This being the case, it is difficult, if not impossible to introduce a different fare collection system, such as off-board fare collection, for the BRT service. Even more difficult is service design. Service level should be planned not only for the BRT, but also for the corridor as a whole. Therefore, the first question is whether to leave the underlying local and overlay a BRT service on top, or replace both local and limited with a BRT. For example, the combination option would include a local service with low frequency and closely spaced stops overlaid complemented by frequent Rapid service with far spaced stops. The BRT only option might include a Rapid service with increased frequency and stop spacing between that of the local and a combination Rapid. Which of these two options would provide the desired service level at lower cost? Which would generate higher ridership?

If the service option of complementary local and BRT is selected, how should planners coordinate service design to minimize operation cost and maximize level of service and ridership response? With different scheduled running times on routes, there is the likelihood that BRT buses will pass local buses in service. The optimal set of departures from route terminals to minimize customer wait and travel times is not obvious. Further, while it has been demonstrated that “branding” is an important characteristic of BRT services, merchandising a local and a BRT product in a single corridor without implying that the local service is “inferior” (as opposed to providing other mobility functions) is difficult.

There are also command and control issues with mixed operation in corridors. If a bus controller observes bunching, what are appropriate strategies for equalizing the gap between buses? Should the control system treat BRT and other services as distinct entities or attempt to smooth operations between vehicles regardless of type of route?
Suffice to say, a transit operator has several challenges in making BRT work on an arterial corridor that also has local, limited stop or express services as well. We recommend that there be some research and identification of “best practices” in planning and management of various service types in a single corridor. At present, there is no body of research available to assist in making these strategic and tactical decisions.

**Research Objectives**

- Identify methods to maximize total user benefits of all services in a corridor with BRT and other types of operations
- Publish some practical guidance on the design and operation of BRT services in such corridors including establishing stopping patterns and headways, scheduling operations/dispatching, fare collection, marketing/promotion and command and control.

**Previous Research**

To our knowledge, there has been no documented work done in this area.

**Estimate of the Problem Funding and Research Period**

A budget of approximately $300,000 is proposed, with the research to be done over 18 months.

**Urgency and Payoff Potential**

With a sizable number of transit systems initiation bus rapid transit initiatives, this research problem statement is quite timely.

**Relationship to FTA Strategic Goals and Policy Initiatives and TCRP Strategic Priorities**

This proposed research is consistent with the TCRP strategic priorities of Placing the Customer First and Continuously Improving Public Transportation

**Process Used to Develop Problem Statement**

This research proposal was one of several to emerge from a workshop on research needs in Bus Rapid Transit held in May, 2005 sponsored by the Bus Transit Committee of the Transportation Research Board.
Submitted By

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This is for identification purposes only. The actual problem statement development was assembled by several persons.
I. PROBLEM TITLE

Public Transportation in Campus Environments

II. RESEARCH PROBLEM STATEMENT

College and university campuses, along with medical centers, business parks, and mixed-development centers present special transportation needs. These needs are often predicated based on certain overwhelming factors, such as a large number of users who do not have access to a motor vehicle, limited or expensive parking, congested surface streets, circulatory restrictions, pedestrian-oriented layouts, and satellite arrangements requiring efficient connections. Public transportation can thrive in these types of environments, particularly if services are efficient, frequent, fast and safe. A number of excellent cases exist, such as Cornell University in Ithaca, New York, Clarian Health Center in Indianapolis, Indiana, and West Virginia University in Morgantown, but a database of case studies has not been developed. A better understanding of how public transit manages to be successful in these environments may help transit agencies, along with planning organizations, to better align transit services with potential users. A study may also provide guidance on orienting development – and development patterns – toward transit.

III. OBJECTIVE

One objective of this research would be to develop a database of campuses and their public transit systems, including campus and system characteristics, statistics on the surrounding communities, measures of the performance of the campus transit systems, parking supply and demand, roadway capacity, circulation and congestion information, and other pertinent data, such as campus growth measures. A second objective of the research would be to identify exemplary cases worthy of a closer examination, such as a unique form of transit service (e.g., Morgantown, West Virginia) or very high patronage relative to community size (e.g., Ames, Iowa). A third objective of the research would be to perform several case studies, focusing on site-specific parameters, discussions with local planners and operators, identifying integrated efforts between campus administrators and the surrounding community, and any special studies that enhanced the development of transit services.

IV. RESEARCH PROPOSED

The tasks envisioned for the proposed research would include:

1. A literature review of campus transportation studies, emphasizing U.S. efforts.
2. An overview of international efforts in campus transportation planning.
3. The development of a database of campuses and campus transit systems, with special attention to:
   - Campus characteristics (number and types of users, size, land uses)
   - System characteristics (modes, fleet, patronage, costs, service parameters)
   - Community data (area, population, age distribution, incomes, employment)
   - System performance (effectiveness, productivity, efficiency)
   - Parking supply and demand (spaces, costs, restrictions, occupancy, accumulation, turnover)
   - Roadway data (campus cordon volume and capacity, circulation issues, congestion measures)
   - Campus history (growth, transit service changes, patronage changes)
4. An identification of exemplary campus environments in which public transit thrives (i.e., high patronage, significant transit mode split, recovery of operating costs, integrated system).
5. Case studies of campus transit systems, potentially including colleges and universities, medical centers, mixed-use developments, and other activity centers, along with their surrounding communities.
6. An assessment of the successful elements of these systems, such as service parameters, compensation for limited parking, and innovative funding.
7. A prognosis or plan for incorporating the successful elements of campus transit systems into general, urban transit systems.

The study may need to be delineated according to campus or community sizes, thereby distinguishing large campus-small city combinations from small campus-small city, large campus-large city, and other combinations.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $200,000-250,000.

**Research Period:** 18-24 months.

VI. URGENCY AND PAYOFF POTENTIAL

There is a heightened level of interest in transit-oriented development (TOD). Numerous campus environments in which public transit is successful were in existence long before the enlivened interest in TODs, however. There have been few studies of campus transit, however, potentially ignoring an arena that could provide lessons for making transit successful in other environments. Guidance on TOD may exist within the arrangements that have been made for integrating transit services into campus environments. The payoff from this research may be in the form of strategies that could enhance the role of transit in the general urban landscape. One barrier may be the notion that campuses feature special users who can be targeted, and that strategies that work for these groups may not work elsewhere. A second barrier may be the notion that campuses can limit motor vehicle access, thereby increasing the criticality of transit. That is, one perspective may be that such restrictions cannot be readily duplicated elsewhere. A third barrier may be in the difficulty of replicating campus transit funding sources, which may in many cases come from campus user fees.

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

FTA Strategic Research Goals

**Increasing ridership** – The proposed research would directly address this goal by identifying and examining successful transit operations in campus environments. The findings may serve as guidance for successful transit operating – user – land use arrangements that feature high levels of patronage.

**Improving capital and operating efficiencies** – The proposed research would directly address this goal by identifying campus transit systems that feature high levels of capital and operating efficiency. Case studies would investigate the characteristics, operating aspects and planning processes of these systems.

**Improving safety, security and emergency preparedness** – The proposed research would not address this goal, although certain systems, such as Morgantown’s Group Rapid Transit, may be recognized for their extremely strong safety and security records.

**Protecting the environment and promoting energy independence** – The proposed research would directly address this goal in working toward a better understanding of environments in which transit can be successful. Improved transit services in communities that foster transit use can lead to reduced automobile dependence, leading to energy independence.

TCRP Strategic Priorities

**Place the transit customer first** – The proposed research would indirectly address this goal through case studies in which customers may have been incorporated into service planning and decision-making.

**Enable transit to operate in a technologically-advanced society** – The proposed research would not directly address this goal.

**Continuously improve public transportation** – The proposed research would directly address this goal, as noted above under the FTA Strategic Research Goals.

**Flourish in the multi-modal environment** – The proposed research would directly address this goal, particularly in case studies of successful campus transit systems in which transit thrives in mixed-mode environment of automobile use, limited parking, pedestrianism, and other non-motorized forms of transit.

**Revitalize transit organizations** – The proposed research would indirectly address this goal in working toward strategies for increasing patronage, and enhancing capital and operational efficiency.
VIII. RELATED RESEARCH

The proposed research would build on the findings of TCRP Project H-05, Identification of Research Needs to Increase Transit Ridership, TCRP Project H-27, Transit-Oriented Development: State of the Practice and Future Benefits (along with H-27A), and TCRP Synthesis 39, Transportation on College and University Campuses. The proposed research may also be related to TCRP Projects B-09, Market Segmentation Strategies to Increase Transit Ridership, B-11, Customer-Defined Transit Service Quality, B-15, Characteristics of Urban Travel Demand, H-03, Policy Options to Attract Auto Users to Public Transportation, and H-04, Transit Policy-Related Research (multiple studies). The contractor would be advised to consult these studies in developing the research plan, and to integrate relevant findings into the investigation.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

The problem statement was conceived and developed by the author, based in part on discussions with members of the Advanced Transit Association, the Committee on Major Activity Center Circulation Systems, and colleagues at West Virginia University.

References


XI. DATE AND SUBMITTED BY

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June 15, 2007

Submit to: Christopher W. Jenks
Director
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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
TCRP

Problem Statement

I. PROBLEM CATEGORY-
   Improving Capital and Operating Efficiencies-
   Maintenance and Operations

II. PROBLEM TITLE-
    Rail Vehicle Technical Specifications Manuals Development

III. RESEARCH PROBLEM STATEMENT
    Technical specifications for commuter rail, heavy rail rapid transit, and light
    rail vehicles have changed considerably over the past ten years as new rail
    cars and locomotives have entered service and older rail cars have been
    overhauled, revitalized, and retrofitted with systems that employ advanced
    technologies. It is imperative that comprehensive technical reference
    materials addressing these changes be developed and periodically updated
    to reflect the technical specifications of the nation’s locomotive and rail car
    fleets.

    Members of the APTA Rolling Stock Equipment Technical Forum (RSTEF)
    canvassed rail car manufacturers, car maintenance and overhaul
    specialists, car systems manufacturers, engineering consultants, and APTA
    staff about their rail car technical information needs. Industry professionals
    have stressed that the creation of comprehensive rail car equipment
    technical specifications rosters is important for the industry. Such
    manuals, illustrating all technical aspects of rail cars and locomotives,
    would provide excellent reference materials for anyone in the industry who
is involved in the operation, maintenance, manufacture and overhaul of rail vehicles.

The rolling stock technical specifications rosters provide useful resource information for the industry. The effectiveness of this information would be enhanced by use of a common electronic format for all three modes (commuter, heavy and light rail) to the extent possible, and with use of common information sorting tools. For example, with such a roster in place review of HVAC systems could be done industry-wide and sorted by supplier, capacity etc. The information could be used by operating agencies planning rehabilitation programs, suppliers planning product improvements or new products, for specification development, etc.

Rosters would be useful in new start and expansion efforts as planning tools. For example, with sufficient information included in the roster(s) static clearance requirements, seating and standee capacity, power requirements etc could be investigated.

IV. **Objective**

The objectives of this proposed research are-

2. The updating of the Commuter Rail Vehicle Technical Specifications Roster.
3. Creation of a comprehensive Light Rail Vehicle Technical Specifications Roster

New and updated technical specifications manuals will assist industry managers in their efforts to improve capital and operational efficiencies through the following-

- Enhance the knowledge among car builders, overhaul contractors, rail car system equipment manufacturers, consultants, and the transit operators, concerning the overall specifications of all rail car classes, and their associated systems, components and sub-components.

- Enhance communications among operators who share common equipment.
**Financial Benefits Realized-**

1. **Maintenance Benefit-**
   Utilizing the reference manuals, rail equipment operators can learn which other railroads or transit agencies within the industry are utilizing similar types of rail car systems and components. The operators experiencing maintenance, and operational issues on similar types of rail vehicle components and sub-components, can communicate with their colleagues, and learn about the solutions that were developed on rail car systems on other properties throughout the industry. This can ultimately save manpower and materials costs as operators do to attempt to solve technical problems on certain car systems that were already accomplished by other properties.

2. **Material and Inventory Control-**
   - Rail vehicle operators can also use the manuals to research properties that are storing and utilizing the same rail car system parts and materials. Utilizing this knowledge, agencies can work together to jointly place orders for necessary replacement items with manufacturers. This can help to overall lower costs. Railroads and transit agencies can also swap inventory, and exchange spare parts for similar car systems.

3. **Rail Car Design, Construction, and Overhaul-**
   - Rail car designers, manufacturers, car overhaul vendors, and vehicle systems manufacturers, can reference the technical specifications manuals to learn what types of cars and related car systems are being utilized throughout the industry. This knowledge has already assisted rail car manufacturers and car system overhaul specialists during the writing of car specs and procurement of materials.

4. **Safety Devices-**
   - Rail car operators, who are in the process of purchasing new rail cars, or overhauling their existing fleet, can research what kind of safety and anti-terror devices are being incorporated into rail cars throughout the industry. Designers, manufacturers, car overhaul vendors, and vehicle systems manufacturers, can also benefit from this information.

V. **Research Proposal**

Thus far, a great deal of work has been accomplished by RSETF volunteers to create technical specifications rosters for heavy rail rapid transit cars
and commuter rail locomotives and cars. This work has been conducted over the past 17 years. The publication and periodic updating of such comprehensive manuals has been a major undertaking. Databases have been created that analyze a rail car’s various systems from major components to sub-components and hardware. Unfortunately, RSTEF members have found it difficult to continue this successful program solely on a voluntary basis. This is particularly the case considering the fact that the Forum is obligated to work on several other important projects for APTA.

The RSETF is now working to develop new rosters for rapid transit cars, to update the commuter rail roster, and develop and publish a new light rail and street car roster. Because of the comprehensive volunteer work involved in this project, the RSETF is looking for financial assistance to continue this important work.

Under this project, a contractor would be retained to continue an existing program that has been conducted totally on a voluntary basis. The following tasks will be performed:

1. Task One

Create a new Roster of North American Rapid Transit Cars.

There have been considerable technical enhancements added to systems aboard heavy rail car fleets over the past 17 years. These have included the introduction of cars that incorporate advanced technologies into various systems and related components. Therefore, the RSETF is presently planning to update this roster in the near future.

A contractor will assist RSTEF members as they develop a new roster. This work will entail-
- An industry survey with the goal of soliciting opinions as to the formatting and information to be included in the new roster.
- Industry survey of new technologies that have been incorporated into cars. This will establish what new categories will be included into the roster.
- Establish the electronic format for the roster.
- Conduct a field survey of heavy rail properties for car systems technical informational input into the roster.
- Publishing of the roster.
Project Status- 1993 Roster of North American Rapid Transit Cars

In 1990, members of the RSETF developed a database that analyzed the heavy rail cars and their various systems and associated components in the following 15 categories. Within each of the sections, the specifics of the particular system were itemized. The final product broke a rail car down into 345 specific items for reference.

1) General Car Information
2) Overall Technical Car Specifications Information
3) Performance Characteristics
4) Carbody Specifications
5) Friction Braking System Specifications
6) Truck and Suspension System Specifications
7) Coupler and Draft Gear Technical Specifications
8) Locomotive Propulsion Specifications
9) Miscellaneous Electrical Equipment Specifications
10) Train Control / Operational Information
11) Lighting System Specifications
12) Door System Specifications
13) Communication Equipment Specifications
14) Heating, Ventilation and Air Conditioning (HVAC) Specifications
15) Passenger Amenities System Specifications

After the database was created and finalized, it was sent to the various transit operators throughout the U.S. and Canada. Information provided by the operators was input into the database. Utilizing the database, APTA created a reference document for the industry. In 1993, APTA published the “Roster of North American Rapid Transit Cars.” 14 operators in the U.S. and Canada had each of their particular car classes listed in the roster.

2. Task Two

Update the 2001 Commuter Rail Vehicle Database.

There have been considerable changes to the locomotive and car fleets within the past six years. Therefore, the RSETF is now planning to update this manual. This will require field work and a considerable amount if follow up to ensure that information is complete and accurate.

A contractor will assist RSTEF members as they update the existing roster. This work will entail-
Industry survey of new technologies that have been incorporated into diesel-electric and electric locomotives, multiple unit electric cars, diesel multiple unit cars, coaches and cab cars. This will establish what new categories will be included into the roster.

Conduct a field survey of heavy rail properties for locomotive and commuter rail car systems for technical informational input into the roster.

Publishing the updated roster in its present electronic format.

**Project Status - 2001 Commuter Rail Vehicle Database**

In 1997, the RSTEF started to work on similar databases that address the technical specifics of commuter rail equipment. Because of the various types of equipment being utilized by commuter railroads, this became a monumental undertaking. Twenty one separate databases were created to address the technical specifications for each of the following categories—diesel-electric and electric locomotives, electric multiple unit cars, diesel multiple unit rail cars, coaches and cab cars. The technical expertise of RSETF members was utilized to accomplish the task of finalizing the databases. The databases were sent out to various commuter rail operators for technical specifications input. Team members worked with APTA staff to ensure that all of the commuter railroads provided as much technical information as possible for a new reference manual. In 2001, the “Commuter Rail vehicle Database” published by APTA. This new manual lists the technical specifications of all rail cars and locomotives for 18 commuter rail properties. This comprehensive manual gives over 500 pages of detailed equipment information, and is also available from APTA on a CD-ROM.

- **2008 Light Rail Vehicle Technical Specifications Roster**

There has been enormous growth in light rail and street car development throughout the industry. Thousands of new cars have incorporated new technologies and safety equipment. Up to this point, a comprehensive technical specifications roster has not been created for light rail and street car classes. Therefore, the RSETF is presently planning to create this roster in the near future.

**Project Status - Light Rail Technical Specifications Roster**
In 2003, a preliminary database was developed for light rail vehicles. Presently, RSETF members have not been able to continue on this work without assistance.

A contractor will assist RSTEF members as they develop a new roster. This work will entail-

- An industry survey with the goal of soliciting opinions as to the formatting and information to be included in the new roster.
- Industry survey of new technologies that have been incorporated into cars. This will establish what new categories will be included into the roster.
- Establish the electronic format for the roster.
- Conduct a field survey of heavy rail properties for car systems technical informational input into the roster.
- Publishing of the roster.

VI. Estimate of the Problem Funding and Research Period

Thus far, the work to develop the original Heavy Rail and Commuter Rail rosters were accomplished with voluntary work. Thus no costs have been incurred.

Task 1: 400 man-hours  
Task 2: 400 man-hours  
Task 3: 400 man-hours  
Interim and final reports: 200 man-hours  
Total: 1400 man-hours ($50,000)

VII. Urgency and Payoff Potential -

The urgency associated with the proposed research is viewed as the mitigation of the penalty paid in efficiencies lost to the industry for each year that the roster work remains incomplete.

The payoff potential is anticipated as high. A partial list of payoff areas is provided below:

- improved operating efficiency through operator-to-operator communication, enhanced joint procurement opportunities, vehicle retirements as sources for spare parts, recognition of special features (i.e., crashworthiness) in the roster(s), development of procurement and rehabilitation specifications.
VIII. **Relationship to FTA Strategic Goals and Initiatives and TCRP Strategic Priorities** –

All five of the TCRP strategic priorities would be supported by the proposed research.

Submitted by:

Paul Messina, Chair, APTA Rolling Stock Equipment Technical Forum

Philip Strong, PS Consulting

June 13, 2007
TCRP Problem Statement

I. PROBLEM TITLE

Wireless Power Transmission-Remote Vehicle Charging (WPT-RVC) -- A New Platform for Transportation Technology

II. RESEARCH PROBLEM STATEMENT

WPT-RVC Creates Bridge and New Growth Platform for Renewable Energy Sources for Transportation

Transportation today remains the largest single sector of the US economy where no significant displacement of fossil fuels as the primary energy source has occurred. Yet there is a unique and unrealized potential synergy that exists between renewable energy, energy storage and electric transportation. Wireless power transmission (WPT) becomes the common denominator and strategic enabler in this transition from fossil fuels for transportation to renewable energy sources. Wireless distributed power for transportation will enhance the smart grid of the future by creating a potential new growth platform for innovative schemes and multiple applications for energy storage, management and transportation security.

Solution to Oil Energy Dependence, Global Climate Change and Pollution

US dependence on foreign oil, global climate change, eroding air quality due to harmful emissions and pollution continue to loom as unmet challenges and opportunities. WPT will enable public transportation systems the same range, power, mobility and maneuverability currently enjoyed by internal combustion engine-based transport systems with the advantages of a scalable all-electric, non-polluting transportation platform with viable near-term bridges to a renewable energy-based transportation system.

Growth Platform Technology for Electric Drive Transportation with Multiple Transit Applications

WPT-RVC’s advanced transport technology uniquely fuses the electricity-transportation-technology triad, creating the potential for emission-free breakthroughs and practical transport technology applications with clean and renewable energy. It provides a near-term systems’ approach to clean, intelligent, multi-modal mass transportation and a bridge to an ultra-smart and secure energy-transportation and remote-monitored grid network. WPT-RVC offers a scalable path for integrating transportation innovations including but not limited to: HOV/BRT, ITS, electronic guidance, power line communications and enhanced public transportation security.

III. OBJECTIVE

The anticipated research products are analyses of the WPT-RVC technology as a means to power a range of electric drive technologies for transit or rail use. This research will be the precursor to a demonstration of the WPT-RVC platform technology in a public transit-based bus or rail application.

Overview of the WPT-RVC Platform Technology

What is it? Wireless power transmission for automatic replenishment of vehicle energy storage.

What does it do? Wireless power transmission charging system for clean transportation vehicle modes.

Result: Vehicle system with automatic constant “refueling,” no attendants, no driver intervention, no off-line recharging and unlimited vehicle range with potential for mating with renewable power sources and data links.

WPT-RVC Description

Wireless Energy Transmission-Remote Vehicle Charging (WPT-RVC) is a transportation technology that replenishes onboard vehicle energy storage systems with electrical energy in the form of microwave power beams transferred cleanly, safely, silently, securely and unobtrusively from a fixed or mobile source to a remote stationary or mobile electric vehicle. The vehicle could be either hybrid electric or all-electric. The power grid is the initial primary energy source (and could eventually be mated with renewable energy sources) BUT installation of WPT-RVC occurs above both roadway and sidewalks using power transmitters on existing power line (utility) poles or stand-alone poles in conjunction with extant infrastructure, thus reducing costs, construction and inconvenience. The specific design features of WPT-RVC ensure safety of vehicle occupants, pedestrians, animals & inanimate objects by providing continuous monitoring of wireless power transmission to the vehicle during recharge. Coded signal ID, electronic communication and wireless power recharge operate in a pole-mounted, grid-based network ensuring a constant direct data link to ensure a safe/secure and constant two-way information access to the vehicle. WPT-RVC safety & security systems include: encrypted link-up, power signal guidance,
line-of-sight transmission, locked two-way communication, energy packet transfers with built-in acknowledgement gate-check before continuing, and fail-safe shut down of transmitting power hardware.

Two WPT-RVC transportation research applications include:

- Analysis of WPT-RVC system while public transit vehicle is in motion.
- Analysis of WPT-RVC system for stationary public transit vehicles at an energy recharge station.

IV. RESEARCH PROPOSED

The two WPT-RVC applications to be investigated as part of this research include:

- Analysis of WPT-RVC system while vehicle is in motion.- a commercial public transportation bus or similarly sized vehicle that can be used in a city application
- Analysis of WPT-RVC system for stationary vehicles at an energy recharge station - a public transportation bus or vehicle that is housed or curbside overnight or between morning and evening rush hours.
- Evaluation of both the stationary and mobile recharge vehicle cases to determine the best technical and cost-efficient approach to achieve wireless recharge.
- Potential research areas of interest of WPT-RVC system include:
  - Vehicle platforms for transmission/receipt of microwave power and data
  - Roadway infrastructure for transmission/receipt of microwave power and data
  - Utility/grid-connected microwave power and informatics
  - Telematics & intelligent transportation systems (ITS) convergence
  - Renewable energy-based & grid-connected systems (battery, capacitor, flywheel, fuel cell, etc.)

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $675,000 to $750,000

Research Period: 18 to 24 months

VI. URGENCY AND PAYOFF POTENTIAL

“Electric drive systems are appealing to transit because they offer the promise of reduced or even zero vehicle emissions; increased efficiency; enhanced performance; reduced fuel use; quiet operation; and, the potential for lower maintenance costs.”


The WPT-RVC is a scalable technology that enables the rapid advancement of electric drive technologies for public transit applications across bus, shuttle, trolley and rail systems. It is transparent to pedestrians and motorists, noiseless with no harmful pollutants released, and safety features included. The WPT –RVC system improves vehicle performance in terms of life cycle costs, longevity, reliability, noise, emissions, and vibration. It creates a real bridge to renewable energy sources for transit applications.

The environmental improvements, ridership enhancements, energy independence, climate change, and technology growth platform benefits cannot be underestimated.

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

The WPT –RVC system is consistent with and supportive of FTA strategic research goals and TCRP strategic priorities.
WPT-RVC protects the environment and promotes energy independence by advancing electric drive technology and creating a path for incorporating renewable energy sources.

It meets the FTA strategic research goals for Protecting the Environment and Promoting Energy Independence as well as Improving Safety, Security and Emergency Preparedness:

WPT-RVC is a paradigm shifting technology that reduces petroleum consumption, reduces emissions, promotes energy independence and fosters the introduction of economical and environmentally friendly transit vehicles. The WPT-RVC system also allows for remote monitoring and enhanced security features.

It also meets the two TCRP strategic priorities - Enabling Transit to Operate in a Technologically Advanced Society by integrating state of the art technology and serves as a technology platform for Continuous Improvement in Public Transportation.

VIII. RELATED RESEARCH
Currently, there is no comparable wireless power transmission remote vehicle charging research that is occurring in the public transit arena. There has been some general research conducted in the defense and homeland security areas but it has not focused on transportation.

IX. PERSON(S) DEVELOPING THE PROBLEM/

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT
This problem statement is the product of a teaming arrangement among Dr. Parise (patent holder) and his team, Messrs. Ferri and Adragna, and institutional partners, Raytheon and AECOM.

XI. DATE AND SUBMITTED BY
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I. PROBLEM TITLE
Lightweight and Cost-Effective Thermoplastic Composite Materials and Manufacturing Technologies for Mass Transit

II. RESEARCH PROBLEM STATEMENT
Weight reduction and increased energy-efficiency in mass transit buses, light rail and light/heavy trucks has a direct benefit in terms of reduced fuel consumption, less road wear (due to lighter weight), less maintenance and increased durability. Several states have imposed stringent weight requirements on mass transit buses. For example weight reduction of 3000 to 7000 pounds is almost certain to be mandated in the states of California and New Jersey. It is logical that mass transit companies will need to incorporate technologies that lighten mass transit.

Millions of dollars are spent annually in maintenance and parts replacement due to corrosion and cracking. Reducing the noise (sound) and vibration (quieter buses, rail and trucks) is assuming increased importance due to increased noise pollution concerns. There are several key components on existing mass transit that need replacement and retrofit. Also issues of part interchangeability on and among buses need to be addressed along with modular concepts that would reduce tooling costs.

Safety of transportation is becoming vital. As mass transit systems in a global context come under increased threat due to terrorism, vandalism, fire, blast and related events, the materials and components used in these systems must be able to resist and withstand the loads and environments encountered in such unforeseen events. The structure must be able to provide sufficient deformation resistance to enable passengers to safely exit the structure and/or for emergency personnel to access the same.

As roads and city environments rapidly change, mass transit systems must be able to rapidly reconfigure to their new and revised environment. The vehicles must possess ease of assembly/disassembly and ease of maintenance as examples of such factors. Increased multi-functionality, readily modularized designs and ability to integrated sensors and safety devices are becoming increasingly important. Weight, cost, sound dampening, safety and uniqueness of approach are all prime requirements.

III. OBJECTIVE
The objectives of this research are: (a) To develop advanced composite materials (emphasis on thermoplastic composites) and manufacturing technologies that will make structural components in mass transit buses, light rail and trucks - lighter, cost-effective, damage tolerant, easier to maintain, possess improved sound and vibration dampening, lower corrosion, fire resistant and energy efficient; (b) To develop the design, analysis, and manufacturing prototypes with form-fit function and performance that will readily enable technology ; (c) To develop the base science of advanced materials that will add to the knowledge-base of advanced materials and innovative cost-effective manufacturing; and (d) to create the future workforce for transportation technologies by way of trained graduate and undergraduate students, including minority students.

IV. RESEARCH PROPOSED
We propose research and development of thermoplastic composite materials and product forms and to develop and demonstrate fabrication methods for molding these materials into components for use in buses, light rail, light and heavy trucks, and other mass transit applications. The ultimate purpose is to demonstrate that these technologies can provide lower cost, lighter weight, increased safety and improved performance structures for mass transit applications.

The UAB team has been developing unique low-cost thermoplastic materials and fabrication technologies. New solutions have emerged that hold promise to produce lightweight, low-cost thermoplastic composite structures with excellent potential for structural load bearing, improved safety against events such as fire and blast, and capable for high rate of manufacturing (See Related Research Section VIII). New hot-melt impregnation technologies and process models developed by our team provide the capability to combine various high strain-energy fibers with a wide variety of tough thermoplastic polymers to produce low cost (<$2/lb) composite products.

In brief, continuous reinforced tows are pultruded through a heated die during which the individual filaments are wet-out with the thermoplastic resin such as polypropylene (PP), polycarbonate (PC), and nylon (Figure 1). The wet tow is cooled and may be chopped into pellets of desired length at the end of the line, maintained as continuous tow rods, or may be woven into tape form. If pelletized into long fibers, the resulting product has properties of superior strength and toughness compared to unreinforced or short fiber-reinforced thermoplastics. These materials can be fabricated into continuous and long fiber composite structures using low cost fabrication techniques, such as extrusion/compression molding and vacuum thermoforming, to name a few processes. As seen in Figure 2 the sound and vibration dampening characteristics of these materials is several orders of magnitude higher than traditional metals used in present mass transit systems.

In this proposed research we will conduct full cycle design, analysis, manufacturing, prototyping and component demonstration for form-fit-function in conjunction with our bus partner, North American Bus Industries (NABI), Anniston, Alabama. The goal is to realize weight savings in excess of 35% and significant life-cycle cost savings along with adding value in terms of safety and performance. Candidate components identified for such developments include, but are not limited to; (a) Belt guard on the engine; (b) Engine access door on the interior of the bus which needs fire-stopping function and a good seal; (c) Front wheel box; (d) Rear engine access panels on the exterior; (e) Engine grill on side of bus- now a stainless mesh; (f) Various side access panels; (g) Top hinged covers over CNG and other items; (h) Driver enclosure; (i) Flooring panels; (j) Battery carrier; (k) Fuel conduit cover-interior part-currently steel; (l) Electrical and equipment trays; (m) Steel handles on doors and (n) Heavy thermoset interior covers.

The specific research tasks are to: (a) understand existing design and performance requirements for various candidates; (b) develop material and product forms for incorporating lightweight materials; (c) conduct full-cycle design, process modeling and simulation; (d) perform materials characterization (e.g. fatigue, vibration/sound dampening, strength/stiffness, wear resistance, thermomechanical characteristics) analysis; (e) generate realistic cost-models to project technology transfer and manufacturing in the US; and (f) to create future workforce for transportation technologies by way of trained graduate and undergraduate students, including minority students.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** The funding request under this proposal would be $500,000. The breakdown of the funds (including indirect (overhead) costs) are anticipated as follows:

(a) Personnel and Staff: $95,000
(b) Graduate and Undergraduate Student Researchers: $110,000
(c) Design, Analysis and Modeling Software: $25,000
(d) Manufacturing, Tooling and Prototyping: Product Development: $125,000
(e) Testing and Verification: $15,000
(f) Collaborating Partners*: Triton Systems ($50,000); Southern Research Institute ($25,000); Ticona ($25,000)
(g) Technology Transfer ($30,000)

*North American Bus Industries (NABI) will provide in-kind support as the end-user of the technology.

Research Period: The estimated period of time needed to complete the research including 3 months for review and revision of a draft final report is 2 years (i.e. $250k per year for 2 years, total of $500k)

V. URGENCY AND PAYOFF POTENTIAL
The need is immediate for cost-effective mass transit safety, increased passenger comfort in terms of reduced sound (quieter interior), modular mass transit that can adapt to changing road and city conditions, lower fuel consumption, reduced maintenance and less road wear. Advanced thermoplastic and thermoset composite materials can play an important role in improving the efficiency of mass transit for a variety of structural and non-structural components. The use of lightweight, high-performance materials will contribute to the development of vehicles that provide better fuel economy, less harmful emissions, increased safety, fire resistance, ability to absorb large amounts of energy (such as from a blast), and lighter weight.

As an example, the technologies proposed can lighten the weight of most structural components on mass transit by an average of 40%, which can translate to billions of dollars in life-cycle cost savings (road wear, fuel saving, less hardware etc.). These benefits can be realized without any foreseeable institutional, political and/or socio-economic barriers to implementation.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
The proposed research falls into the Strategic Research Goals of the FTA (a) Increased Ridership (improved comfort due to lightweight, quieter mass transit systems), and (b) Improving Safety, Security and Emergency Preparedness (materials with enhanced energy absorption, vandalism and fire resistance). In terms of the Strategic Priority Areas, the proposed research is directly applicable to I. Place the Transit Customer First (attention to comfort and ridership); II. Enable Transit to Operate in a Technologically Advanced Society (public transportation that integrates state-of-the-art technology so that mobility needs can be served as communities change and customer needs evolve). III. Continuously Improve Public Transportation (support communities throughout the United States to continuously improve public transportation).

VIII. RELATED RESEARCH
The Engineering Research & Application Development team at UAB has developed unique thermoplastic composite materials and processing technologies for a number of targeted applications for mass transit systems. A significant amount of work focused on basic research of thermoplastic materials that offers enhanced durability, impact resistance, damage tolerance, enhanced sound and vibration dampening, lightweight and corrosion resistance.
Over a five-year period (2000-2006), the UAB research team developed thermoplastic composite materials and manufacturing technologies for various mass transit bus components. These include; a two-passenger bus seat, a floor segment, a side body panel and structural frame segment, battery box access door and an air-conditioning roof cover door for a conventional steel articulated bus, referred to as the 60 ft BRT bus. For these components, weight savings in the order of 40% and projected life-cycle cost savings in the order of 45-50% were demonstrated using thermoplastic composites replacing traditional materials such as steel, plywood, and aluminum. These applications are briefly discussed below:

The E-glass/polypropylene long fiber thermoplastic (LFT) 2-passenger bus seat (Figure 3) weighed only 22 lbs as opposed to 47 lbs for the existing steel/sheet molding compound shell design used on most city mass transit systems. The thermoplastic structure required fewer assembly points compared to the metal/SMC design.

The conventional floor on buses features steel and plywood. Steel corrodes and plywood rots due to acid washes and moisture. A typical bus requires several replacements of the floor. The woven fabric E-glass/polypropylene floor segment (Figure 4) was 40% lighter than the conventional metal/plywood floor. The thermoplastic composite floor was significantly more damage tolerant, easy to replace and install, had superior (an order of magnitude higher) vibration and sound dampening.

Conventional buses use a welded tubular steel frame over which cosmetic body panels are mounted. In the thermoplastic design, the structural load bearing was shared across the body panel and the structural frames. A powder impregnated carbon fiber reinforced polyphenylene sulfide structural frame that assembled to a body panel was developed. The body panel featured a load bearing sandwich panel made of E-glass/polypropylene random chopped facesheets and a hexagonal shaped polypropylene core. Here the frame was 60% lighter than corresponding steel, and the body panel+frame assembly (Figure 5) was 40% lighter for equivalent structural performance.

For the battery box door, a 60% lighter long fiber thermoplastic door (Figure 6) replaced a steel frame welded to a sheet steel. The steel corroded due to the battery acid and associated corrosive fumes. The LFT door featured ribs to support the structural loads eliminating the steel frame entirely.

On the air-conditioning cover access door, a thermoplastic polyolefin (TPO) bonded to a vacuum formed thermoplastic lofted polypropylene ribbed interior replaced an aluminum skin welded to a steel stringer (Figure 7) that is featured on current buses. This reduced the AC door weight from 27 kg to 12 kg. Each bus has 12 such doors, so the roof weight can be reduced by approximately 500 lbs (250 kg) by adopting the thermoplastic composites technologies.

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT
The University of Alabama at Birmingham (UAB) has developed this problem statement as a group of researchers focused in the area of advanced composite materials and manufacturing technologies. The team comprises School of Engineering researchers with the Engineering Applied Research Complex (EARC) dealing with application focused engineering along with industry partners – North American Bus Industries (NABI), Anniston, Alabama (end-user), Triton Systems (US manufacturing partner) and Ticona Inc. (materials supplier).

XI. DATE AND SUBMITTED BY: June 14, 2007
I. PROBLEM TITLE: Integrating Solar Panels into a Hydrogen-Powered Rural Transit System

II. RESEARCH PROBLEM STATEMENT

Hydrogen-powered transit buses are currently in operation at several test sites in the U.S. and around the world. The majority of these efforts are taking place in urban areas. Gaining consumer acceptance of this alternative-fuel source must include demonstration projects that reach beyond our cities and into the more rural areas of the United States. Many people in middle-America have not yet been exposed to the idea of hydrogen as an alternative fuel, and have not been adequately educated on the safety aspects related to the use of hydrogen. Because of lack of education and awareness, many local officials do not yet embrace hydrogen use and are even opposing projects that could have long-term benefits for their communities. In addition, we must find ways to reduce the cost to produce hydrogen, in order to make it a truly sustainable future fuel source.

The University of Missouri-Rolla, in cooperation with the Missouri Transportation Institute, is implementing a Hydrogen-Powered Rural Transit System test bed. This test bed is provided through the integration of two hydrogen-powered transit buses into an existing commuter service between the town of Rolla, Missouri and the Fort Leonard Wood military installation. Included in the test bed is the construction of a hydrogen fueling station whereby hydrogen will be manufactured on-sight through electrolysis. The energy for the electrolysis will come from the existing electrical grid. In order to create a hydrogen fueling station that is truly energy-efficient, the UMR Hydrogen Team desires to install solar panels that will provide a solar-powered water electrolyzing hydrogen fuel source.

This project will allow for the development of public awareness programs, permitting procedures, training, and identification of the infrastructure required to sustain a rural hydrogen-based transit system. By integrating solar panels into the test bed, we can demonstrate that hydrogen is not just a clean-fuel, but that it can be produced through energy-efficient means.

III. OBJECTIVE

Support the President’s “Hydrogen Economy Initiative” through the expansion of a rural hydrogen-powered transit test bed for promoting hydrogen-based technologies in a real-world environment.

Solar panels will be integrated into an existing hydrogen fueling station to demonstrate a holistic approach to the evaluation of hydrogen as a future fuel source. We will address lessons-learned and the technologies developed will be shared with other national
hydrogen centers to support national efforts. The test bed will serve as the focal point for the overarching goals of collecting and evaluating real-world performance and utility of hydrogen-powered vehicles in a rural transit system, and benchmarking issues related to the safety, operation, maintenance, and energy-efficiency of a solar-powered water electrolyzing hydrogen fueling station.

IV. RESEARCH PROPOSED

Integrate solar panels into an existing hydrogen-powered rural transit system test bed to further demonstrate the feasibility of hydrogen as a future fuel source.

Tasks include:

- Evaluate and validate, under real-world and heavy-load conditions, the emerging energy concept of solar-powered water electrolyzing hydrogen fueling station for the deployment of hydrogen-powered vehicles in rural regions.
- Review existing solar-powered water electrolyzing hydrogen fueling stations to determine best methodologies and resources for integrating solar panels into an existing hydrogen fueling station.
- Collect and evaluate real-world data to address safety and environmental issues related to deployment of hydrogen technology under diverse operating conditions.
- Test, demonstrate, and validate hydrogen powered vehicles, hydrogen transportation infrastructure, and vehicle and infrastructure interfaces for complete system solutions.
- Provide commuter service customers with a positive experience, helping to overcome perceived fears of hydrogen technology and to promote hydrogen energy systems.
- Integrate research results into comprehensive undergraduate and graduate curricula to educate the future workforce on hydrogen technologies.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $200,000  
**Research Period:** Two Years

VI. URGENCY AND PAYOFF POTENTIAL

Two Ford hydrogen-powered shuttle buses will be delivered to UMR in July 2007, and will be integrated into the existing rural transportation test bed. The hydrogen fueling station that is part of the rural test bed will be constructed by January 2008. The hydrogen will be produced through electrolysis, utilizing the existing electrical grid. If solar panels can be integrated into the initial construction of the fueling station, we can demonstrate a less expensive and more energy efficient means of producing hydrogen and therefore demonstrate its feasibility as a future fuel source.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

This proposed research project is directly aligned with the Federal Transit Authority’s Strategic Research Goal #4: Protecting the Environment and Promoting Energy Independence. The implementation of a hydrogen-powered rural transit system test bed will not only support the President’s “Hydrogen Economy Initiative”, it will provide solid information that can be utilized to lead the movement and help gain public acceptance of evolutionary improvements and paradigm-shifting changes as we reduce our dependence on foreign oil.

The project also supports all five of TCRP’s strategic priorities by improving public transportation in a rural environment; integrating state-of-the-art hydrogen technology; and by partnering with local communities and other federal agencies in the development of a safe, responsive, energy efficient, and effective rural transit program.

VIII. RELATED RESEARCH

The University of Missouri Rolla, in partnership with the Missouri Transportation Institute, is currently engaged in a research project entitled “Show Me the Road to Hydrogen”. A grant has been provided by the Defense Logistics Agency (DLA) for development of a hydrogen-powered rural transportation test bed. Two hydrogen-powered shuttle buses will be integrated into a newly developed commuter service for employees who reside in Rolla, Missouri and work at Fort Leonard Wood, Missouri. The project also includes the production of hydrogen through electrolysis utilizing the existing electrical grid.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Problem statement was developed by the UMR/MTI “Hydrogen Highway” Team.

XI. DATE AND SUBMITTED BY

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I. PROBLEM TITLE: Reforming Ethanol to Support a Hydrogen-Powered Rural Transit Test-Bed

II. RESEARCH PROBLEM STATEMENT

Many people in middle-America have not yet been exposed to the idea of hydrogen as an alternative fuel, and have not been adequately educated on the safety aspects related to the use of hydrogen. Because of lack of education and awareness, many local officials do not yet embrace hydrogen use and are even opposing projects that could have long-term benefits for their communities. Ethanol has received much wider acceptance within the Midwest as an alternative fuel source. Researchers at the University of Missouri have developed a revolutionary fuel reformation technology that uses supercritical water to convert a variety of liquid hydrocarbon fuels, including ethanol, into hydrogen with excellent conversion efficiency. This revolutionary technology overcomes two of the major hurdles in moving to a hydrogen economy—the source of hydrogen and the storage and distribution of hydrogen. This method overcomes these hurdles by allowing for different hydrogen sources, including agricultural based ones, and alleviating the issue of storage/distribution by efficiently producing hydrogen on-demand in small to medium quantities.

The University of Missouri-Rolla, in cooperation with the Missouri Transportation Institute, is implementing a Hydrogen-Powered Rural Transit System test bed. This test bed is provided through the integration of two hydrogen-powered transit buses into an existing commuter service between the town of Rolla, Missouri and the Fort Leonard Wood military installation. Included in the test bed is the construction of a hydrogen fueling station. Our desire is to generate hydrogen on-site and on-demand through ethanol reformation.

This project will allow for the development of public awareness programs, permitting procedures, training, and identification of the infrastructure required to sustain a rural hydrogen-based transit system. By integrating ethanol reformation into the test bed, we can demonstrate that hydrogen is not just a clean-fuel, but that it can be produced through energy-efficient means, utilizing agricultural energy sources that are so widely available in the Midwest.

III. OBJECTIVE

Support the President’s “Hydrogen Economy Initiative” through the expansion of a rural hydrogen-powered transit test bed for promoting hydrogen-based technologies in a real-world environment.
On-site generation of Hydrogen from ethanol reforming will be integrated into an existing hydrogen fueling station to demonstrate a holistic approach to the evaluation of hydrogen as a future fuel source. We will address lessons-learned and the technologies developed will be shared with other national hydrogen centers to support national efforts. The test bed will serve as the focal point for the overarching goals of collecting and evaluating real-world performance and utility of hydrogen-powered vehicles in a rural transit system, and benchmarking issues related to the safety, operation, maintenance, and energy-efficiency of on-site hydrogen generation through ethanol reformation.

IV. RESEARCH PROPOSED

Preliminary experimental results obtained from a single-stage, non-catalytic, supercritical reforming indicate nearly 100 percent conversion of ethanol to product gas containing over 60 percent hydrogen. Further refinement and optimization of the process could generate much higher concentrations of hydrogen. Overall, the process technology can result in a minimum of 100-fold space savings when compared to a comparable reforming technology applied to ethanol. The process is believed to be capable of producing 2.0 – 2.6 million standard liters of hydrogen from 1 metric ton of ethanol. This estimate does not include any external energy input to the process for operation. The completion of the following tasks will demonstrate the feasibility of implementing this supercritical water reformation technology into an existing rural transit test-bed:

- Modify the current 1-liter reactor mini pilot system for ethanol reforming.
- Demonstrate process feasibility and proof of concept via ethanol-to-hydrogen reformation using a continuous mini pilot experimental unit.
- Implement secondary processing, water gas shift reaction, acid gas removal and gas purification, and recycled use of water for continuous operation.
- Complete a process engineering study for optimization and energy integration.
- Test, demonstrate, and validate hydrogen powered vehicles, hydrogen transportation infrastructure, and vehicle and infrastructure interfaces for complete system solutions.
- Provide commuter service customers with a positive experience, helping to overcome perceived fears of hydrogen technology and to promote hydrogen energy systems.
- Integrate research results into comprehensive undergraduate and graduate curricula to educate the future workforce on hydrogen technologies.

Deliverables: The process feasibility and high hydrogen productivity will be demonstrated on a continuous basis using a mini pilot-scale process unit. This unit will provide the hydrogen required to fuel two shuttle buses within an existing hydrogen-powered rural transit system. The kinetics of the supercritical reforming of ethanol will also be provided.
V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

    Recommended Funding: $340,000
    Research Period: Two Years

VI. URGENCY AND PAYOFF POTENTIAL

Two Ford hydrogen-powered shuttle buses will be delivered to UMR in July 2007, and will be integrated into the existing rural transportation test bed. The hydrogen fueling station that is part of the rural test bed will be constructed by January 2008. Our desire is to provide on-site hydrogen generation through ethanol reformation. If we can integrate this production process into the initial construction of the fueling station, we can demonstrate the benefits of agricultural-based energy sources for the production of hydrogen, and efficiently produce hydrogen on-demand in small to medium quantities, further demonstrating its feasibility as a future fuel source.

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

This proposed research project is directly aligned with the Federal Transit Authority’s Strategic Research Goal #4: Protecting the Environment and Promoting Energy Independence. The implementation of a hydrogen-powered rural transit system test bed will not only support the President’s “Hydrogen Economy Initiative”, it will provide solid information that can be utilized to lead the movement and help gain public acceptance of evolutionary improvements and paradigm-shifting changes as we reduce our dependence on foreign oil.

The project also supports all five of TCRP’s strategic priorities by improving public transportation in a rural environment; integrating state-of-the-art hydrogen technology; and by partnering with local communities and other federal agencies in the development of a safe, responsive, energy efficient, and effective rural transit program.

VIII. RELATED RESEARCH

The University of Missouri-Rolla, in partnership with the Missouri Transportation Institute, is currently engaged in a research project entitled “Show Me the Road to Hydrogen”. A grant has been provided by the Defense Logistics Agency (DLA) for development of a hydrogen-powered rural transportation test bed. Two hydrogen-powered shuttle buses will be integrated into a newly developed commuter service for employees who reside in Rolla, Missouri and work at Fort Leonard Wood, Missouri. The project also includes the production of hydrogen through electrolysis utilizing the existing electrical grid.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Problem statement was developed by the UMR/MTI “Hydrogen Highway” Team.

XI. DATE AND SUBMITTED BY

Submitted on June 14, 2007 by:
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Submit to: Christopher W. Jenks
Transportation Research Board
500 Fifth Street., N.W.
Washington, D.C. 20001
202/334-3089
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I. PROBLEM TITLE
Hydrogen Fuel Cell Bus Availability Management System

II. RESEARCH PROBLEM STATEMENT
Hydrogen fuel cell buses are finally transitioning from the R&D stage to the pre-production and production stages. As capital and infrastructure cost investments of this technology are still very expensive, it is important to set a process to control operational costs and above all reliability. In order to meet or exceed conventional transit bus reliability, transit systems operating fuel cell fleets must understand the parameter and variable influencing the performance of this new technology.

Currently BC Transit is conducting an initiative for a commercial procurement of hybrid fuel cell buses to support British Columbia’s commitment to the Hydrogen Highway. The hybrid fuel cell buses and supporting hydrogen infrastructure will be showcased in the Resort Municipality of Whistler (Whistler). It is then intended to operate these buses in regular revenue service in Whistler. An efficient mover of people, public transit fleets are a natural platform for the introduction of this emerging technology that is environmentally benign.

In this context, BC Transit and its partners would put together a Bus Availability Management System during the first 2 years of deployment of a pre-production and 19 production buses (Phase 1). Building on the experience of the pre-production bus, this system would, pursuant to an approved process, meet regularly to establish working plans for issue mitigation and manage corrective actions in accordance with commercial terms as applicable.

III. OBJECTIVE
The Bus Availability Management System would integrate this work into an automated process to collect and analyze data and detect trends related to system performance. The joint task force would then manage corrective measures and integrate them into the fleet management processes.

By putting together an Availability Management System, BC Transit would be able to control and lower maintenance and operational costs by increasing vehicle on-road service and collect an in-depth knowledge of the fuel cell hybrid lifecycle. The processes and solution developed for this project will be transferred over to BC Transit to integrate in their operations during the lives of the vehicle. It will also be possible to use some of these tools for the fleet management of regular diesel buses.

IV. RESEARCH PROPOSED
During pre-production bus acceptance and deployment, BC Transit and its partners would be working together to meet service demand and availability standards. During that period, the parties would:

- Define bus availability
- Define measurement standards and metrics to be collected in order to monitor and improve availability
- Define process to collect and analyze data in order to determine failure mode and corrective action, recommended parts supply and implementation of predictive and preventative maintenance programs
- Mitigate bus operating issues as they arise in a timely manner
- Integrate training and documentation into the mitigation action plan

In order to maximize the fuel cell hybrid bus availability, the partners would set-up a task force that will establish process to monitor, predict and improve bus service availability. Following the pre-production bus acceptance, the task force will be working, using current maintenance program and known issues, to automate and manage the program for the rest of BC Transit’s fuel cell hybrid fleet. The
preliminary process work for the System would be included in the pre-production bus acceptance phase.

The project (development of system and deployment) would start in September 2008 and would continue over the evaluation of the pre-production bus and the deliveries of the 19 production buses until August 2010.

Pre-liminary phase included in the delivery and acceptance of pre-production bus

October – December 2007 – Term of Reference, Definition of bus availability, definition of measurement standards and metrics
January - May 2008 – Data collection, determination of potential corrective measure processes

Actual Bus Availability Management System

September 2008 - February 2009 – Platform choice, programming of metrics, pilot implementation of the automated process
March 2009 - August 2010 – Final implementation on pre-production and production buses
September 2010 – Draft Final Report

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
Data Collection, Operational Metrics, System Design, Program and Implementation - $600,000
Project Management, Term of Reference, Definitions, Coordination, Reporting - $200,000
Total: $800,000

Research Period: The project would be conducted over a 3 year period from October 2007 to December 2010.

VI. URGENCY AND PAYOFF POTENTIAL

Benefits to the transit industry will include:
☒ Data to improve overall design and reliability of fuel cells and hybrid drive systems
☒ Creation of comparable benchmark between fuel cell hybrid projects
☒ Process that could be carried over to other advanced hybrid transit fleet in the rest of the World

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

This project would be vitally linked to FTA strategic research goal 4: Protecting the Environment and Promoting Energy Independence and
2: Improving Capital and Operating Efficiencies

VIII. RELATED RESEARCH

Transforming the future: Moving Toward Fuel Cell-Powered Fleets in Canadian Urban Transit Systems (2005), Marcon-DDM HIT

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This statement was developed by BC Transit and industry partners.
XI. DATE AND SUBMITTED BY

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Submit to:

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

SURVEY OF AVAILABLE BRAKING ENERGY RECOVERY FROM LOCOMOTIVE HAULED COMMUTER RAILCARS

II. RESEARCH PROBLEM STATEMENT

At the APTA 2006 Rail Conference held in New York City, Paul Kaufmann of STV Incorporated and Tom Bartley of ISE Corporation presented a paper (attached) that described the recovery and recycling of braking energy during the operation on passive commuter railcars. Every time a 125,000 pound railcar is stopped from 70 mph 7.8 kWh of kinetic energy is dissipated as heat and brake wear. That paper went on to estimate that each car experienced 25,600 energy reclamation opportunities per year resulting in 120,320 kWh of clean renewable energy per car per year at a 60% recovery efficiency.

APTA has a rail data base that identifies locomotive hauled commuter railcars in service. With estimates exceeding 1200 railcars the potential energy savings is over 144 million kWh per year. At 26% diesel engine efficiency this represents a locomotive diesel fuel savings of 14.4 million gallons per year.

These projections are only estimates and a survey of actual cars in use needs to be done to determine the real potential of this energy savings concept. The numbers are required for a more accurate cost benefit analysis.

III. OBJECTIVE

The objective is to determine more detailed estimates of actual benefits to the cars in service. The benefits include fuel, emission, and green house gas savings, brake wear savings, enhanced performance with faster schedule times, and other advantages related to onboard power usage and emergency batteries. Ideally, the result would be a spreadsheet listing for each railcar that identifies the value amounts saved in each category. The resulting numbers form the basis of development and marketing decisions in the evolution of the technology.

IV. RESEARCH PROPOSED

The real braking energy can be calculated from the commuter railcar speed before each stop. The proposed method of research is to use a written questionnaire and interviews of people within each of the organizations responsible for the operation of the individual or groups of railcars. Groups can be studied simultaneously because a consist has multiple cars and multiple consists travel the same routes.

The envisioned tasks are:
• Prepare a questionnaire to identify the in service use characteristics of each passive commuter railcar listed in the APTA data base. The questionnaire can also be used to identify any new railcars not in the database.
• Prepare a spreadsheet analysis data capture to efficiently handle the information returned from the questionnaire.
• Identify the appropriate points of contact to provide the requested information.
• Send out the questionnaires in the US Post Office mail.
• Receive the questionnaires and follow up with telephone, email, and personal interviews as necessary to assure confidence in the information.
• Process the data and analyze the resulting projected benefits.
• Prepare a report with priorities in cost benefit pay offs.
• Present the report.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $300,000 for one to two professional staff-years.

**Research Period:** 12 months including 3 months for review and a revision of a draft final report.

VI. URGENCY AND PAYOFF POTENTIAL

A proposal is pending for IDEA Program funding for the next step in design analysis towards an implementation of a system to recycle the presently discarded braking energy. The results of this survey would identify the cost benefit values of that technology to specific transit properties and help focus the priorities of design variables and system characteristics.

With the political and social interest in climate change and global warming, the potential savings of 14.4 million gallons of fuel per year (see Section II), at 20 pounds of CO₂ per gallon of fuel, is a potential savings of 144,000 tons of CO₂ per year that would otherwise be released into the atmosphere.

There are no known institutional, political, or socio-economic barriers to implementation of the anticipated research products of this proposal.

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

(1) **Increasing Ridership:** Not only will the proposed work identify the potential improvements in economic and environmental benefits of Federal investments as listed above, but the enhanced consist performance provides quicker accelerations and shorter trip times that encourage increased ridership and general increased productivity associated with less commute travel times. Also, reduced diesel fuel consumption puts a downward pressure on fuel prices.
(2) **Improving Capital and Operating Efficiencies:** Efficiencies are related to costs and one of the products of this proposed work is to identify the cost benefit of recovering and recycling presently wasted braking energy.

(3) **Improving Safety, Security and Emergency Preparedness:** One of the objectives in the proposed work is to investigate the benefits of a change in the emergency battery back up of each commuter railcar. The current battery backup would be replaced with the onboard energy storage for the capturing the braking energy. This offers more capacity and eliminates most of the maintenance associated with emergency backup batteries. This is another cost benefit that is expected to be better defined from the analysis of the collected data.

(4) **Promoting the environment and Promoting Energy Independence:** As described above will better define how much of the 14.4 million gallons of fuel savings per year potential can really be realized along with the exhaust emissions savings and the 144,000 tons of CO$_2$.

I. Place the Transit Customer First: The enhanced acceleration performance will give the ridership shorter travel times.

II. **Enable Transit to Operate in a Technologically Advanced Society:** With advanced energy storage available on each commuter railcar the use of the recovered braking regeneration energy can be adapted to the best use of the route cycle and changed for different routes, thus, optimizing for a changing environment. This parameter will be difficult to measure directly form the collected data, however, the data should suggest different categories that could be examined for flexibility to change.

III. **Continuously improve Public Transportation:** Over 1,000 hybrid-electric transit buses are now in use and the number is increasing. This research examines the payoff potential of using that technology in a rail application.

IV. **Flourish in the Multimodal Environment:** The proposed research will look at use in different applications and as such can help evaluate the amount of flexible cost benefit in different operating modes.

V. **Revitalize Transit Organizations:** If the benefits of the proposed technology are real, the route, scheduling, and maintenance in the workplace will change towards a less costly reinvention. This research will help identify the preferred directions to take on a priority basis.

VIII. RELATED RESEARCH

Please see the attached paper. As stated in Section VI, a proposal to advance the design concept has been submitted to the IDEA Program.

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

This problem statement is the product of an individual, Tom Bartley, with consulting inputs from Paul Kaufmann and various other individuals.

XI. DATE AND SUBMITTED BY

June 15, 2007
Tom Bartley
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 catenary 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
ADVANCED STEEL FIBER REINFORCED CONCRETE TO REDUCE TRANSIT CAPITAL COST

PROBLEM STATEMENT

Prepared for

Transit Cooperative Research Program (TCRP)
Transportation Research Board
Washington, DC

15 MAY 2007
Dear Mr. Jenks:

General Atomics (GA) takes pleasure in submitting this problem statement in response to the referenced announcement. GA is a world-class advanced technology company with over half a century of experience in developing innovative, yet real-world, first-of-a-kind systems for challenging defense and energy applications.

If you have any technical questions, please contact Dr. Sam Gurol, Director of Maglev Systems, at 858-455-4113 (voice), 858-455-4341 (fax), or sam.gurol@ga.com (e-mail). Please direct administrative or contractual matters to the undersigned at 858-676-7255 (voice), 858-676-7290 (fax), or victor.gomez@ga.com (e-mail).

Sincerely,

Victor Gomez
Sr. Contract Administrator
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I. PROBLEM TITLE

Advanced Steel Fiber Reinforced Concrete to Reduce Transit Capital Cost

II. RESEARCH PROBLEM STATEMENT

Reducing the capital cost of the guideway is the most cost-effective means of reducing the overall cost of grade-separated transit systems. The guideway structure for these systems is generally over 60 percent of the total cost of the system. General Atomics (GA) is developing advanced approaches for fabricating concrete guideways using steel fiber reinforced concrete (SFRC), which offers the potential to greatly reduce the cost of the guideway, resulting in substantially lower capital cost for transit systems. This is because SFRC has many advantages over conventional construction techniques. SFRC is lighter, stiffer, stronger, and less expensive than conventional concrete construction. It offers a smaller, less obtrusive cross section, better performance in terms of strength and stiffness, and less costly construction.

III. OBJECTIVE

The objective of this proposed study is to validate the cost and strength benefits of SFRC for a full-scale girder beam. The end product of this study will be a comparison of SFRC to conventional fabrication approaches, including an evaluation of performance improvement and potential capital cost reduction for representative transit systems.

IV. RESEARCH PROPOSED

The specific research proposed is to design, fabricate, and test a full-scale girder beam for a representative transit application. The measured stiffness and strength will be compared to predicted values. These results will be compared to conventional concrete fabrication approaches to validate the potential cost reduction to be achieved with SFRC. A conclusion will be drawn regarding the overall benefits to reduce cost for elevated guideways for transit systems.

The basic cross section of the proposed guideway is shown in Fig. 1 for a 30-m (98.4-ft)-long girder span. Characteristic dimensions are 1.4 m in depth and 2.0 m in width. The resulting stiffness measured by L/D ratio, where L is the length and D is the deflection, will be designed to be a value of 3,000, accommodating an 18-tonne (40,000-lb) vehicle. As such, it will only deflect 10 mm (0.4 in.) in a 30-m (98.4-ft)-long span. This is ideal to avoid resonance problems for transit applications.

This full-scale, 30-m (98.4-ft)-long SFRC girder will be designed, fabricated, and tested. The girder will be simply supported and load-tested. Strain and deflection will be measured. The test results will be compared to predicted values and used to evaluate potential capital cost reduction over conventional rebar concrete fabrication approaches.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

The recommended funding for this activity is $499,000. Please note that this estimate is for budgetary purpose only and does not constitute an offer.
The period of time needed to complete this research is 12 months, including a 3-month period for review and revision of a draft of the final report.

VI. URGENCY AND PAYOFF POTENTIAL

Due to the high cost of transit infrastructure capital cost, completion of many projects are delayed or never funded. Consequently, congestion has continued to grow and in many areas has reached a critical stage, leading to severe impacts on the environment and the national economy. Girders constructed using SFRC offer the potential to reduce the cost of guideways. While the cost of the SFRC raw materials is slightly higher than the cost of conventional rebar concrete construction, the performance improvement outweighs the increased materials cost, resulting in a net savings of over 25 percent [Ref. 1 and 2]. Major cost reduction of this magnitude can pave the way to expand and build more transit projects.

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

The objective of the proposed study dovetails into the Federal Transit Authority (FTA) strategic initiative, specifically item (2) “Improving Capital and Operating Efficiencies.” The research and demonstrations are designed to help contain capital costs for transit systems. The SRFC technical and process advances would help control capital investment costs and contribute to better cost-effective management of design and construction of major transit investments. This problem statement evaluates the contribution of specific innovations toward cost containment. The proposed study also addresses several Transit Cooperative Research Program (TCRP) strategic priorities, namely items (II.) “Enable Transit to Operate in a Technologically Advanced Society” and (III.) “Continuously Improve Public Transportation” by funding studies for integrating state-of-the-art technology to lower capital costs and supporting public transportation improvement by making it more affordable to communities.

VIII. RELATED RESEARCH

Over a decade ago, GA performed initial development of SFRC under contract with the U.S. Air Force. Under a separate federally funded program performed during 2003, GA developed a new SFRC mix design working with San Diego State University (SDSU). As shown in Fig. 2, comprehensive tests were conducted with laboratory and field trials of the various mix designs. The test results of the selected mix design were very encouraging and yielded results with significant performance improvement. Because of the continuous micro-stitching properties of the randomly distributed steel fibers, there was a significant increase in the flexural strength. Subscale sample test measurements of the maximum ultimate flexural bending stress proved to be five times higher than conventional reinforced concrete.

In early 2007, GA worked with Mackin Engineering Company and San Diego Precast to fabricate and test a one-quarter-scale beam for elevated transit applications. Photographs of the test setup and the beam subjected to static loading are shown in Figs. 3 and 4, respectively. These activities were performed as part of an FTA administered program on Urban Maglev development [Ref. 3].

Although the beam withstood substantial static load, as shown in Fig. 4, it only reached about two-thirds of the design goal. Nonetheless, the results were very encouraging. Posttest analysis indicated that improvement is needed in fiber pullout strength and other considerations are being evaluated, such as...
increasing the fiber volume in tensile zones and reducing the fiber volume in compressive zones. Additional research and development to resolve this issue is already underway. The findings regarding fibers improvements will be incorporated in the full-scale beam development proposed herein.

**Fig. 3.** Test setup for 8.84-m (29-ft)-long one-quarter-scale SFRC beam

**Fig. 4.** SFRC beam under static loading

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

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

This problem statement was developed by General Atomics, Electromagnetic Systems group located in San Diego, CA and Mackin Engineering Company located in Pittsburgh, PA.

**XI. DATE AND SUBMITTED BY**

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**REFERENCES**


I. PROBLEM TITLE

National Standards for “Bus-Only Shoulders” on Freeways.

II. RESEARCH PROBLEM STATEMENT

Many of the most congested freeways in urban areas do not have sufficient right-of-way to add HOV or bus lanes. Environmental concerns and neighborhood opposition preclude condemning adjacent property for freeway expansion. Funding is rarely available for elaborately engineered solutions. Consequently, “express” transit buses cannot operate efficiently or offer a desirable alternative to the drive alone commuter.

The Minnesota Department of Transportation and authorities elsewhere have found a solution in Bus-Only “Shoulders”. In the past decade over 250 miles of Bus-Only shoulders have been put into operation in the Minneapolis-St. Paul metropolitan area. Bus-Only Shoulders are only 10 feet wide, rather than the standard 12 foot width required for a lane. They do however require specific guidelines for construction and transit operations.

In spite of extensive operational experience in Minnesota and a few other locations in the US, the Bus-Only Shoulder is foreign to most MPOs and state DOTs, including ones with the highest levels of urban freeway congestion. Officials feel that they cannot implement Bus-Only Shoulders until they have completed a several year demonstration project of limited scope and completed a lengthy evaluation process. Individual jurisdictions envisage spending time and money to reinvent from scratch something that is already at a mature level of implementation elsewhere in the country.

III. OBJECTIVE

Produce national standards for Bus-Only Shoulders based on a synthesis of existing experience so that each and every district of each and every state DOT does not have to conduct their own lengthy demonstration project followed by a lengthy evaluation period before they can implement Bus-Only Shoulders.

IV. RESEARCH PROPOSED

Interview state and local DOTs, law enforcement and transit providers who have extensive experience with Bus-Only Shoulders. Synthesize interviews and completed studies into an implementation manual for highway engineers and transit operators.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $280,000.
Research Period: One year for research, including 3 months for review and revision of a draft final report.

VI. URGENCY AND PAYOFF POTENTIAL

Bus-Only Shoulders guarantee express transit buses a minimum operating speed of 25-30 mph, even on freeways where peak average speeds are less than 15 miles per hour. They can be implemented at a fraction of the cost and construction time of additional “lanes”, to say nothing of a rail transit line.

Bureaucratic risk avoidance syndrome is the major institutional barrier to research product implementation. State and local level authorities fear being blamed for any real or perceived negative impact of any
innovation, and if compelled to innovate, insist on having an exhaustive and exhausting demonstration project with officiated findings (this research product) that they can deflect potential criticism to.

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

- Increase the mode share of transit by making transit trips faster, with better schedule reliability than car trips during peak commute times
- Decrease per vehicle mile cost (operating cost) of providing transit service by increasing vehicle miles per hour
- Decrease transit capital cost by making it possible for fewer buses to provide the same service frequency
- Minimize construction costs of transit infrastructure
- Minimize environmental impacts.

VIII. RELATED RESEARCH

Minnesota DOT seems to have to the most research that is available on-line.

IX. PERSON DEVELOPING THE PROBLEM

Paul Casey, Senior Transit Programs Analyst, City of Santa Monica, Big Blue Bus, 1660 7th Street, Santa Monica CA 90401 paul.casey@smgov.net 310-458-1975 x5847 fax: 310-581-7925.

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Product of an individual from the Los Angeles area who happened to notice the Bus-Only Shoulder in Virginia arriving from Dulles and who then approached Caltrans upper management about adopting the concept but encountered unfamiliarity and reluctance, in spite of desperate need for this solution.

XI. DATE AND SUBMITTED BY

Submitted May 21, 2007
by Paul Casey, Senior Transit Programs Analyst, City of Santa Monica, Big Blue Bus, 1660 7th Street, Santa Monica CA 90401 paul.casey@smgov.net 310-458-1975 x5847 fax: 310-581-7925.

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FAX 202/334-2006
I. PROBLEM TITLE

Design and development of Acoustic FRP Highway Noise Barriers

II. RESEARCH PROBLEM STATEMENT

Currently, most highway sound barriers are built from solid concrete wall. It depends on the heavy mass of the wall to absorb sound energy. Existing problems or difficulties include: 1. wind load support capability, 2. strong foundation requirement to support the heavy wall, and 3. desired sound barrier locations often within cities and populated areas. The flat surface of the concrete wall affects the city appearance negatively.

In this proposal, we propose to develop acoustic FRP sandwich panels and FRP column arrays for sound barriers. Though the expense of acoustic FRP sound barriers could be greater, they would be much lighter than concrete barriers. Air paths can be designed to reduce wind load. Yet there would also be compensating cost reductions from the lack of a need to build a strong foundation and from quicker installation. Beyond cost calibrations, two other considerations would favor the acoustic FRP sound barrier: 1. FRP panels can support large deformation and absorb more collision energy. This could reduce mortality and morbidity from vehicle collisions. 2. An improved aesthetic can be designed, which would please many people.

Two acoustic barrier designs will be explored:

In the first design option, an acoustic FRP sandwich panel will be used to shield and absorb sound waves. Sound shielding capacity would depend upon 1) sandwich core internal geometry, 2) air paths inside the panel and 3) core material sound energy absorption capability. The optimal design will be derived through numerical simulation.

In the second design option, vertical FRP columns will be placed in a periodic arrangement, as shown in the Figure 1, to shield and absorb sound waves. Sound shielding ability would depend upon column arrangement. This design option is based upon a physics theory called “band gap phenomenon.”

The research includes three portions:

1) Numerical simulation to design optimal FRP panel geometry and FRP column arrangement
2) Fabrications of prototype sound barriers
3) Experimental research to determine the acoustic effect of the sound barrier

III. RESEARCH OBJECTIVE

Fig.1 FRP columns in periodic arrangement
Objectives of the research project include: 1) to develop the design principles for acoustic FRP sound barriers, 2) to develop a prototype acoustic FRP sound barrier, 3) and to conduct experimental research to examine sound shielding capability.

IV. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $500,000

**Research Period:** Three years.

*(Note: These estimates may be changed by the AASHTO Standing Committee on Research to fit the problem into the broad program.)*

V. URGENCY, PAYOFF POTENTIAL, AND IMPLEMENTATION

Reducing traffic noise is a critical issue in urban areas. Several advantages can be identified with the FRP sound barrier compared to the conventional solid concrete wall. Two that stand out are public safety and city appearance. As has been discussed, FRP sound barriers would support a larger amount of deflection; as such, it would absorb more collision energy. This could reduce mortality and morbidity. Secondly, the flat surface of the concrete wall affects the city appearance negatively. In contrast, the application of FRP column sound barriers (The second design option) would show an improved aesthetic. Further, open columns rather than a wall could also reduce a driver’s psychological pressure when passing heavy traffic because of the lack of an enclosed environment. Other advantages favoring the FRP sound barrier include: quick installation, weight reduction and low maintenance cost.

This research will develop guidance for the design of FRP acoustic sound barriers. Optimal sound barrier design will be derived by numerical simulations and verified by experimental researches. Then, an actual scale sound barrier will be built and tested. Results from this research can be directly used by highway design engineers and contractors.

VI PERSON DEVELOPING THE PROBLEM

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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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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 ANDSubmitted 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, ADTs, 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 roadway 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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TCRP FY 08 Problem Statement: Guidelines for Developing Performance Based, Transit Track Safety Criteria

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 gage 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:

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<tr>
<th>Phase</th>
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<td>$150,000</td>
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<td>TOTAL</td>
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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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OR

Reddy Chidananda P.E.
Sr. Project Manager / Associate
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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FAX 202/334-2006
I. PROBLEM TITLE

Acceptable Rail Break Gaps In Transit Projects

II. RESEARCH PROBLEM STATEMENT

In Transit aerial guideways where Continuously Welded Rails (CWR) are used, a rail break occurs when a thermally induced tensile force, resulting from a significant decrease in temperature, exceeds the ultimate tensile strength of the rail. The rail break is likely to occur at or near the expansion joint in the superstructure or at a bad weld, a rail flaw or other weak spot in the rail.

As continuous welded rail breaks, the broken rail ends will shrink away from the broken point. It will generate a gap between the rail ends. If the rail break gap is too big, it might cause the derailment of the train. Also a broken rail on a LRT bridge is an important consideration in design because of the potential to transfer a large force to the bridge. It is very important to know, what is the allowable safe size of the rail break gap.

TCRP Report 57- Track Design Handbook for Light Rail Transit, Chapter 7 and ACI Committee 358 Report-Analysis and Design of Reinforced Concrete Guideway Structures (ACI 358 1R-86) deals with the design considerations and the empirical limitations of the Rail Break Gap based on the Transit Vehicle Wheel size. However, there seems to be no mathematical substantiation or determination of safe limits on the acceptable width of the Rail Break Gap which may be variable based on the Static and Dynamic characteristics of the transit operations such as the track geometry, wheel configuration, operating speed, etc.

III. OBJECTIVE

The safe size of the gap depends upon many factors. The major factors are the speed of the train, mass of train, size of train wheels, size of rail and rail base plate.

The goal of this research is to determine acceptable safe limits for Rail Break Gap based on theoretical analysis backed by field testing on a test track if possible.

IV. RESEARCH PROPOSED

Phase 1: Literature search of the prior research works.
Phase 2: Create mathematical model to compute the impact force on broken rail ends due to the different speed, mass and wheel size of train to run over a given size of gap. Then examine the rail stress and deformation to see if rail can hold the train on the track.
Phase 3: To use the test track and train to run over the various size of rail gaps and monitor the behavior of rail and construction of train.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

Phase 1: It will take 2 man – months. It is about $30,000 to $40,000.
Phase 2: It will take 6 man – months. It is about $90,000 to $120,000.
Phase 3: It will take 2 man – months to search the test site and planning, and 2 man – months to coordinate and put it to work; 1 man – month to install the monitoring instrument; 3 man – months for testing. Total is $120,000 - $150,000. The instrumentation and equipment needed is assumed to be furnished by a sponsoring Test Track facility.
**Research Period:**

The research will take 18 months to 30 months.

**VI. URGENCY AND PAYOFF POTENTIAL**

At present time the safe gap specified in criteria in the transit industry is about 2”+. It requires a lot of design effort to achieve this requirement. It requires beefing up the fastener strength, increasing bearing size and pier size. The foundation may also need strengthening due additional forces. Without knowing the accurate gap limit the structure could be far over designed. It may be easily increase the construction cost of the aerial guideway by almost 10%.

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

1. Improve safety.
2. Establish well-defined criteria for acceptable rail gap to achieve the most cost effective structure.
3. It will benefit many rapid transit systems.

**VIII. RELATED RESEARCH**

It will affect the rail fastener and girder bearing design.

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

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OR
X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This issue of how much Rail Break Gap is acceptable in the aerial guideway design has been debated on the current DART Phase II extension Project as the current alignment consists of more than 10 miles of LRT Aerial guideway. DART Criteria calls for no more than 2” Rail Gap. Extensive finite element models are used to assess the various Rail Structure Interaction forces in the design of the piers, pier caps, superstructure and the rail fasteners.

XI. DATE AND SUBMITTED BY

Submitted:       June 15, 2007 (anticipated)
Submitted By: Eduardo Ugarte P.E., Reddy Chidananda P.E. and Kang Huang P.E. (refer to Section IX, above)
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
contacting the back of the flange on only the RestRail reduces curving noise, as only one rail and
one wheel is involved, as opposed to two, which results in less “bell-ringing” and wheel squeal
that it significantly reduces wear on the high rail, so that it has a considerably extended life,
roughly equal to the low rail
that by using a purpose-designed RestRail rolled section, such as UIC-33 in the U-69 support
arrangement, adjustment for RestRail wear to maintain check gauge within specified tolerances is
done fairly easily, and that provision for a “raised” guard RestRail is readily accommodated
that their lubrication or friction control can be concentrated on the RestRail, simplifying the
installation of lube or friction control applicator appliances

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 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
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:

Phase 1 $ 300,000
Phase 2 $ 150,000

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
OUTLINE FOR TCRP PROBLEM STATEMENTS

I. PROBLEM TITLE

Evaluation of color contrast, luminance contrast and text legibility.

II. RESEARCH PROBLEM STATEMENT

Conflicting requirements and needs for people with different types of vision impairment, including the elderly who require better lighting, and text legibility needs a study to maximize the effectiveness of signage and access path solutions.

Simple measurement solutions are required.

Design guide information needs to be compared and challenged, and gaps identified for further research.

III. OBJECTIVE

Include a clear, concise statement of the objectives (anticipated products) that are expected to be met by this particular research.

1. Development of simplified measurement system for luminance and color contrast measurement rather than using a spectrophotometer.
2. Review of text fonts used to determine if new fonts such as Highway font are better than Helvetica which is used.
3. Determine if passenger information signs should mandate preferred color combinations (e.g. do not allow red on black in future due to poor contrast)
4. Review “rules” in design guides such as from RNIB, UK Rail Vehicle Accessibility Regulations, and “Lighthouse” for conflicts and agreement.
5. Improved layout of access paths
6. Conduct trials with groups of people with different vision impairments to maximize usability and consistency of solutions adopted.

IV. RESEARCH PROPOSED

Provide a statement of the specific research proposed, how it relates to the general problem statement in Section II and, if possible, the research approach and the tasks envisioned.

1. Reduce the need to use a spectrophotometer by considering alternative measurement such as analyzing digital photos.
2. Review plug in programs which simulate color blindness and other eye defects to assist designers and operational staff to evaluate access solutions, and also in poor lighting emergency evacuation solutions.
3. Review latest signage fonts for improved legibility. Also consider passenger information signs with capitals versus Title case. Specifically review platform information signs listing route/next train information.
4. Review luminance contrast levels specified in different countries.
5. Develop guidelines for effective color contrast solutions versus luminance contrast.
6. Determine if 3D CAD solutions or photographs using virtual reality rooms can be used effectively for people with vision impairment, and also with filters to simulate different vision impairments for use by operators, designers and also simulate conditions such as smoke filled rooms or underground platforms.
V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** Include an estimate of the funds necessary to accomplish the objectives stated in Section III. As a general guideline, the present cost for research usually averages approximately $150,000-$250,000 per professional staff-year. TCRP projects typically are in the $300,000-$500,000 range. A detailed budget is not necessary.

Rough estimate

1 Researcher from Optometry department $150,000
Group of volunteers with different vision impairments
1 software analyzer $100,000
Coordinator /reporter/liaison for volunteer group $40,000
Transport/accommodation of volunteers $10,000
Use of 3D virtual reality room $50,000
Researcher to contact transit operators, review design guides and displayed information and access paths $150,000

**Research Period:** Provide an estimate of the period of time needed to complete the research, including 3 months for review and revision of a draft final report.

Some research work is probably done but needs to be collated and compared.
12 months – rough estimate
3 months review

VI. URGENCY AND PAYOFF POTENTIAL

Include a statement concerning the urgency of this particular research. Identify and, if possible, quantify the potential and magnitude of payoff from the achievement of the project objectives. Any institutional, political, or socio-economic barriers to implementation of the anticipated research products should also be identified.

Ongoing issue that has not been addressed adequately. Requires a standard or design guide to pull all elements together including signage, lighting, passenger information displays, text legibility, use of color and background contrast, and consideration of vision impairments.

Benefit for ease of use by all people, not just those with vision impairment.

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

Categorize this problem statement using the FTA strategic initiatives and the TCRP Strategic Priorities.

The TCRP has also established five strategic priorities:

1. **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.

As per last email in March 2007 from Tom Mahon.
II. Enable Transit to Operate in a Technologically Advanced Society: TCRP will support public transportation to integrate state-of-the-art technology in all aspects of its business so that mobility needs can be served as communities change and customer needs evolve.

As per last email in March 2007 from Tom Mahon

III. Continuously Improve Public Transportation: The TCRP will support communities throughout the United States to continuously improve public transportation.

As per last email in March 2007 from Tom Mahon

IV. Flourish in the Multimodal Environment: More authority for transportation investment decisions is now in the hands of state and local decision-makers. The transit industry must work harder and smarter to realize the intermodal flexibility and community-based planning opportunities offered by federal and other programs.

As per last email in March 2007 from Tom Mahon

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.”

As per last email in March 2007 from Tom Mahon

VIII. RELATED RESEARCH

If available, provide information on other research—completed, in progress, or pending—that is closely relevant to the proposed problem.

Have details of design guides.

IX. PERSON(S) DEVELOPING THE PROBLEM

Provide the specifics (i.e., name, title, address, telephone, and fax numbers) for the person(s) who developed the problem.

Tom Mahon
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309 Edward St
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Australia
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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT
State whether this problem statement is the product of an individual, a formal committee, or another group.

Individual effort with collation of ideas over many years. Personal development outside work hours. Have worked on DDA issues since 1996.

Can get information from CSIRO, Australia in support of color and luminance contrast issues.

Additional information provided below on issues.

**XI. DATE ANDSubmitted BY**

Provide the specifics (see Section IX) of the person(s) who submitted the problem and the date of submission.

Submitted by Tom Mahon on 15 June 2007

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
Subject - Colour and luminance contrast.

1. Review of vision impairment and impact on utilizing transport

2. Types of colour/ luminance loss - no colour perception, colour blindness, glare related issues

3. Issues way finding, reading information, identifying hazards, night and low level lighting issues, background contrasts.

4. Can simple techniques be used rather than a $10,000 spectrophotometer to measure luminance levels.

5. Is colour contrast more important than luminance contrast.


7. How to match colors for consultation with people with vision impairment.
   Can virtual reality studios be used to consult with people with vision impairment.

8. Note there are plug-ins for Paintshop Pro to simulate colour blindness and how colour blind people view signs and photos.
   Can this be extended for designers to cover other vision impairments e.g. retinitis pigmentosa, tunnel vision.
   There are simulation goggles which are used to replicate vision defects. Can this be done on photos on insitu with a digital video camera.

9. Australia and USA use a difference calculation method for luminance contrast. Which is better/practical.

10. A table with increasing luminance contrast on both axes has a diagonal band of say less than 30% contrast.

11. More work on colour matching as a lot of time is still wasted on viewing a colour on the PC monitor, and printing it out on a printer, and then having a different colour used by the printer(Pantone). An enormous amount of time is probably wasted on correcting colour mismatches in all industries.

12. Discuss above with your Access Board.

13. Is contrast to background more important, or should main features such as armrests, hand grabs, and doors be identified.

14. In association with this should newly developed highway sign fonts be used for better clarity.

15. There are comments that mixed case, or title case are better than upper case for legibility by people with vision impairment.
   Is this true is is spacing between letters the key.

16. Station destination monitors - should routes be colour coded. What is the best font and type of text to use. Are full designation names better (shape of word) or larger abbreviations.

17. Is information on your websites such as "www.lighthouse.org" accurate for guidance.

18. The RNIB (Royal National Institute of the Blind) in the UK has produced some documents also. Also Dulux UK has a CD

19. What is the most effective angle for lighting - lip reading issues come in here also with background contrast and glare.

19. The correct luminance and colour contrast with effective lighting without glare can have a major improvement at minimal cost.
   It should be a simple solution which can be adopted quickly.

20. I have a reasonable collection of information which you could use as background research.
COLOR AND LUMINANCE CONTRAST

Literature Review

List documents dealing with measurement, testing, and calculation of color and luminance contrast.

Methods of measurement of luminance contrast e.g. spectrophotometer.

Simple test methods to check colour contrast

e.g. convert a digital photo to grayscale, or photocopy the photo and look for the contrast.

Formulas to measure luminance contrast

Different formulas are used in different countries e.g.

Australia uses the formulas:

difference divided by mean for access areas 30%,
difference divided by background surface for signs.

European formula uses difference divided by sum 30%

(01/16-STO7EN05 PRM –part 2   TSI PRM document)

USA uses 70% contrast

Is colour contrast more important than luminance contrast?

Assumption is that luminance contrast is for people with no color perception, or during low light periods such as dusk where there is no color.

Do people benefit from colour contrast more than luminance contrast?

Using software programs to measure luminance or color contrast

Can Paintshop be used to measure luminance contrast rom a digital photo?

Note Plug in files are available for Paintshop Pro to convert a digital photo to represent common color blindness issues.

Colour and luminance variation under different lighting conditions

Colour can appear completely different under sunlight compared to fluorescent lights. Which test method and lighting should be used in outdoor areas for calculating the contrast.

Public Consultations regarding selecting color and luminance contrast for way finding.

Matching PC monitor displays to Pantone colors for consistency by different people in different places viewing the same colour
TCRP Problem Statement

I. Empirical Comparison of Ground-Borne Vibration Transfer Mobility Measurement Techniques

II. Research Problem Statement

The Federal Transit Administration and the Federal Railroad Administration have promulgated a detailed procedure for predicting ground-borne vibration generated by transit and high-speed rail vehicles. The procedure includes the use of in-situ vibration testing methods designed to measure the propagation effects of vibration waves as a function of distance ("transfer mobility") at the project site. The measurement generally involves inputting a known force into the ground using an instrumented hammer or similar method, and measuring the resulting vibration pulses using ground-sensors. The measured data are post-processed using Fast Fourier Transform algorithms to generate the transfer mobility.

Several acoustical engineering firms in the United States perform transfer mobility measurements using a variety of methods and equipment. While data generated using different methods are generally considered to be compatible with one another (Company B uses the data provided by Company A), no studies have conclusively demonstrated that the various methods used produce the same results when performed at the same site. Different acoustical firms are often used for various project phases; therefore, transfer mobility tests may be performed at the same location by different firms because of concerns about the compatibility of previously measured data. This has the effect of increasing project costs and prolonging project schedules. There is a need for a cooperative measurement program to conclusively determine that the transfer mobility measurement methods used by various firms give the same results.

III. Objective

The objective of this research is to demonstrate that various transfer mobility measurement techniques produce comparable data under similar reference conditions.

IV. Research Proposed

This research project would involve multiple firms performing transfer mobility measurements using their various methods at a reference site. These measurements would provide a set of results for each measurement that could be directly compared with one another. If the data are shown to be similar, there would be no need for redundant transfer mobility measurements in projects that may require measurements across different project phases (for example Environmental Impact Statement preparation and Final Design). If differences are found between results, these data would be used to provide adjustments that can be applied to future measurements to normalize the results generated by different testing methods.

A team of up to nine firms would conduct this research. The prime contractor would supervise the overall measurement program, provide coordination with TCRP and subcontracting firms, determine the project schedule, and make necessary arrangements at the reference site. Up to eight subcontracting firms would be selected to perform the actual in-situ transfer mobility testing at the reference site under the observation of the prime contractor. Each of those subcontracting firms would be responsible for reducing the data generated by their methods. These data would be forwarded to the prime contractor who would analyze the aggregate data and provide a summary report.
The following tasks would be required to achieve the stated objective:

Phase 1. Prime firm identifies up to eight U.S.-based firms that currently perform transfer mobility measurements; Prime chooses a suitable measurement site where all firms can perform transfer mobility measurements in a controlled environment free of extraneous activity; Prime coordinates with subcontractors to schedule transfer mobility measurements. Estimated time: 4 months

Phase 2. Subcontracting firms conduct transfer mobility measurements at reference site. Estimated time: 1 month

Phase 3. Subcontracting firms analyze transfer mobility results and forward resulting data to prime contractor. Estimated time: 1 month

Phase 4. Prime firm, in coordination with subcontracting firms, performs analysis of aggregated results, and provides draft and summary reports. Estimated time: 6 months

V. Estimate of Problem Funding and Research Period

To complete the research as described above, funding will be required to cover labor costs, travel costs, equipment rental, permits, and site leases. The estimated cost breakdown is as follows:

Prime contractor labor, administrative costs, and fixed costs: $75,000
Subcontractor labor and fixed costs: $40,000 per firm.

The total estimated required funding is $395,000 if eight subcontracting firms are chosen to participate in this research.

The total project schedule is estimated to be 12 months.

VI. Urgency and Payoff Potential

Transfer mobility measurements are vital for accurate transit vibration assessments but can be time consuming and costly. This research could lead in increased confidence in the transfer mobility results obtained by different firms, which would eliminate the need to repeat these measurements across different project phases.

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

The objective of this research is consistent with FTA goals in protecting the environment while reducing project development costs.

VIII. Related Research

The objective of this problem statement is consistent with the goals of ongoing TCRP Project D-12 that also strives to reduce the costs associated with transit vibration analysis and mitigation.

IX. Person Developing the Problem Statement

Herbert Singleton Jr., P.E., proprietor of Cross-Spectrum Labs developed this problem statement. Mr.
Singleton's contact information is provided below:

Herbert Singleton Jr., P.E.
Cross-Spectrum Labs
P.O. Box 90842
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X. Process Used to Develop Problem Statement

An individual developed this problem statement.

XI. Date and Submitted By

This problem statement is submitted by Herbert Singleton Jr.

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Transportation System Usability Testing, Transportation Research Board Proposal for the National Academy of Science 2008

I happened to notice an article that was looking for transit problems: "2007 Transit Cooperative Research Program (TCRP) Problem Statement Sought". Well, I am just a working stiff that takes the bus to the job, the bus has a reputation of being almost unusable for transit, a last resort, so hey, I'll propose a problem to get some organized research into usability testing public transit.

Here is my evolving application, watch it change until the June 15 2007 deadline:

I. PROBLEM TITLE

The title should be no more than 10 words.

Title: Usability Testing Public Transit.

II. RESEARCH PROBLEM STATEMENT

In no more than three paragraphs, provide a general description of the problem or need.

I am a working stiff trying to get to work and get home, raising a family in Minneapolis - St. Paul, the Twin Cities, I take the bus and it is barely a usable alternative when subsidized over 50% by my employer. With billions of dollars invested in public transportation systems there should be a scientific and system wide testing program that improves the usability of the transit system. There does not seem to be much actual testing of transportation usability which is testing people trying to get from one place to another on a public transit system, for this problem proposal "transit usability" is defined as the use of transit by all people.

Design of a transit stops or a set of navigation guides is one thing, but the implementation of a design in a transit system is another thing altogether. There should be testing to prove that the design that has been implemented actually works. Some people use focus groups or surveys to try to improve usability but observation of human behavior in transit is a method venue that seems to be overlooked, focus groups and surveys tend to give results that are not the same as observed behavior of test subjects in the field.

There are many transit usability testing areas that could yield effective usability improvements; transit can be inconvenient, hard to find the way, uncomfortable, slow, dangerous and annoying. Many of the problems are unintended design artifacts that are barriers to transit use, removing the these barriers will improve the service dramatically. An quick and inexpensive usability testing program should be able to find improvements in procedure and infrastructure that will drop barriers to usability and raise ridership and the status of public transit in a cost effective
manner. Usability testing is used in many products and software systems, but I see none of it used for transit and transit suffers from many usability problems.

**III. OBJECTIVE**

*Include a clear, concise statement of the objectives (anticipated products) that are expected to be met by this particular research.*

A set of test objectives, scenarios and methods for public transit systems to test their own systems would be the objective. For example, a set of wayfinding and navigation test objectives, scenarios, test methods and the results of the testing as examples for other transit systems to use in usability testing would be an objective. Or a set of transit stop test objectives and scenarios and a method of testing the objectives and scenarios to evaluate transit stop usability would be the objective of the research. The methods researched should be inexpensive and quick to implement for transit systems to improve service quickly.

Some basic starting points to develop test objectives and scenarios:
- The people should be able to find routes to destinations.
- The people should be able to find and recognize the destination when using the transit mode.
- The people should not be stressed or uncomfortable using transit, and basic rights of people using the system.
- The people should be able to switch from one mode of transit, like car to bus or rail to bus, easily and with convenience.
- The people should be able to pay a fare conveniently and across the system with the same method and fare structure.
- The people should be able to have commute times that are close or better than auto only commute times.
- The people should be able to safely use and interact with the transit mode.

**IV. RESEARCH PROPOSED**

*Provide a statement of the specific research proposed, how it relates to the general problem statement in Section II and, if possible, the research approach and the tasks envisioned.*

- Usability testing of the navigation aids at transit stops, bus schedules, train schedules and maps. Design objectives and scenarios and testing methods to find and fix problems and so improve people finding the way through the transit system.
- Usability testing intermodal transit objectives and scenarios to find barriers to transferring from one mode to another.
- Usability testing configurations of transit stops to find configurations that work best and test solutions to reconfigure problem transit stops.

The above suggestions are just a few of the possibilities for transit usability. Comfort, fare structure, safety, security also can be researched.
V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: Include an estimate of the funds necessary to accomplish the objectives stated in Section III. As a general guideline, the present cost for research usually averages approximately $150,000-$250,000 per professional staff-year. TCRP projects typically are in the $300,000-$500,000 range. A detailed budget is not necessary.

Research Period: Provide an estimate of the period of time needed to complete the research, including 3 months for review and revision of a draft final report.

Recommended Funding:
I am sure a number of usability test objectives, scenarios and methods could be developed for $200,000 or one professional for nine months. I have some sample scenarios on my website: http://www.tc.umn.edu/~hause011, but of course I am just a person that tries to use transit to get to work and not a transit usability professional.

Research Period:
- 3 Months to plan and devise test objectives, scenarios and test methods.
- 3 Months to try out a set of tests of the objectives, scenarios and methods.
- 3 Months to review and revise the draft final report.

VI. URGENCY AND PAYOFF POTENTIAL

Include a statement concerning the urgency of this particular research. Identify and, if possible, quantify the potential and magnitude of payoff from the achievement of the project objectives. Any institutional, political, or socio-economic barriers to implementation of the anticipated research products should also be identified.

Public Transit, especially bus transit is considered a last resort for a method of travel by most people. Public Transit can be inconvenient, hard to find the way, uncomfortable, slow, dangerous and annoying. Usability testing and finding problems is the first step to finding solutions and improving the transit service to a public that may need a greatly expanded mass transit system in the near future. It would be better to expand the transit system in ways that work instead of repeating untested design problems. Usability testing is a proven method of improving quality in web site design, software design and product design. There is a good possibility that those results can be translated to results for improving transit systems in a quick and cost effective way.

There probably will be internal institutional barriers to implementing usability testing. No transit institution wants to actually test if their own transit system is usable, the results could be embarrassingly bad publicity and could show problems that are not easily or cheaply fixed. Without an independent testing group, testing can be affected by other internal institutional factors to mitigate this problem an outside or independent group should probably test the transit system. Of course, then there will be the problem of the transit system institution accepting the
usability testing and recommendations of the outside or independent testing group. I think these problems can be overcome in most transit institutions.

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

Categorize this problem statement using the FTA strategic initiatives and the TCRP Strategic Priorities.

FTA-TCRP Strategic Initiatives and Priorities here.

FTA Goals

(1) Increasing Ridership: Usability testing and the solutions found to usability problems should make the use of transit easier by removing the barriers to using transit, this will increase ridership.

(2) Improving Capital and Operating Efficiencies: "...contribution of specific innovations toward performance improvement..." Usability testing would be used for finding specific fixes to improve the performance and use of the transit system.

(3) Improving Safety, Security and Emergency Preparedness: "...provide practical solutions that work to increase transit safety..." Usability testing can be used to find safety problems and discover solutions for the specific safety problems found.

TCRP Strategic Priorities

I. Place the Transit Customer First: By definition usability testing is finding out what the customer really needs by testing, maybe not what they want from a survey or a focus group but what they really need to overcome usability problems in the transit system.

III. Continuously Improve Public Transportation: Usability testing is a process to continuously and incrementally improve the existing transit system with a very small capital investment.

IV. Flourish in the Multimodal Environment: Intermodal interfaces are filled with usability problems that need testing to find the problems and fix the problems found to make transit between modes easy and safe to use.

VIII. RELATED RESEARCH

If available, provide information on other research completed, in progress, or pending that is closely relevant to the proposed problem.
I would say the usability testing methods and work of Don Norman (www.jnd.org) and Jakob Nielsen (www.useit.com) are models of what could be accomplished, they have plenty of published work to give direction to researchers and show how to adapt a set of usability testing problems to the public transit system universe.

As a basic pattern I suggest the testing of transit systems be looked at like usability testing done by Don Norman who has a background in product and systems testing as well as software testing. Usability tests could be run as described by Jakob Nielsen, small numbers of test subjects given an objective and test scenario, a test observer records problems encountered by the subjects and fixes can be effected as fast and cheaply as possible. Hueristic analysis by usability interface designers and testers should be able to get some basic test scenarios objectives and testing methods to quickly point out easy to find and fix usability problems in the transit systems.

In transportation a usability study of transit websites was done: usability guidelines for transit websites by testing. The point of this problem statement is to extend the usability testing to the rest of the transit system: intermodal transfers, signs, maps, navigation and wayfinding, transit stops, paying fares, fare structure, interactions with bus drivers, safety, and not just limit usability testing methods to transit web sites.

There is also research in transit called "human factors" such as Guidelines for the Location and Design of Bus Stops 1996 TRB that includes some field studies which are similar to the research proposed here. I noticed that the field studies did not check northern climates where snow can be a factor. I would also note that Twin Cities Metro Transit does not seem to follow these bus stop guidelines over the last 11 years and an new emphasis on human factors and usability is needed for transit to focus on field studies to show whether or not transit systems comply with recommended designs and whether the designs have usability problems.

A Multidisciplinary Approach Toward Improving Bus Schedule Readability 2004 also includes field testing the bus schedules by users which is in the spirit of this proposed problem.

IX. PERSON(S) DEVELOPING THE PROBLEM

Provide the specifics (i.e., name, title, address, telephone, and fax numbers) for the person(s) who developed the problem. Name: Steven Hauser Address: Minneapolis, MN Email: hause011@umn.edu Email me for specific address and contact details.

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

State whether this problem statement is the product of an individual, a formal committee, or another group.

The idea for the problem was developed through a series of articles on public transit usability testing that I have published. An article, Usability Testing Transit and Bus Wraps, may have influenced Metro Transit in Minnesota to change bus wrap policy from full window covering
wraps to covering only %50 of the windows to improve the usability of buses for riders and drivers and another article on usability testing transit comfort may have influenced Metro Transit of Minnesota to re-upholster seats on 180 buses that had no seat padding. Other articles are included in a list below.

XI. DATE AND SUBMITTED BY

Provide the specifics (see Section IX) of the person(s) who submitted the problem and the date of submission.

Steven Hauser submitted this problem June 8, 2007.

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

Other transit usability articles:

Bus Transit Usability Problems with Commercial Advertising.
Transportation Usability Testing, a New Field.
Fare Structure Barrier to Transportation Usability.
Bicycle Network Usability Testing Finds No Network.
Transit Network Navigability Usability Testing.
Transit Network Usability Testing Comfort.
Transportation Usability Testing Bus Shelters and Stops.
Testing Transit Usability Testing of Metro Transit
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 insulated 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 caused 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 tests 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 tests 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 bars 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
I. PROBLEM TITLE

A.C. Circuit Breaker Re-ignition Transients Creating Resonant Overvoltages in Traction Power Rectifier Transformers

II. RESEARCH PROBLEM STATEMENT

There were two sequential failures of 26.4 KV/490V, 3 MVA, ANSI 25, 26 traction rectifier transformers in a single traction substation. The 2nd transformer failed upon being installed and energized as a direct replacement for the first failed transformer. The 2nd transformer was completely factory tested prior to being placed into service.

From the nature of the failures (turn/winding fault in the middle of the center coil), it was speculated that a resonance overvoltage phenomena within the transformer windings had occurred, possibly due to the transients associated with the line side vacuum breaker operation. The theory is that a resonant overvoltage may be generated within a transformer’s windings if the circuit breaker re-ignition transients create a transient frequency which matches a natural frequency of the transformer. Additionally, there are numerous traction power transformer failures suspected of the same cause of failure in the transit industry.

III. OBJECTIVE

Development of an application guide and testing methods to demonstrate in a practical sense (without resorting to speculative, extensive and expensive modeling) the precise factors which create resonant condition within a substation, so that it may be addressed by either the equipment manufacturers or through proper equipment layout in the substation during the design stage.

IV. RESEARCH PROPOSED

Gather data on transformer failures within the transit environment. Supplement data with other applicable industry transformer failure information.

Identify, organize and describe the reasons for transformer failures focusing on failures associated with re-ignition.

Determine location of failures within the failure listing. Ascertain if failures were associated with vacuum circuit breakers. Research power feeder cable electrical characteristics associated with failures. Prepare a matrix of failures ad causes.

Determine through engineering analysis if the “pingtest” is a viable and accurate method of determining presence of resonance overvoltage by transience associated with vacuum breaker operation to damaged transformers. Evaluate the necessity of
applying snubber circuits to transit transformers to eliminate failures due to transience associated with vacuum breaker operation.

Generate guidelines that will provide approaches for engineers to apply results of research in designing and operating transit system power transformers.

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.

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

While the current available data does not indicate any failures associated with resonance associated with vacuum circuit breakers; there have been significant number of transformer failures that could possibly be the result due to vacuum circuits technically in transit power systems. It is suspected that significant number of transit failures are a result of this phenomenon. The pay off potential is associated with capital cost of new and existing transit power systems which could result in reduction of cost to the FTA.

There is no institutional, political, or socio-economic barriers to implementation of the 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  
June 15, 2007
I. PROBLEM TITLE
The Use of Composite Link Slab in Bridge Repair

II. RESEARCH PROBLEM STATEMENT
The bridges in North America face a persistent and costly performance and maintenance problem resulting from deteriorated deck joints. According to the 2004 National Bridge Inventory (NBI) data, 70% of the highway bridges in United States are designed as single or multiple simple-span structures (FHWA 2004). The joints are used to accommodate deck thermal movements as well as other short and long-term movements; however, they tend to deteriorate and leak causing superstructure and substructure damage, due to:

1. Contaminated deck drainage water leaking through joint openings and damaging the superstructure and the pier caps below, there by destroying vital bridge parts, such as prestressing cable anchorage systems, beams, and bearings.
2. Accumulated debris that causes increased pavement pressures that squeeze bridge decks.
3. The high risk of span separation of multiple simple-span bridges due to earthquakes or flood and water surge during hurricanes. The use of short bearing seats at the joints was the main cause of several bridge failures during earthquakes in the last few decades.

An excellent solution to reduce the multimillion dollar rehabilitation/maintenance costs, improve riding quality, lower impact loads, and improve seismic resistance is to eliminate the joints and have continuous jointless decks providing a concrete link slab, made of cementitious and composite materials. Both numerical and experimental investigations are being developed to address the unresolved issues of link slab flexural rigidity, to analyze the behavior of bridges with partially debonded jointless decks, and to explore using a link slab of ductile composite materials that reduce potential cracking and achieve high durability. The performance of link slabs will be evaluated by testing link slab specimens with the modified composite materials and comparing them with those of an ordinary reinforced concrete (RC) link slab. The mode of deformation, fatigue cracking resistance, and design of link slab and crack width will be discussed.

III. OBJECTIVE
1. Investigate the feasibility and performance of an innovative jointless bridge system that eliminates expansion joints and thus reduces construction and maintenance costs.
2. Design and experimentally investigate the performance of the link slabs of composites (fibers in the concrete mix) and monitor their behavior that meets the conflicting requirements of maintaining both adequate strength and flexibility. The data will be used to verify the link design and investigate its durability. The data collected from previously done field work and from literature review will be used in developing performance prediction models for the Fiberglass Reinforced Plastic (FRP) and conventional link slabs.
3. Investigate several types of FRP materials (e.g. glass and carbon) used for link slab reinforcement to determine the most cost-effective one.
4. Develop a simple software to compare with a numerical finite element analysis capable of analyzing both composite and non-composite, fully continuous and non-continuous beams, and continuous deck-simple beam systems, having different steel reinforcement ratios in the deck, under different loading and support conditions.
IV. RESEARCH PROPOSED

The proposed research design investigates a jointless system that has a link slab connecting two adjacent simple-span girders to eliminate the deck joint. The negative moment developed at the joint location, subjecting the link slab to a tensile force will also be investigated. The tensile strain developed at link slab will be reduced due to the debonding effect. The purpose of the analytical program is to study the feasibility of the proposed partial continuous system as an alternative design method for jointless bridge decks. Validation of this analytical study with field and experimental test results is also essential to verify analytical procedures proposed through this study and developed by other researchers. The main parameters investigated in the analytical program are:

1. Stiffness ratio (girder vs. deck connection element)
2. Types and amounts of reinforcement (Steel, FRP)
3. Different fibers in the concrete link slab and the optimum concrete mix design suitable for crack reduction
4. Optimum length of link slab (optimum debond length), and types of supports
5. Effect of time-dependent material behavior and temperature effects.

Research Tasks
1. Review all available literature pertaining to jointless and integral bridge construction and analyze the results of existing experimental studies.
2. Develop a new analytical tool to extensively investigate various parameters that affect the behavior of the jointless system.
3. Conduct experimental investigations on different jointless systems with different composite materials to verify the developed analytical model. Experimental study on the proposed new system will be done by testing a full-scale link slab portion, replicating the end rotations imposed on the link slab by the adjacent spans in a bridge, using the actuator in the University of North Florida laboratory facility.
4. Laboratory testing of different concrete mixes having fibers in the concrete link slab under flexure, axial tension, cyclic loading.
5. Experimental investigations, simplified software, charts and tables developed, based on the analytical tool, will be introduced to help designers in implementing the jointless system design.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $300,000
Research Period: It is anticipated that the proposed tasks and completion of the research will be conducted in two years.

VI. URGENCY AND PAYOFF POTENTIAL

Urgency: It is essential to preserve the huge investment in our bridges that face a persistent and costly performance and maintenance problem resulting from deteriorated deck joints. This study will address the overlooked issue of the relative stiffness of the girder to connection element and how this affects the modeling. The bridge engineering community has not fully adopted the technique of bridge integration and some departments of transportation that adopted the jointless deck still design it simply as supported girders.

Payoff potential: The research outcome will undoubtedly reduce both construction and maintenance costs which will benefit the economy nationwide. The investigators believe that the jointless system has many advantages that bridge engineers have yet to utilize, in both design and using new materials. The proposed research will provide engineers with a simplified analysis tool to assist in the engineering of girders with jointless deck systems. The acceptance of the proposed research will result in savings in cost and design time of jointless bridge systems.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

The proposed research will contribute to improving capital and operating efficiencies through eliminating maintenance and initial costs. The elimination of joints is considered to have a great impact on the economics of bridges. Also, it helps provide safer bridges by eliminating problems with vulnerable concrete, steel, and prestressing steel. The proposed research focuses on better ride-ability for the customers by providing a smooth continuous deck, reducing the impact imposed on the vehicles at the joints, and providing a design tool for engineers to optimize their design.

VIII. RELATED RESEARCH

Wing and Kowalsky evaluated the link slab concept proposed earlier by Zia, Caner, and El-Safty. Engineered Cementitious Composites (ECC) was proposed to replace conventional concrete slabs in Michigan. Kim et al. evaluated the performance of link slabs designed with ductile ECC experimentally. Although the life-cycle analysis performed by Keoleian et al. has indicated that ECC link slabs has significant advantages over conventional steel expansion joints, the high cost of ECC material ($540/m3) compared to conventional concrete ($100/m3) is a major concern to some departments of transportation. Also, the quality control of casting ECC link slabs is the field is another concern due to its significant impact on the long-term performance of these slabs.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

The problem statement is the product of individuals.

XI. DATE AND SUBMITTED BY

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June 15, 2007
I. PROBLEM TITLE
Cost/Benefit Analysis of Converting a Lane for Bus Rapid Transit (BRT)

II. RESEARCH PROBLEM STATEMENT
Existing freeway systems are at capacity with very little room to expand. Additional freeway lanes are either cost prohibitive or physically not feasible. Without additional freeway capacity, congestion will increase. In some urban areas (e.g. San Francisco) we are in critical dispute with local entities about how to manage our state system. Local agencies want BRT on state system, even if it means taking a lane. Most state agencies are against this, causing strife with partners. State agencies need help in developing criteria for when it is appropriate to take a lane, even if it causes some congestion of vehicles in mixed flow.

Bus Rapid Transit advantage is due to bus only lanes. Based on past experience, some DOTS will not convert existing lanes to HOVL. Traditional highway performance is based on vehicle throughput and not people throughput. Possibly research the change of measuring person throughput, which may be a cultural and technical change.

III. OBJECTIVE
The project objectives are: (1) to locate and assemble documented information; (2) to learn what practice has been used for solving or alleviating the problems; (3) to identify all ongoing research; (4) to learn what problems remain largely unsolved; and (5) to organize, evaluate, and document the useful information that is acquired.

IV. RESEARCH PROPOSED
Study the effectiveness and public feasibility of converting an existing lane to a High Occupancy Vehicle Lane (HOVL) and other options to increase capacity of moving more people over vehicles. In other words:

Review Operation Effectiveness including: a) Operational effectiveness of lane conversion on freeways b) Operational effectiveness of lane conversion on conventional highways.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $125,000
Research Period: unknown

VI. URGENCY AND PAYOFF POTENTIAL
This research is urgent as many state agencies are in need of developing design criteria for BRT concepts for street re-alignments, geometric considerations, right-of-way acquisition, signal preemption, dedicated/shared bus ways on major state arterials, and integrating BRT into existing and future managed lanes (HOT/HOV). The joint partnership with transit agencies and other private/public partnerships will help state agencies in developing, identifying, and evaluating the analysis tools and methodologies required to plan BRT. Integrating BRT into existing and future management lanes will be instrumental in
planning and designing case studies. By maximizing transportation system performance outputs and increasing accessibility will result in increases in transit ridership and improved air quality.

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

This research will assist in advancing of the FTA’s strategic goals (1) Increasing Ridership and (2) Improving Capital and Operating Efficiencies, as well as the TCRP’s strategic priorities (1) Place the Transit Customer First (2) Enable Transit to Operate in a Technologically Advanced Society (4) Flourish in the Multimodal Environment and (5) Revitalize Transit Organizations.

VIII. RELATED RESEARCH

East Bay BRT Project, San Leandro/Oakland/Berkeley (DEIR, MIS)
SF Van Ness BRT Project, San Francisco (Feasibility Study)
HOV/HOT Lane Study, San Francisco Bay Area (conversion of HOVL to HOTL)
Freeway Transit Lane Demonstration Project, San Diego (transit on shoulders)

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

California Department of Transportation (Caltrans)  
Division of Mass Transportation  
Strategic Research Process

XI. DATE AND SUBMITTED BY

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June 15, 2007
I. PROBLEM TITLE
Return of the Streetcar: Implications for Design and Maintenance of streets and tracks

II. RESEARCH PROBLEM STATEMENT
As streetcars are re-introduced to the streets of America’s cities, advanced technologies for better pavements, tracks, stations and power delivery should be employed to reduce the inherent adverse effects of streetcar infrastructure and operation in mixed traffic.

III. OBJECTIVE
This research will produce a state-of-the-art report that will be a benefit to public works departments, local authorities, and transit operators as they seek to construct new streetcar systems in mixed-flow traffic settings. New design, construction and maintenance methods may be required to accommodate the modern-day streetcar operation, whether related to sub-structures and pavements to reduce noise and vibration or related to overhead trolley wires or catenary’s lines. Requirements for special infrastructure (lane widths, pedestrian crossings, signal priority) may require new policies, legislation and legal initiatives.

Tasks for this research would include (a) a review of state-of-the-art strategies for improving street structures and environments for streetcars, (b) a review of streetcar systems (worldwide) that have introduced new technologies, (c) preparation of detailed specifications and drawings of the applied technologies, (d) evaluation of six to eight case studies, (e) documentation of the results, and (f) development of a state-of-the-art design and construction report.

IV. RESEARCH PROPOSED
Develop a model based upon the initial post processing adjustment work. Develop an evaluation methodology to apply to TOD projects after they are implemented and operating.

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

VI. URGENCY AND PAYOFF POTENTIAL
Recently implemented streetcar systems have been closely related to the enhancement and revitalization of commercial, entertainment and residential districts. From an engineering perspective, there are major issues related to the disruption and design issues related to the construction of the railway trackage on existing thoroughfares. The application of modern construction methods and vehicle power technologies may reduce cost of installation and maintenance and speed-up projects. Much has changed in our knowledge of roadway and railroad design and since the 1900s (when 22,000 miles of streetcar track handled the operation of over 60,000 streetcars in the U.S.). This report will highlight modern engineering approaches that have been shown to enhance the final product, speed-up its construction, and contain the overall costs.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
This project supports FTA Strategic Goals 1, 2, 3, 4 as well as TCRP Strategic Priorities I, II, III, IV, and V.
VIII. RELATED RESEARCH

The literature reveals that many cities are promoting the re-emergence of the streetcar on public roads and streets. In the Western States of Oregon, California and Washington, the cities of Portland, San Francisco, San Pedro, San Jose, Seattle and Tacoma now operate modern, vintage (antique) or heritage (replica) streetcars on downtown thoroughfares.

For safety and maintainability, tracks placed where autos and pedestrians share the right-of-way call for new paving methods and materials to improve ride/wear and to reduce vibration and noise. Recent innovative methods include embedded rail in asphalt (ERIA).

Installing overhead-wire power contacts creates unacceptable visual intrusion in many urban settings. One alternative is the ground level switched contact system that is only active while a streetcar is passing over it. Roadway-powered electric vehicles may also become viable as will other autonomously-powered vehicles.

Streetcars typically interact with mixed-flow traffic and are a potential factor in serious pedestrian and vehicular accidents. Designs of stations and intersections need special treatments for safer operation.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

California Department of Transportation (Caltrans)
Division of Research and Innovation
Strategic Research Process

XI. DATE AND SUBMITTED BY

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June 15, 2007
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.
- Provides 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.
- Provides 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

Transit Passengers’ Safety & Costs - Blue Collar Workers’ Best Practices

II. RESEARCH PROBLEM STATEMENT

Transit is a labor intensive industry which may fail to fully utilize the knowledge of all workers in providing safe, dependable, effective and efficient service. Transit demand is increasing due to oil prices and market leaders’ emphasis on “going green” Transit demand is increasing due to aging of population and other socio-economic factors. Many transit workers will be retiring over the next 10 years, creating recruitment and training demands of new workers. The new workers may have English as a second language and need innovative training methods for quick/effective learning of their new tasks. Standard Transit training follows Pedagogy methods rather than Andragogy (Malcolm Knowles- Adult learning model).

III. OBJECTIVES

1. State of the art summary of current training practices of transit systems compared to public and private organizations. Objective obtained through 200 hours of literature search.

2. Documented training methods, tools and results of 50 FTA supported transit systems - Survey.

3. In depth review of training impact on safety, dependability effectiveness and efficiency at 10 transit systems through Case Study – Telephone & personal visits.


IV. RESEARCH PROPOSED

1. Literature search to determine and document current training practices within and outside transit industry. Special emphasis will include peer to peer solutions, visual/auditory/kinesthetic examples of incremental improvements. Sampling of learning methods utilizing technology based training, contests and rewards systems. Literature search and documentation of finding 200 hours.

2. Documentation of training methods, tools and results will be completed through survey of 50 randomly selected transit properties listed in National Transit Database.

3. Case study of 10 transit properties will include with survey interview with 3 drivers, maintenance and cleaning staff members, 1 immediate supervisor, operations manager, CEO and chair person on governing body. Target is to determine current training models impact on rider’s safety, the service’s dependability, effectiveness and efficiency. Blue collar workers and supervisor will be queried concerning their perspective and improvements in training methods.

4. Final report will be summary of quarterly progress reports and detailed summary of finding plus indications of additional research needed.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
**Recommended Funding:** $280,000 estimate of the funds necessary to accomplish the objectives stated.

**Research Period:** 21 months estimated time needed to complete the research, including 3 months for review and revision of a draft final report.

VI. **URGENCY AND PAYOFF POTENTIAL**

The research project proposed may prove worthless, but may open up further research and study of systems to create tremendous long term value in transit service. Demand Response Transportation (DRT) is least safe for individual customers/guests and requires the greatest subsidy from taxpayer’s. DRT holds best opportunity for return on training investments. DRT provides the best opportunity for applied research, in addition the DRT offers a smaller target population of only 34,000 Blue collar workers.

Further improvements could be identified:

1. Employee attitude toward their work through personal and professional training recognition
2. Reduced training expense
3. New application of vendors existing or improved goods/services
4. TRCP, TRB and America’s Transit industry receiving credit for leadership in researching better training and best practices systems within service sector.

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

1. Riders could experience improved service through their driver’s easy access to state of the art best practices. With the improved service, projections include increase frequency of use by existing riders and expansion of individuals using DRT. The number of riders served per hour/mile will increase at a higher rate than costs by the improved effectiveness of industry’s access to best practices. Service alternatives are also expected to be better tailored for the individual rider. More progressive transit properties may have Riders take an active role in selecting their service from a menu of best practices.

2. Transit Industry workforce might decide to test and use the cutting edge technology. “Babel Fish” or other translation program could provide translation of information into most languages, allowing transit to broaden labor pool when recruiting new workers.

3. As a labor intensive industry, personnel is Transit’s greatness operation expense. An example of best practices creating 1 cent net value in safety or effectiveness for 73 million trips would have a $730,000 impact in costs. Value would provide for better service or over 45,000 additional trips without increase in cost for taxpayer.

The research fits better with the TCRP strategies of

1. Customer First- by improving the safety and effectiveness of DRT service improvements projected for both riders and prospective riders. DRT Customer base extends past the people eligible for DRT under ADA and includes their family, friends and loved ones. Tax payers helping
subsidize DRT are another customer group and may recognize the efforts to be good stewards of their cash subsidy.

2. The research can build a basis for further technology use in transit industry by introducing applied technology to hourly workers and first line supervisors.

3. Transit industry does well with implementing major improvements, but incremental improvement (<1 cent), even if recognized, may fail to meet the criteria for distribution outside immediate work team.

4. The research and publicity on the research project should help revitalize transit industry by

   4.1 Helping identify and apply “off the shelf” Information technologies while (4.2) facilitating easy transfer of personal knowledge within transit’s changing work force. 4.3 Partnerships throughout the community of practice may result and expand with people outside the COP.

Categorize this problem statement using the FTA strategic initiatives and the TCRP Strategic Priorities.

VIII. RELATED RESEARCH

Although over 50% of gross national product is based on service sector, research is generally limited relating to service sector. Much of the existing research is focused for use by upper management, even American Productivity and Quality Center (http://www.apqc.org) has little available in task specific products for typical entry level or low skill service worker.


The knowledge management work by World Bank (http://www.worldbank.org/ks/km.html) and NASA (http://appl.nasa.gov/businessunits/knowledge/articlesnews/articles_nets.html) are better examples for entry level personnel.

Universities have already completed work in the area of Knowledge Management. Among the more progressive are Indiana University Bloomington, MIT, University of Texas and Harvard. University of Wisconsin. is exploring the use of contests in adult education (http://www.wistech nology.com/article.php?id=958 & http://www.educationarcade.org/)

KNEXA Solutions LTD. (http://www.knexa.com/) this research project might include examples of systems.
Kevin Kruse has begun some excellent work with his introduction to Instructional Design and use of the ADDIE system. Mr. Kruse co-authored the book Technology-Based Training
IX. PERSON(S) DEVELOPING THE PROBLEM

Bill Osborne, Director - Southeast Missouri Transportation Service (SMTS), Inc, 700 Highway 72 East, Fredericktown, MO. 63645.0679- 800.273.0646V -573.783.55050 V- 573.783.7011 F bill@ridesmts.org

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Problem statement is the product of B. Osborne. Special thanks for training, assistance and support of Malcolm Campbell, Northeastern University Boston, George Smucker University Indiana, Dave Cyra University of Wisconsin, Don Boesch, University of Missouri Extension, Linda Yaeger, OATS, Mokhtee Ahmad, Federal Transit Administration, Steve Billings, John Rice and Shirley Tarwater Missouri DOT, Lianna Stover, Stover Data Systems and Chauncy Buchheit, Regional Planning and Economic Development Council. As well as Current Works by John Naisbitt, Malcolm Gladwell and Kevin Kruse.

XI. DATE AND SUBMITTED BY

DATE – 31, May 2007- Submitted by Bill Osborne, Director - Southeast Missouri Transportation Service (SMTS), Inc, 700 Highway 72 East, Fredericktown, MO. 63645.0679-800.273.0646V -573.783.55050 V- 573.783.7011 F bill@ridesmts.org

Submitted:

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TCRP Research Problem Statement

I. PROBLEM TITLE
Maximizing Benefits and Addressing Challenges of Volunteer Driver Transportation Programs

II. RESEARCH PROBLEM STATEMENT
Since the mid to late 1970s, the use of volunteers, and particularly volunteer drivers, has become an increasingly popular strategy to accommodate the unmet mobility needs of seniors and, to a certain extent, other transportation-disadvantaged people. This is particularly the case in rural areas where more traditional transit and paratransit strategies are cost prohibitive. Formalized volunteer driver programs have become a staple for many transit and human service agencies, sometimes as a stand-alone program or as one component of a broad array of transportation services. In the last decade, organizations dedicated to the delivery of services to seniors or others solely through volunteer drivers have been formed throughout the United States. The Beverly Foundation, for example, has a database of almost 400 volunteer driver programs reflecting a variety of program models. Examples of different models include:

- TRIP Volunteer Friends model in Riverside, CA
- Ride Connection volunteer driver and brokerage program organized by Tri-Met in Portland, OR
- YCCAC paratransit service in York County, ME, that includes a volunteer driver program;
- Caregiver program in West Austin, TX, organized by an interfaith community and linked to seven programs in the Greater Austin area
- Independent Transportation Network in Portland, ME.

These particular examples have budgets that range from $65,000 to $5,000,000 and provide service in a wide variety of settings including urban, suburban, and rural locations. They also have stood the test of time, averaging more than 18 years of operation. States have also recognized the value of volunteer driver transportation services. For example, volunteer drivers are used extensively by the coordinated community transportation providers in Vermont, in large part due to a statewide insurance policy that covers volunteer drivers. And the state of Maryland has recently initiated a grant program to fund public, private and faith-based organizations with volunteer transportation services for low- and moderate-income seniors.

The role of volunteer-based services is one of many important strategies to serve seniors, people with disabilities and those with low incomes. For many customers, the provision of such services can make the difference between mobility and immobility by enabling them to reach both life-sustaining and quality-of-life destinations. Volunteer drivers often can provide a much higher level of assistance and a “personal touch” absent from other modes. For transit agencies, and particularly public transportation providers in rural areas, volunteer drivers can provide a cost-effective way to service remote areas and make crucial longer distance trips to medical centers or dialysis facilities. Indeed, using a volunteer driver is often the only practical way to serve such trips. In all areas, senior centers, churches and faith-based organizations, and other human service agencies rely on volunteers to get seniors and others to agency programs and services, food shopping, religious services, and personal activities such as banking, lifelong learning, and personal shopping.
Moreover, with a growing need and limited resources for senior transportation funding, volunteer driver programs present a cost-efficient resource to senior and community transportation service delivery networks.

We often hear about the success stories at the expense of learning from those that did not succeed. Indeed, the difference between success and lack of success can be traced to many factors such as volunteer driver recruitment and retention strategies, requirements for driver screening and insurance coverage, driver training, driver reimbursement and subsidies, drug and alcohol policies, provision of and maintaining vehicles, vehicle safety and management practices, among many others. Furthermore, although recently retired seniors comprise the vast majority of volunteer drivers, insurance and tax issues, as well as safety concerns, can deter the recruitment and utilization of many older volunteers. Clearly, research on the national level is needed to identify the factors which contribute to the success of volunteer driver programs in different settings. Beyond that, additional research is needed to determine the community benefits of such programs. The areas that have proved problematic for the programs, such as insurance, also need research. The following questions are central to this proposed research:

1. In what settings are volunteer driver programs meeting unmet needs and filling gaps as an alternative or supplement to other service modes in transportation networks?
2. Where, when, and in what ways do volunteer driver programs complement or compete with public and/or private operators; and, in what settings might such programs hinder the growth of public or private providers?
3. Why do certain volunteer driver programs succeed and why do others not? Are there common factors for success or lack of success? What operational characteristics are central to successful programs and what elements of the program enhance a program’s long-term sustainability?
4. What additional metrics beyond those commonly used for demand-response transportation are currently used and should be used to measure the success of volunteer driver programs?

III. OBJECTIVE

National research is needed to identify:

1. The optimal role of volunteer drivers for organizations that are responsible for providing/purchasing transportation; and where and when and for which types of trips such benefits and shortcomings materialize;
2. The settings where volunteer driver programs complement vs. compete with other transportation providers;
3. The role of insurance as a major impediment to volunteer drivers programs,
4. Best practice methods, policies and procedures, program elements, operational characteristics, and models in various settings that will help transit agencies and other organizations address the inherent challenges of using volunteer drivers and help increase the likelihood of program success;
5. The best methods and metrics to measure program success.
IV. RESEARCH PROPOSED

The proposed research should include a review of the literature in order to ascertain what policies, procedures, and other programmatic elements are currently thought to foster or thwart the success of volunteer driver programs. It will be relevant to look at existing research on transportation options, volunteer drivers, and senior and rural transportation options in general. In addition, the study should review and analyze existing volunteer driver program databases; while these databases exist, not much analysis has been performed. This research should be bolstered by targeted surveys on special topics such as the relationship of volunteer driver programs to paratransit services, private transportation services, and transportation services in rural America. The inclusion of case studies would serve to illustrate exemplary program elements, polices, models, etc., that match certain settings/environments. Each of these research methods is expected to provide insight into the benefits to the community in which they are located, the involvement of other human service and transportation services; and the impact on customers that use the services.

The research efforts and case study approach should also incorporate the experience with volunteer driver programs in other countries. There are successful volunteer driver programs in the U.K. and Europe, as well as in Japan, Hong Kong, and São Paulo. For example, the U.K. is experiencing a shift within the health service industry where health care providers are pulling out of non-emergency transport services and relying on volunteer drivers to get people to and from the hospital for appointments. In some rural areas of the U.K., this has resulted in a dearth of volunteer driver capacity for other (non-medical) trips.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

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

VI. URGENCY AND PAYOFF POTENTIAL

The planned research will provide a better understanding of (1) how volunteer drivers may be used to provide cost-effective service, especially in areas where more conventional forms of transit and paratransit are not possible or cannot meet all of the needs of persons with limited mobility; (2) the dynamics between volunteer driver programs and other public/private transportation services; and (3) the practices which contribute to program success.

As states and regions put together their response to SAFETEA-LU’s requirements for coordinated planning, it is important that entities that are developing strategies for their region consider the benefits and shortcomings of volunteer driver programs as a potential strategy in certain situations. This research will help establish those situations, and provide help toward implementing successful programs or re-structuring or revamping current programs that are struggling.

The urgency of this research is heightened by the rapidly increase in the nation’s population of older adults. The current community transportation services that are oriented to older adults are in danger of imploding as the population of older adults increases without sufficient federal funding dedicated to senior transportation. In almost every setting, and especially in rural areas, agencies responsible for senior transportation are looking for ways to stretch the federal and local funding that is available. Volunteer driver programs, in concert with coordination strategies, are certainly a
resource that can be tapped in certain settings to accomplish this goal. The need to provide to planners and policy-makers with better information about such programs has never been more critical than it is today.

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

This study is in line with 2008 TCRP strategic research goals of increasing ridership (complementary or sole provision of volunteer services creates ride opportunities to meet needs) and capital and operating efficiency (volunteer programs cost less to operate). It also supports the TCRP strategic priorities of placing the customer first (directing volunteer transportation to meet targeted needs) and flourishing in a multimodal environment (volunteer operations are another mode which can complement public and private services).

Volunteer driver programs have become a key component in many coordinated community transportation plans and services that have resulted from the FTA’s United We Ride initiatives, SAFETEA-LU requirements, and policy statements from the Federal Inter-Agency Coordinating Council on Access and Mobility. Volunteer driver programs are also key to the mobility of older adults, and sometimes are the only viable means of public/agency transportation in rural America.

VIII. RELATED RESEARCH

The Beverly Foundation, established in the late 1970s, is dedicated to fostering new ideas and options to enhance mobility and transportation for older adults, and has focused much of its research activity over the past 10 years on identifying and documenting transportation options for this population. The Foundation currently maintains a database of more than 800 STPs (Supplemental Transportation Programs for seniors) of which almost 400 are volunteer driver programs. The Foundation has also piloted a low-cost, low-maintenance model of volunteer driver transportation delivery (Volunteer Friends) that requires limited infrastructure and limited operational funding.

A number of older studies suggest that the topic is in need of a fresh look. These include:

- Evaluation of the Specialized, Volunteer Transportation Program of the Area IV Agency on Aging and Community Service2 (1987)
- Analysis of Volunteer Driver Systems in Rural Public Transportation3 (1979)

There are also a number of complementary studies that would benefit from the proposed study:

- State Laws on Volunteer Driver Liability Fact Sheet4
- Rural Facts: Supported Volunteer Rural Transportation Program5
- Volunteer Transportation Network Handbook6

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1 pubsindex.trb.org/document/view/default.asp?lbid=359087
2 ntlsearch.bts.gov/tris/record/ntl/5579.html
3 pubsindex.trb.org/document/view/default.asp?lbid=147461
4 www.aarp.org/research/housing-mobility/transportation/ncsl.html
5 rtc.ruralinstitute.umt.edu/Tn/SVRTfacts.htm
On the international front, the UK Department for Transport recently conducted a review of voluntary transport, while the Eastleigh Southern Parishes Older People’s Forum has produced a report on transport to hospitals in Hamble le Rice, which contains useful data on travel modes and stakeholder perceptions.

IX. PERSONS DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This volunteer driver program problem statement percolated to the top of the list of needed research topics at the meeting of the Research Subcommittee of TRB’s Paratransit Committee at the TRB Annual meeting in January 2007. Hal Morgan and Will Rodman volunteered to develop the problem statement. Helen Kerschner was subsequently recruited to assist with its development. At the 2007 Annual Meeting, the topic was brought to the attention of the Rural Committee and the Committee on Accessible Transportation and Mobility. Both committees indicated an interest. This problem statement was provided to the chairs and members of all three committees. Feedback from members of the three committees was used to revise the problem statement. The submitted statement has received an endorsement from the three committees.

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6 www1.va.gov/vhapublications/ViewPublication.asp?pub_ID=1572
7 www.dft.gov.uk/transportforyou/access/voluntary/
8 www.espopf.org.uk/sic_transit.pdf
XI. DATE AND SUBMITTED BY

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I. PROBLEM TITLE

Research to Identify and Address Causes of Demographic Disparities in Bus Operator Recruitment

II. RESEARCH PROBLEM STATEMENT

On Dec. 19, 2006, in response to concerns regarding inequities in Bus Operator recruitments at Miami-Dade Transit (MDT) and the disproportionately small number of non-blacks being hired in the position, the County commissioned an investigation into the causes of the disparities. The investigation and resulting Bus Hiring Practices report showed no evidence of intentional discrimination in hiring, but indicated that the primary reason for the disparity is that the percentage of non-black applicants compared to black applicants continues to be very low (between 23 and 36 percent since 1998). As a result, Hispanic females make up only 2.9 percent of the current class of full-time Bus Operators and 5.6 percent of part-time Bus Operators, despite the fact that Hispanics make up approximately 61 percent of Miami-Dade County’s population; while non-Hispanic white males and females make up only 2 percent of both full-time and part-time Bus Operators, despite making up 19 percent of the overall population. The County Manager directed Miami-Dade Transit, and the Communications, Employee Relations, and Fair Employment Practices departments to create a comprehensive plan to increase interest and participation in the County’s recruitment process, with measurable results to be achieved by the next recruitment scheduled for early 2008.

III. OBJECTIVE

The objective of this research is to determine the reasons for the low interest among non-black residents, and particularly Hispanic females, in applying for the position of Bus Operator with Miami-Dade Transit, and to determine what messages, training opportunities and other measures would be effective in encouraging more individuals from these underrepresented groups to apply.

IV. RESEARCH PROPOSED

The research is to be performed primarily through focus groups made up of Bus Operators and non-Bus Operators from demographic groups that are underrepresented among the current class of Bus Operators. Four focus groups of 15 members each are proposed, with the following make-ups: current Hispanic Bus Operators, current white Bus Operators, Hispanic non-Bus Operators, and white non-Bus Operators. The focus groups will be conducted by Carmen Morris and Associates and Creative Ideas Advertising Inc., A Joint Venture.

The findings of the focus group will be used to develop a comprehensive outreach and promotional campaign to reach the afore-mentioned underrepresented groups, to include the possible development of new training programs and partnerships, job fairs, print, radio and TV ads and promotional videos, etc.
Miami-Dade Transit also will evaluate industry best practices to develop a preparatory program which will enhance employability skills for future Bus Operators. MDT will evaluate the bus operator training program developed by Los Angeles Metropolitan Transportation Authority, which assists prospective applicants with taking the Bus Operator and Commercial Driver License test and completing the application and interview process, including instruction in vocational and Transit English, basic math, critical thinking, time management and study skills and customer service. While Miami-Dade Transit’s Bus Hiring Practices Report indicated that English has not been a significant obstacle for Hispanic applicants who take the test, the Focus Groups will determine whether otherwise qualified Hispanics are intimidated from applying in the first place because they lack English proficiency, and whether the availability of a free training program that includes instruction in vocational and Transit English would encouraged them to apply in greater numbers than in the past.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** This proposal is submitted as a statement of need. As such, the estimated funding of $100,000 to cover the cost of this research would require confirmation via a Request for Proposal process.

**Research Period:** The focus groups are to be conducted June 2007, with findings completed in early July 2007. Research into Bus Operator training development should be completed by October 2007.

VI. URGENCY AND PAYOFF POTENTIAL

The next Bus Operator recruitment will occur early next year, so it is critical that this research be completed and any resulting corrective measures be implemented as soon as possible in order to show a significant increase in the diversity of the applicant pool by the time of the next recruitment. This would demonstrate our commitment to being an Equal Opportunity employer and enable us to provide better customer service that more effectively meets the language needs of our customers and potential customers, especially the large population of Spanish-only speakers who may need to communicate with Bus Operators to ask them questions regarding a route’s destination, transfer and fare policy, trip planning, etc.

Furthermore, by helping MDT, overcome perceptions of bias (see Section VII below), it is believed that a more representative class of Bus Operators will have the desired effect of increasing ridership among underrepresented groups in proportion to the increase in their numbers among our Bus Operators. In addition, a more demographically diverse class of Bus Operators would be able to better meet the community’s language needs and therefore further contribute toward encouraging greater ridership among a wider cross-section of the community.

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

This problem statement may be categorized under FTA strategic initiative 1 (Increasing Ridership). Due to the disproportionately small number of non-black Bus Operators, Miami-Dade Transit currently suffers from a public perception that it discriminates against certain segments of
the community in hiring, which it is believed is having the effect of driving away customers who feel discriminated against. MDT’s 2007 Tracking Study, which includes a demographic profile of MDT passengers, appears to bear that out, as it shows that non-Hispanic whites, for example, make up only 2 percent of our passengers despite representing 19 percent of the county’s population.

VIII. RELATED RESEARCH

In the summer of 2006, the Los Angeles County Metropolitan Transportation Authority (Metro) approached Los Angeles Valley College for assistance with the development of a training program to provide skills training including vocational and transit English instruction to assist Hispanics with the application process.

IX. PERSON(S) DEVELOPING THE PROBLEM

Developed by Michael De Cossio, Chief of Advertising and Media Relations for Miami-Dade Transit; phone 305-375-1331, fax 305-375-6150, e-mail Mike1@miamidade.gov.

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the product of an individual.

XI. DATE AND SUBMITTED BY

This problem statement is being submitted by Michael De Cossio on June 15, 2007.
I. Problem Title
Exercising Decision Makers in Incidents that Disrupt Transit Operations

II. Research Problem Statement
Threats that disrupt transit systems are real and devastating. Threats come from natural disasters, such as hurricane Katrina, terrorist attacks, such as the train attack in Madrid, Spain, and accidents, such as an overturned truck carrying hazardous materials. Transportation organizations must be able to effectively coordinate, collaborate, and communicate with each other and local, state, federal, and military organizations in order to respond properly and recover quickly. Lack of experience in responding to critical incidents within an interagency environment is a long-standing problem. Transit agencies must understand the processes and procedures for information exchange within their own and other agencies as well as resource allocation, planning, execution and coordination activities associated with critical incident response from an interagency perspective.

Multi-agency training is an effective way to improve communication and collaboration prior to and during crisis situations. Usually this training involves tabletop exercises and live, full-scale exercises, which are costly and time consuming. Transit agencies need an effective tool to train decision makers to adequately prepare for and respond to incidents that disrupt transit operations. Using a computerized exercise tool is not only cost- and time-efficient, it also provides a safe and realistic environment in which to hone decision-making skills. Structured scenarios provide practice in situations that are strategically and cognitively relevant, and embed the time-pressure and information overload present in real-life situations. Training at the command-level provides practice in how to manage complex, dynamic situations, identify and mitigate problems, and coordinate with others to find effective solutions.

An exercise tool of this nature must be cost-effective, easy to setup and use, have readily available support, provide a measured assessment, and allow participants to exercise the resources and policies they use in every day life. The training tool should comply with guidelines and recommendations resulting from recent research efforts such as the Public Transportation Emergency Mobilization and Emergency Operations Guide (TCRP Report 86, Volume 7), Guidelines for Transportation Emergency Training Exercises (TCRP Report 86/NCHRP Report 525, Volume 9), Best Practices in Emergency Transportation Operations Preparedness and Response (FHWA Report), and the findings of the role of public transportation in emergency evacuation resulting from in progress research (TCRP H-35).

III. Objective
The objective of this effort is to create a version of the Emergency Management Staff Trainer (EMST) to train and exercise command-level transit personnel. The existing EMST system framework provides learners at all experience levels the opportunity to gain the knowledge, skills, and abilities needed to make timely and effective decisions in times of crisis. EMST is a scaleable and modular system, meaning it was designed to train decision makers in any domain by the addition of domain-specific “modules”. Modules are in development for National Guard Joint Operation Centers, state public health agencies, and civil aviation emergency operation
centers. An additional EMST module will be created for exercising decision makers within transit organizations.

Development of EMST for transit involves designing and developing realistic scenarios of incidents that impact public transit systems. Scenarios will be for individuals and teams within and across agencies with the purpose of increasing collaboration and preparedness of pre- and post-emergency incidents. The resulting system will use comprehensive instructional systems design techniques, cognitive task analysis (CTA), and critical decision methodologies. EMST training will provide automated assessments of performance and both automated and facilitated feedback.

IV. Research Proposed
This research will identify the training needs that address pre-incident preparations and post-incident response in transit emergencies and develop a transit module for EMST, for both individuals and teams (multi-agency and single agency). Training will focus on developing scenarios for large city subway and bus systems where multiple transit and emergency response agencies, both public and private, must coordinate. This training will focus on the mid- and upper-level decision makers within transit organizations.

Task 1: Conduct an instructional analysis. Review pertinent literature and current training programs. Perform a needs analysis, skill gap analysis, and a target audience analysis to establish the most pertinent training needs of the target audience. Develop an instructional design document that outlines the learning objectives along with the proposed learning strategies used in the scenario content.

Task 2: Conduct cognitive task analysis (CTA) with experts in transit security and emergency response. Ascertain how experienced responders conduct pre-attack/disaster planning and evaluate threat information to make vital decisions. Identify the specific situational cues and strategies used to interpret unfolding crisis events and make decisions. Gather information about post-event planning and response across various agencies and identify critical tasks, needs, and decisions both within and across agencies. Identify the training scenarios most relevant to transit authorities, along with the tough decisions and challenges they face during crises.

Task 3: Develop an EMST transit module. Develop training content and scenarios that enhance knowledge, increase situational awareness, promote collaboration, and challenge learners to make critical decisions about transit safety and security. Develop instructional content from defined learning objectives to teach at the application, analysis, synthesis, and evaluation levels of learning.

Task 4: Post-training effectiveness tests. Post-training assessment of the training provided by the transit module of EMST will allow for further gap/needs analysis, training development, and security enhancements. Effectiveness tests should assess both EMST and student skill acquisition and knowledge development.
V. Estimate of the Problem Funding and Research Period

Table 1. Rough Order of Magnitude (ROM) cost and period of performance.

<table>
<thead>
<tr>
<th>Task</th>
<th>ROM Estimate</th>
<th>Period of Performance</th>
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<tbody>
<tr>
<td>Task 1: Conduct Instructional Analysis</td>
<td>$80K</td>
<td>3 months</td>
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<tr>
<td>Task 2: Conduct CTA with experts in transit agencies, emergency</td>
<td>$100K</td>
<td>3 months</td>
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<tr>
<td>operations</td>
<td></td>
<td></td>
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<tr>
<td>Task 3: Develop interactive scenario-based training and simulations</td>
<td>$170K</td>
<td>6 months</td>
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<tr>
<td>Task 4: Post-training effectiveness tests and final report</td>
<td>$50K</td>
<td>6 months</td>
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<tr>
<td><strong>Total:</strong></td>
<td><strong>$400K</strong></td>
<td><strong>18 months</strong></td>
</tr>
</tbody>
</table>

VI. Urgency and Payoff Potential
There are many services and tools available to help organizations train and exercise for emergency situations. Very few, if any, are available free of charge. A training tool that is government-owned and freely available to transit organizations would provide a significant return on investment in terms of overall transit community preparedness. Being free also greatly increases the chances that the transit community will put the tool to use.

EMST for transit will simplify the task of organizing and facilitating training exercises, providing potential for big payoff. The predecessor of EMST, AEAS, is a similar system for emergency response exercises. Evaluation of AEAS training during a National Guard Civil Support Team event showed that using AEAS required less exercise planning and support personnel than traditional training. Parallel exercises were run; two with AEAS, one without. The two AEAS exercises used a total of five support personnel, while the single traditional tabletop exercise used six\(^1\) (Tamash 2005).

VII. Relationship to FTA Strategic Goals and Policy Initiatives and TCRP Strategic Priorities
FTA Strategic Goal (3): Improving Safety, Security and Emergency Preparedness. A tool for training and exercising interagency coordination before and during emergency incidents will meet this Strategic Goal. EMST is a new technology that can provide a useful and cost-effective training and exercise solution for transit organizations. Transit organizations will be able to train with EMST to enhance their collaboration and coordination skills, resulting in entire communities that are better prepared for emergencies.

TCRP Strategic Priority #I: Place the Transit Customer First. Transit organizations that are better trained and prepared can only increase the safety of transit customers during day-to-day activities, as well as in times of crisis. The public will gain a greater sense of security knowing that transit organizations are conducting joint training and exercise events in an effort to improve coordination between organizations and with emergency response agencies.

TCRP Strategic Priority #II: Enable Transit to Operate in a Technologically Advanced Society. Using a system such as EMST, which represents the latest technology in training simulation systems, allows for easier and cheaper training for transit organizations. EMST incorporates easy to use tools for modifying training so it can remain relevant as organizations and threats change.

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TCRP Strategic Priority #IV: Flourish in the Multimodal Environment. Transit organizations who utilize EMST to train and exercise their personnel will be better prepared to answer questions and provide guidance to state and local emergency response decision makers during crisis situations. In addition, they will be more involved in their communities’ disaster planning/recovery efforts by using EMST capabilities to facilitate joint training with state and local decision makers.

VIII. Related Research
The cognitive components of threat assessment and crisis response are vital to understanding the cues and factors that impact situation-shaping decisions both before and after incidents. Research has shown that improving sensemaking abilities and situational awareness enhances ability to take effective actions. Experienced decision makers continue to develop these skills until they become automatic, or intuitive. By eliciting this knowledge from experienced decision makers, it is possible to pass their skills on to less experienced decision makers (Crandall, et al., 2006; Klein, 1998). Researchers have used CTA techniques to uncover and describe the tacit knowledge and cognitive strategies of experts in a multitude of complex domains, ranging from military command and control, to baggage screening, medical emergencies, military time-sensitive targeting, and tactical urban operations. This knowledge contributes to the development of training systems that address crisis preparation, pre-incident threat assessment, and post-incident response.

The Airport Cooperative Research Program for FY2007 has funded a version of EMST for civil aviation communities. The project is ACRP 04-04, titled “Exercising Command-Level Decision Making for Critical Incidents at Airports”. Although the EMST modules for airport and transit training would be separate tools containing scenarios most relevant to each domain’s needs, they both leverage EMST so joint training is possible.

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 named above and their colleagues.

XI. Date and Submitted by


I. MAINTENANCE OF NON-ATO TRAIN OPERATOR PROFICIENCY

II. RESEARCH PROBLEM STATEMENT

Communication Based Train Control (CBTC) became operational on the “L” Line at New York City Transit (NYCT) in 2006. One component of CBTC is Automatic Train Operation (ATO), a function which controls train movement automatically without extensive intervention by train operators. NYCT intends to implement ATO by the end of 2007.

ATO will automatically adjust operating speeds and train braking as well station stops. Train operators must depress the ATO START Button to engage ATO (when available) and whenever the train comes to a stop. Train operators must also depress a safety indicator (the Alerter Button) every 20 seconds or less. This feature provides a visual and audible indication to the train operator that ATO is controlling movement of the train. If the Alerter Button is not pressed and released every 20 seconds (or less) the Alerter Push Button will flash orange and an audible alarm will sound. If ignored, an emergency brake application will occur.

Should CBTC fail at any time, all trains will be required to operate in a Restricted (non-ATO) Mode wherever they are located on the “L” Line. The maintenance of train operator proficiency in Restricted (non-ATO) Mode operation is necessary for such contingencies. Scenarios at other transit properties have occurred where manual (non-ATO) operation resulted in serious delays to service due to train operators’ lack-of-proficiency operating in a manual mode.

III. OBJECTIVE

Establish a standard for use by all transit properties as a baseline for maintaining the skill levels required of train operators moving trains when ATO fails.

IV. RESEARCH PROPOSED

Develop standards for manual operation proficiency for transit properties that operate primarily in ATO by:

- Reviewing standards in place on these properties.
- Measuring how manual operation proficiency degrades after extended ATO operation.
Service disruptions can be prevented or mitigated if train operators change from ATO to manual operation in a timely manner.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:
Since NYCT is a 24/7 operation, the proposed research program will require at least three professional staff to conduct research and subsequent field operation testing during the morning (AM), afternoon (PM) and midnight (MID) periods. The cost is estimated at approximately $300,000.

Research Period:
We recommend a period of twelve months to complete the research, which includes nine months of research /field operations testing, and three months for review and revision of a draft final report

VI. URGENCY AND PAYOFF POTENTIAL

Presently, the “L” Line provides train service to approximately 85,380 daily riders. The “L” Line is comprised of two tracks running in opposite directions with headways as short as four minutes. Were service delays due to ATO failures to occur, and train operators were unable to operate proficiently in a manual mode, train service would stop since the track layout on the “L” Line does not facilitate the ability to “run-around” blockages. This would result in:

β Interrupted train service to tens of thousands of customers.
β Hazards associated with customers on stalled trains for extended periods.

If train operators are adequately prepared to switch to a manual operation mode in a timely manner service reliability can be maintained.

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

FTA Strategic Goals

β Increasing Ridership
Trends indicate that “L” Line ridership will continue to increase. Reliable and on-time service will attract more riders which, in turn, will stimulate economic growth in areas adjacent to the “L” Line.

β Improving Capital and Operating Efficiencies
When ATO and manual operation can be utilized interchangeably, there will be minimal interruptions in train service, resulting in higher operating efficiencies.

Improving Safety, Security and Emergency Preparedness
Train operator proficiency in ATO and manual modes will facilitate the movement of trains and customers during system failures.

TCRP Strategic Priorities

NYCT’s goal is to provide safe and efficient train service to the public as ridership continues to increase. This makes it necessary to continuously maintain the quality of public transportation service by implementing new technological while maintaining the proficiency of our personnel’s operating skills.

VIII. RELATED RESEARCH

Not available.

IX. PERSON(S) DEVELOPING THE PROBLEM

Paul J. McPhee, Operations Manager, Rapid Transit Operations, NYCT, 130 Livingston Street, Brooklyn, New York, 11201, (212) 712-4187

Karen Tam, Associate Transit Management Analyst, Rapid Transit Operations, NYCT, 130 Livingston Street, Brooklyn, New York, 11201, (212) 712-4203

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Problem statement is the product of Paul McPhee and Karen Tam.

XI. DATE AND SUBMITTED BY

TCRP Problem Statement

PROBLEM TITLE

Develop a transit oriented development component, for certification and/or licensing of planners, architects and engineers.

PROBLEM STATEMENT

Planners, engineers and architects have oversight responsibility for all aspects of the design of the physical built environment, including general urban form, streetscapes, and the layout of new residential, office, commercial and industrial developments. As a result, these design professionals have considerable influence over the effectiveness and success of public transit. General and specific plans, infrastructure design and the final designs for specific development projects all influence whether transit can effectively play a role in providing mobility and accessibility within a community. The directness of pedestrian access, the conditions the pedestrian experiences while accessing and waiting for transit, the ability to efficiently design transit routes, and the ability to safely operate transit at higher average speeds on our streets and highways or other guideways are the direct result of the work of planners, engineers and architects, whether they are planning and designing for the private sector, or approving plans for the public sector. These professionals also frequently influence public policy on matters that impact the effectiveness of transit. It is desirable for planners, engineers and architects whose work involves public infrastructure to demonstrate understanding of what is required to provide effective transit service, as it applies to their particular discipline.

OBJECTIVE

Develop a transit oriented development component, make it available to licensing boards, and encourage its use for relevant certification and licensing examinations and in the recommended education or preparation process for planners, civil and traffic engineers and architects.

RESEARCH PROPOSED

Identify the role each profession can play in the effectiveness of transit service design and delivery; identify the certification and licensing requirements that apply to relevant professions; identify the process used by licensing boards to make revisions to these licensing requirements; make contacts with the appropriate organizations (possibly in concert with FTA, APTA, CTAA and other supporting agencies or organizations) to initiate the change process; develop a draft transit oriented development education and/or examination component for each professional licensing program; and identify further research that may be necessary to support each draft transit oriented development component.

ESTIMATED FUNDING AND RESEARCH TIME
URGENCY AND PAYOFF POTENTIAL

Urban form and characteristics of the built environment have a significant impact on transit use and on the potential for transit to play a more relevant part in developing more sustainable communities, energy-efficient transportation and healthier lifestyles. Planners, architects and engineers play a significant role in shaping urban form. All of these professions have been recently involved in research and other activities to encourage movement away from our current auto-dominated communities. Therefore, the better newly licensed professionals understand the role transit can play and what is necessary to achieve maximum effectiveness, the more likely it is that urban form will gradually become more transit friendly; and the more successful transit can be in effectively attracting and retaining customers.

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

FTA Strategic Goals and policy Initiatives:

Ridership. This effort will result in plans and project designs that will encourage greater transit use.

Improving Capital and Operating Efficiencies. This effort will shape new development in a manner that enhances the overall efficiency and effectiveness of transit service delivery.

Protecting the Environment and Promoting Energy Independence. Improving the understanding of transit among relevant professions supports a sustainable transportation network.

TCRP priorities:

Place the customer first. This effort is designed to offset decisions that create transit unfriendly environments and conditions that limit travel choices or opportunities available to individuals.

Continuously improve public transportation. Increasing transit’s role 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
TCRP Problem Statement 2008

Problem Title: Healthy Habits for Transportation Employees
CDL/ Bus Operators

Research Problem Statement: In the 21st century the need for public transportation is growing significantly due to a booming population growth, limited highway space for motorist and rising fuel cost. More commuters are depending on public/private bus services to transport them to and from their homes and work locations. Due to this increase in public transportation service, the average bus operator is facing serious health challenges juggling to provide safe service, on time performance, and customer service. The nature of the bus operator’s position requires them to sit for many hours each day in the driver seat. At the same time, this population is trying to maintain their health and provide superior service. The bus schedules were developed with a main thrust of providing service without considering the human factor that is essential in maintaining consistent service and high performance. Long hours of driving and limited “swing time” for eating helps to perpetuate an unhealthy work force of bus operators who are at risk to develop Diabetes Type 2, High Blood Pressure, Obesity, Sleep Apnea and other disease that lead to an untimely death or increase the risk of accidents.

Objective: To develop a Wellness/ Training program to improve the bus operator’s health and reduce the risk of Diabetes Type 2, High Blood Pressure Obesity and Sleep Apnea and other health risk that this population is more susceptible too. Educate the bus operator in nutrition, exercise, weight-management and maintaining good health. Inform this population that a healthy bus operator is a productive operator in his or her personal and professional life. Provide incentives/ rewards for employees who are able to improve their sick leave usage and reduce their health risk and cost.

Research Proposed: To study the bus operator population at New York City Transit, Department of Buses for a period of a year. Secondly, to determine the internal and external factors that contributes to this population growing health and safety risk. Based on their finding, establish an internal wellness training program that addresses and minimizes bus operator’s health and safety risk, assess work schedules and examine the impact of
limited lunch periods and productivity. Design and develop healthy food selections for this particular group. The overall impact of unhealthy bus operators in the workforce and its effect on the day to day bus operations Motto: “An unhealthy bus operator is an unsafe driver.”

**Estimate of the Problem Funding and Research Period:**

**Recommended Funding:** The average cost for this project would be approximately in the $300,000- $500,000 range.

**Research Period:** I would like this population to be studied for a one year period.

**Urgency and Payoff Potential**--- This situation is a very urgent matter not just here at NYC Transit but across the country. A few changes in the workplace could reduce personnel cost and increase productivity. A large segment of the population has developed serious health conditions in this job position. This is a critical situation that can directly impact on the agency’s operating budget: by an increase in accidents/ personal injuries, a jump in hiring cost, a rise in overtime expenditures, chronic sick leave usage and low productivity.

**Relationship to FTA Strategic Goals and Policy initiatives and TRCP Strategic Priorities**

This problem can be addressed under TRCP strategy priorities number 3 and number 5. The finding of this study can be used nation wide to address a growing health and safety concern with the CDL/Bus operator population.

**Related Research** – At New York City Transit, Dept of Buses, Safety and Training Division, I have implemented a training program called Healthy Habits for over a two year period to address some of these concerns. However, the scope of this training is limited. A more extensive assessment of this problem is needed in order to identify the root cause of the problem and practical solutions that can improve and reduce this growing health crises and safety risk in this industry.
**Person Developing the Problem**

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Manager, Trainer
Dept of Buses,
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Bronx, New York 10473
I. Transit Industry Life Cycle Cost Analysis

II. Problem Statement

For decades, the U.S. military has been a driving force behind a field known as Integrated Logistics Support (ILS). ILS focuses on the support side of an item, whether that item is as simple as a radio or as large and complex as a ship or aircraft. The emphasis on the supportability side of the equipment is a pre-emptive cost containment measure against the long term support costs of the equipment, which can significantly exceed the initial procurement cost. As such, ILS activities include analyses that focus on every part of the item’s design from a support perspective, in order to optimize the availability of the equipment at the lowest life cycle cost. ILS activities include reliability analysis, sparing analysis, training and technical manual development and the identification of tools and support equipment necessary to support the fielded items. An additional tool used in ILS is life cycle cost analysis. Life cycle cost analysis encompasses the entire procurement, fielding and sustainment strategy of an item and provides predicted calculations on the total cost of that item during its life cycle. This analysis is used by procuring agencies to assist in the initial award selection process and also by industry during the initial engineering development phases to assist with design and support trade-off analysis.

The procurement, development, fielding and sustainment efforts for transit systems can rival those of a military ship or aircraft. Equipment complexity, repair structure, training requirements and spare parts management are also comparable, and each of those elements are significant contributors to the item’s life cycle cost. Life cycle cost analysis, using tools specifically targeted to the transit industry, would provide a proven tool in cost containment and visibility into cost drivers that is not available today. As an example, one output of the analysis is a recommended repair concept for the equipment, whether it is more cost effective to repair or discard equipment based on factors such as cost and failure rates (and many others). This output has a ripple effect across spares purchases, technical manual content, training, tool and support equipment purchases, etc., all of which are significant contributors to the life cycle cost of equipment.

Life cycle cost analysis is typically performed using software tools, called models, and many models exist today. The best life cycle cost models are those which address factors unique to a particular industry in order to attain a measure of the true life cycle cost. The models currently in existence today, having their genesis in the military arena, are not specifically focused on the commercial world, or more specifically, the transit industry. Research is required to investigate the current status of today’s available life cycle cost models and to determine their applicability to the transit industry.

III. OBJECTIVE

The main objective of this analysis is to investigate the impact of life cycle cost analysis as related to the transit industry, identify the major cost drivers in the area of maintenance and supportability and to create a baseline specification for the transit industry specific life cycle cost model.

IV. RESEARCH PROPOSED

In order to determine the extent of the impact that a transit industry specific life cycle cost model will have, it will be necessary to research the tools that currently exist and also to investigate the transit industry supply and maintenance environments to assess the cost drivers. The research will consist of three major efforts:

1. A review of the current Life Cycle Cost models, their scope of coverage and an understanding of their life cycle cost computation methodology.
2. A determination of the major cost drivers related to the transit industry, including procurement, fielding, and sustainment factors.
3. A mapping of the transit industry cost drivers to a basic framework of a transit industry-specific life cycle cost model to determine the scope of the model.
V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** The initial estimate indicates an anticipated funding request of $350,000. This would cover those efforts listed in Section IV above.

**Research Period:** The research period is anticipated to span between 18 and 24 months, to include the three months for final report preparation, review and delivery.

VI. URGENCY AND PAYOFF POTENTIAL

The urgency of this project should be dictated by the potential cost savings that can be realized by the adoption of techniques and tools that have already proven their worth in comparable industries. This analysis can pay immediate dividends in setting the course for the development of a standardized tool that can be used to allow transit authorities to assess the real, total ownership cost of equipment before any purchases are made. Another side benefit envisioned from this analysis is an identification of the current significant cost drivers for the supportability side of equipment, be it parts obsolescence, repair costs, training or any of a number of potential factors. This may promote further initiatives. No potential institutional, political or socio-economic barriers are foreseen.

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

This analysis addresses the second of the TCRP’s stated goals; *Improving Capital and Operating Efficiencies*, specifically in the area of controlling costs of maintenance/support. Life cycle cost analysis is a modern, viable practice that should be examined for introduction into the transit industry, with significant long term benefits and cost identification and containment. The substantial costs associated with maintenance and long term support of transit vehicles are identifiable, containable and deserve further investigation.

VIII. RELATED RESEARCH

None.

IX. PERSON(S) DEVELOPING THE PROBLEM

This was developed and prepared by;

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the result of the work that D & R has been performing in both the commercial and military arenas. Knowledge of the different approaches prevalent to equipment procurement and development in the commercial world vs. the military has helped form the foundation of this statement. D & R has been performing ILS activities, including life cycle cost analysis, for military programs since 1990, and has been developing training and technical manuals for the transit industry for the past ten years. That blend of experience and visibility into the approaches used to manage long term supportability costs has positioned us with the knowledge and expertise required to perform this task.

XI. DATE AND SUBMITTED BY

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**

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 APTA’s Communications Subcommittee with input from APTA’s Research and Technology Committee.

**Date and Submitted by:**
Submitted by: Jonathan McDonald 6-7-07
I. PROBLEM TITLE
   New Paradigms: New Directions in Fundamental Organizational Change, 2007

II. RESEARCH PROBLEM STATEMENT

The examination of prospective fundamental organizational change in public transit agencies was carried out earlier this decade and presented in TCRP Report 97, “Emerging New Paradigms: A Guide to Fundamental Change in Local Public Transportation Organizations.” The original project sought to answer the question, ‘What might public transit agencies look like in 10-15-20 years?’ in response to the rapid pace of change in the global economy, and ‘What lessons can be learned from the responses of business and industry to those same forces and factors?’ In addressing these questions, the project reviewed changes taking place in businesses and industries, worldwide, both public and private, as well as the specific forces and factors that had begun to precipitate fundamental organization changes and fundamental redesign of business models and processes.

The work revealed a set of six basic dimensions over which fundamental changes were occurring that were increasingly common to across all businesses and industry groups, including the transportation sector broadly, as well as selected transit agencies here and abroad. These included:

- Mission shift, from operation of owned assets to managing mobility on behalf of customers;
- Obsession for the customer that introduced and applied new measures of organizational performance;
- Collaboration among former competitors
- Integration of assets, functions and resources;
- Application of information technology to link customers and partners in real time; and
- Attendant changes in organizational structure.

The material and conclusions from the original project are now somewhat dated while the pace of change and adaptation among all types of organizations continues unabated. Proposers believe
that an updated assessment of ongoing organizational change is warranted and timely to provide a renewed framework for continued paradigm shift in the nation's public transit organizations.

III. OBJECTIVE

While the findings and conclusions of the original New Paradigms project were embraced, supported and pursued within the industry, it will be nearly a decade since these emerging paradigm shifts were traced and the framework for fundamental change presented for industry consideration. The proposed project is intended to test whether the original New Paradigms framework – forces, factors and dimensions of change – are still valid and/or how they are being currently responded to and pursued.

The proposed project is intended to update the New Paradigm by:

1. Reassessing whether the dimensions and shifts first noted across business and industry, in the transportation sector and among transit agencies here and abroad are continuing, evolving or changing course;
2. Reexamining the motives for and current directions of fundamental organizational change today; and
3. Arriving at an updated framework for guiding and evaluating continued fundamental change – paradigm shift – in the U.S. transit industry in the years ahead.

IV. RESEARCH PROPOSED

The proposed research would involve:

- Revisiting the fact-finding on forces and factors that have been responsible for fundamental organizational changes in business and industry and reformulating conclusions originally drawn from changes taking place in a variety of individual businesses that were the subject of the original analysis. This basic task would be carried out, as it was originally, through review of recent literature as well as interviews with key individuals across the several organizations originally examined, as well as others, as appropriate;
• Adjusting and revising the original New Paradigms framework – forces, factors and dimensions of change – to reflect more recent experiences, outcomes and plans; and

• Exploring the extent to which earlier paradigm shifts evident in specific North American transit organizations have continued or changed course in recent years, the underlying conditions, and examining additional, new or emerging examples of fundamental change or paradigm shift among North American transit agencies today.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $350,000

Research Period: 18 months

VI. URGENCY AND PAYOFF POTENTIAL

Traditional institutional roles and responsibilities are under increasing scrutiny and reevaluation within the U.S. transportation sector in the effort to address mounting travel demand, shifts in the nature and geography of travel and travel markets, and in the effort to link transportation decisions and investment more closely to common broad-based goals. In this dialogue, growing emphasis is being placed on many of the same basic dimensions of fundamental change that were revealed in the original paradigms project – partnerships, collaboration, coordination, integration and the application of new information and other technologies.

Updating the findings, framework and experiences presented in the original New Paradigms project will serve to directly inform current debates over future organizational structures, roles, responsibilities, business models and public policies.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
Updating the New Paradigms framework and specifically the continuing importance and progress across the six major dimensions of change identified originally serve both directly and indirectly to support FTA strategic research goals and TCRP strategic priorities.

With regard to DFTA goals, the shift in mission to “managing mobility” on behalf of the customer speaks to the goal of increasing ridership as well as safety and security, as two key concerns in riders’ mode choice. Increasing collaboration, integration and deployment of state-of-the-art information technologies in service design and delivery speaks directly to the goals of increasing efficiency and reducing environmental and energy impacts.

The proposed project and the New Paradigm dimensions to be reexamined perhaps provide a clearer linkage to TCRP strategic goals. The New Paradigm ‘obsession’ for the customer represents an obvious direct connection as does the application of state-of-the-art information technology. The project’s heightened emphasis on the importance of collaboration among actors and greater integration of resources, assets and functions advances the broadly multimodal theme. In addition, all of the dimensions of paradigm shift to be reexamined, and particularly the focus on shifts in organizational structure and business practices address the notion of ‘revitalizing’ the organizations themselves. And finally, the entire New Paradigm framework is geared to continuous improvement, and more importantly, continuous increases in the relevance of transit in the daily lives of existing and prospective users.

VIII. RELATED RESEARCH

Among the recent and current related research and source materials that may be important to the proposed project are:

- Contributions made by various members of the transit community as well as others to the National Surface Transportation Policy and Revenue Commission which is examining intergovernmental roles as well as the content of a compelling national vision in anticipation of a new generation of surface transportation policies and legislation;
- Evolving Federal policy, programs and research encouraging transit service coordination;
- Policy, guidance and actions implementing the new “mobility management” provisions of SAFETEA-LU;
• The growing body of research, policy, guidance and progress reporting on implementation of the broadening range of public private partnerships (PPPs) along with other examples of broader-based inter agency collaboration; and
• The growing body of research, plans and evaluations of intelligent transportation system architecture design and deployment throughout the transit industry.

The Federal Transit Administration, TCRP and various university centers have been and are continuing to examine separate aspects of the ‘dimensions of change’ highlighted in the earlier New Paradigms project and which are proposed to be reexamined here. However, most of this work is not being done within the overall context of fundamental organization change or paradigm shift. The proposed project will provide an opportunity to integrate much of the activity occurring through these various programs.

IX. PERSON(S) DEVELOPING THE PROBLEM

Robert G. Stanley
Principal, Cambridge Systematics, Inc.
Bethesda, MD

Matthew Coogan
Consultant in Transportation
White River Junction, VT.

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

Development of this problem statement has been precipitated by several events, including:
Informal encouragement from members of the former TCRP New paradigms project panel and other industry leaders familiar and supportive of the earlier project and its conclusions;
Continuing requests for New Paradigms information and insights from industry leaders as well as more recent interest expressed by both FTA staff and APTA staff in the service of new strategic initiatives; and
Intermittent discussions among original New Paradigms Principal Investigator, Bob Stanley, and members of the original research team.
XI. DATE AND SUBMITTED BY

Submitted by Robert G. Stanley, Principal
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TCRP PROBLEM STATEMENT

I. PROBLEM TITLE

Essential State DOT Partnerships for Implementing Bus Rapid Transit Systems

II. RESEARCH PROBLEM STATEMENT

As communities move to implement bus rapid transit (BRT) services on multi-lane highways and freeway facilities, state departments of transportation (DOTs) are not always familiar with the design, operation, financial arrangements and policy/legal aspects of public transportation. At the same time, transit systems may need help in understanding how to work with the DOT organization. Because state DOTs commonly work with the Federal Highway Administration (FHWA) and transit systems are familiar with working directly with the Federal Transit Administration (FTA), institutional rules and processes may differ.

III. OBJECTIVE

This research will produce a guidebook that will be a benefit to transit operators, local authorities and state departments of transportation as they cooperatively seek to construct BRT systems. It will also facilitate the formation of partnerships to bolster implementation of BRT services. State DOTs must become increasingly involved with local/regional transportation agencies with respect to the BRT planning, design, maintenance and operational issues as they affect state facilities. State DOT personnel may need to be trained in the requirements of transit’s intelligent transportation systems (ITS) technology. Requirements for special infrastructure (lane widths, shoulder lanes, signal priority) may require new policies, legislation and legal initiatives.

IV. RESEARCH PROPOSED

This research would at a minimum include (a) an assessment of the potential for infrastructure sharing, traffic management, ITS installations and information systems on state highways, (b) a review of existing BRT systems that operate on or across state highway facilities, (c) identification and description of the key issues that were encountered and addressed between the transit systems and the state DOTs, (d) evaluation of six to eight case studies, (e) documentation of the results, and (f) development of a state system BRT planning and design guidebook.

V. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $280,000,

Research Period: 24-months

VI. URGENCY AND PAYOFF POTENTIAL

At a time when the state highway system is largely built out, bus rapid transit (BRT) offers a transportation demand management strategy to maximize the capacity of the existing transportation system. BRT offers the distinct potential of increasing the person-throughput capacity of the highway system, leading to improved mobility, air quality and congestion management benefits.

Because the state DOTs and the local transit agencies have not generally been close partners (partly due to the historic federal split of highway and transit funding mechanisms), innovative cooperative arrangements are needed to jointly improve the performance of the highway and transit systems.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES AND TCRP STRATEGIC PRIORITIES

FTA Strategic Goals
Bus Rapid Transit (BRT) systems have the ability to dramatically increase transit corridor ridership, including the introduction of a significant number of new riders to transit. Coordination among all key agencies and services that will facilitate growth of BRT systems is key to success: regional MPOs control funding; DOTs control state-owned intersections and arterials, local public works agencies control location and design of sidewalks and bus stops, and land use decisions impact access and proximity by potential users.

TCRP Strategic Priorities
BRT systems offer a new and exciting way of placing “the transit customer first” on our nation’s urban state highway systems. Applications of Intelligent Transportation Systems (ITS) technologies bring transit bus travel up to date with such refinements as transit signal priority (TSP), real-time arrival information displays, and centralized management of real-time operations. BRT represents a significant upgrading of the traditional local transit bus, and it is important that state, regional and local governments are working closely with transit systems to operate the finest and most dependable service possible.

VIII. RELATED RESEARCH


IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem emerged from preliminary investigations by the Caltrans Bus Rapid Transit Task Group.

XI. DATE AND SUBMITTED BY

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June 15, 2007
I. PROBLEM TITLE

Evaluation Performance-Based Measures in Transit Project Monitoring and Evaluation: A Method for Enhancing the Efficiency and Effectiveness of Section 5303 Metropolitan Planning Organization (MPO) Funds Implementations

II. RESEARCH PROBLEM STATEMENT

MPO’s are required to conform to stringent project reporting requirements in order to satisfy the wide range of stakeholders. MPO’s project monitoring and evaluation (M&E) information systems (IS), frequently a requirement for funding, are believed to inform the reporting process. The role that discrete project cycles may play in contributing to broader strategies is well recognized across many sectors (Anton and Kovac, 2000).

Project performance is an obvious, but amorphous concept and may be understood to involve “balancing demands for efficiency and effectiveness”. Accountability is promoted through transparency; performance is promoted by responsive project management decision-making. A project monitoring and evaluation information system (MEIS) is one type of MIS designed to mitigate poor project performance, demonstrate accountability and promote organizational learning for the benefit of future projects. Reporting through an organizational structure is one mechanism by which information flows, and is the basis for assigning accountability.

Effective planning begins with establishing a clear set of goals and objectives to guide the effort. The Long Range Transportation Plan (LRP) is developed in the context of the major planning and investment focus areas (goals) established by the federal government and local and regional conditions and priorities.

Development of the 1995 LRP was principally guided by the 15 planning factors identified in the Inter-modal Surface Transportation Efficiency Act (ISTEA), the federal legislation enacted in Subsequent to the 1995 LRP, the 15 planning factors were modified and collapsed into seven focus areas by the Transportation Equity Act for the 21st Century (TEA-21) which superseded ISTEA in 1998.

This research evaluates the effectiveness of the planning process as proposed and implemented by the 12 Metropolitan Planning Organizations (MPO’s) around the State of Alabama. ISTEA mandates that MPO’s and States undertake integrated planning, linking transportation and use, tying transportation to environmental and socioeconomic concerns, and addressing urban congestion, growth demands and air quality concerns. The new role of MPO’s, their capabilities, and their organizational structures raises some potential challenges in fulfilling these obligations. It is widely recognized that there is a need to develop and use multi-modal monitoring and performance measures in transportation planning and selection of projects.
Research Issues:

(1) How are the ALDOT measure MPOs success?
(2) How well the 12 MPO’s around the State of Alabama compiles with Federal requirements?

III. Aim and Objectives

Aim:

The aim of this research will be to develop and apply a methodology through which performance measures for federal and state discretionary funds used for multi-modal transportation projects (from 1991 to the most recent data available) can be identified, quantified, evaluate, and used in developing MPO’s that have varying degrees of data availability and expertise.

Objectives:

1. to assess the degree to which the 12 MPO’s around the State have administered Section 5303 Metropolitan Planning funds in accordance with the FTA requirements(Title 49) and their local Transportation Improvement Plans(TIP’s);

2. to develop a framework for identifying the required performance measures;

3. to develop a model of transportation plan performance measure, test and evaluate the model for prototype scenarios;

4. to evaluate the effectiveness of the planning process as proposed and implemented by the 12 Metropolitan Planning Organizations (MPO’s) around the State of Alabama.

5. using objectives (i-iv) for exploration of MPOs policy implications as a means of a user and reference guide to multi-modal services.

IV. RESEARCH PROPOSED

Task Descriptions:

Task 1. Examine the literature surrounding federal, state, and local highway and transit funding. The purpose of this task is to obtain the required additional knowledge and to ensure that no research, which might contribute to this study, is overlooked or unnecessarily duplicated.
Task 2. Identify MPOs, municipalities, and transit agencies to determine if a change in the transportation mindset occurred during the ISTEA years.

Task 3. Develop Performance Measures Planning Framework through compilation and summary relevant planning goals, and objectives (Alabama Transportation Plan, Statewide Planning Goals, MPO Regional Transportation Goals)

Task 4. Develop a matrix indicating the levels of funding (federal, state, and local) for multi-modal transportation related projects.

Task 5. Select Performance Measures for Detailed Evaluation through selection of 6 to 12 MPO’S for further analysis and testing and development of tools to implement selected performance

Task 6. Calculate Performance Measures for Prototype Scenarios, and prepare interim report and presentation for ALDOT

Task 7. Select Final Recommended Performance Measures by modification performance measures and prototype scenarios per committee recommendation

Task 8. Revise Performance Measures for Prototype scenarios by performing additional analysis of revised performance measures and test scenarios

Task 9. Prepare Final Report

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD
$250,000 - $300,000

VI. URGENCY AND PAYOFF POTENTIAL
This project will measure the federal and state compliance with the intent of ISTEA to diversify spending for the nation's urban transportation systems. The findings will serve as a "report card" for the nation and individual states. If it is determined that discretionary spending favors multi-modal transportation projects, then public officials and transportation professionals will be able to identify areas for future improvement.

This research will provide a clear framework on how to identify, quantify, and use performance measures for multi-modal transportation in developing communities. The techniques that will be developed through this research will be of a generic nature so that they can be replicated and applied to all developing communities.

Should approval be granted for implementation, the proposed techniques will be refined and improved. The applications will also greatly assist State MPO’s by providing them with analyses of their most important transportation corridors.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
FTA Strategic initiative -
TCRP Strategic priorities -

VIII. RELATED RESEARCH
Research completed:
Research in progress or pending:
(1) Rural transit $180,000
(2) Impact of rural public transportation $170,00

IX. PERSON(S) DEVELOPING THE PROBLEM
JO Oluwoye, PhD
Director
Transportation Research Institute
Department of Community Planning and Urban Studies

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

XI. DATE AND SUBMITTED BY

Submit to: Christopher W. Jenks
Director
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FAX 202/334-2006
I. PROBLEM TITLE

TECHNOLOGICAL CHANGE: A KNOWLEDGE-BASED EXPERT SYSTEM PROGRAM "PLANRIGHT" AS A TOOL FOR PLANNING LARGE TRANSIT PROJECTS.

II. RESEARCH PROBLEM STATEMENT

The development of advanced computer technologies have provided opportunities for re-engineering of engineering, procurement and constructing of major transit investments processes across the project life cycle. One potential area of applying computer technologies to the re-engineering of large transit projects is in the application of artificial intelligence techniques to develop knowledge-based expert systems with the capability to reason like humans and carry out specialized tasks that typically require human judgment and expertise. Expert systems are ideally suited for use on transit projects because constructing of major transit investments is mainly an experience based industry and decision-making in large transit relies more on individual experience than on formalized decision-making methods. Therefore, expert systems present a promising technology for capturing an experienced transit manager’s knowledge about the key attributes of a given situation that should be used to select valid analogies from prior experience and recommending suitable action plans.

III. AIM/OBJECTIVE

Aims and Objectives

The aim of this research study is to apply artificial intelligence techniques to develop a prototype knowledge-based expert system for large transit project planning. Specific objectives of the study are:

1. to develop a framework for measuring the impact of decisions and undertaking “what-if” analyses with a view to accurately forecasting the project time and out-turn costs, risks and constructability of competing design and investments methods.

2. to develop a knowledge-base of (i) investment methods; (ii) resources required for detailed transit operations; and (iii) project environment constraints which affect the implementation of transit operations.

3. to apply artificial intelligence programming techniques to create a representation of the knowledge involved in the transit planning process and develop a prototype expert system capable of reasoning about large transit project planning.
IV. RESEARCH PROPOSED

The proposed prototype expert system will integrate through an expert system building tool, a relational database, knowledge base, a traditional network analysis software; and interfacing programs written in FORTRAN. The first stage of the research project will involve selecting a suitable expert system development tool. Available tools will be evaluated using a modified version of selection criteria developed by Moselhi and Nicholas (1988). A knowledge base will then be developed using knowledge acquired from a previous study undertaken by the author as well as relevant text books and manuals. Applications of construction planning results from Faniran (1995) - a previous study undertaken by one of my successful Ph.D. students will be used for providing core knowledge regarding the impact of project environment constraints on the implementation of transit operations. In addition, project operational plans and schedules prepared by a number of consultants and contractors will be critically analyzed to extract relevant knowledge. The acquired knowledge will be stored in the knowledge base using knowledge representation techniques. A relational database (preferably on-line within the expert system building tool) will be used to store the operational data required for consultation by the expert system. Algorithmic scheduling capability for the expert system will be provided using PRIMAVERA, a project scheduling software which has an export-import facility and allows for “batch-processing”. Interfacing programs written in FORTRAN will be developed to format the inputs for the project scheduling software. The prototype expert system will be tested using a case study. Critiques and peer comments will also be solicited from transit industry practitioners and fellow researchers.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

$350,000 for 2 years

VI. URGENCY AND PAYOFF POTENTIAL

When fully developed, the proposed expert system will be an invaluable transit planning tool. PLANRIGHT will focus on the development of operational plans for different conditions of large transit project environments and will have the capability to perform different “what-if” planning scenarios in order to evaluate alternative transit strategies. PLANRIGHT will also have the capability to provide top management of transit firms with relevant information for making decisions regarding the planning and organizing of transit planning activities within the firm. PLANRIGHT’s applications can also be extended to other problem areas in transit management.

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

FTA Strategic initiative –Project Planning and Oversight
TCRP Strategic priorities –Revitalize Transit Organizations

VIII. RELATED RESEARCH

Research completed:
Research in progress or pending:
(1) Rural transit $180,000
(2) Impact of rural public transportation $170,00

IX. PERSON(S) DEVELOPING THE PROBLEM

JO Oluwoye, PhD
Director
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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement is the product of individual observation and critical analysis of current large transit project issues.

XI. DATE AND SUBMITTED BY

Date: June 12, 2004

Submitted by: Dr. JO Oluwoye

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I. PROBLEM TITLE

Program Guide for Considering Renewable Energy, GHG Emission Reduction and Energy Dependence Options by the Transit Industry

II. RESEARCH PROBLEM STATEMENT

In the last two decades the Transit Industry has shown great leadership in researching, testing and firstly introducing innovative technologies and fuel systems to reduce harmful emissions from their bus fleets. This started with electronically controlled engines, after-treatment devices, a host of different alternate fuels and new propulsion systems. Ongoing activities in this area include research and testing of hydrogen in limited fuel cell applications -- considered by many as a future energy source and propulsion technology. Developments are still ongoing in hybrid-electric buses in a variety of fuel/power configurations. Clearly, available transit bus options are capable of reducing harmful emissions by several orders of magnitude below transit vehicles in use ten years ago. With the recently introduced 2007 diesel emissions requirements, and the upcoming large reduction of NOx emissions for 2010, and considering the small percentage of the transit bus fleet compared to heavy duty commercial fleets, developing technologies to reducing emissions from transit buses are no longer a key objective. Instead, larger societal issues are increasingly cited as the next critical objective and the new research frontier. Of these, the issues relevant to the transit industry are global warming (referred to here as greenhouse gas or GHG), renewable energy and energy independence. Candidate options to be promoted as potential solutions to both of these issues are renewable energy, domestic synthetic fuels, and conservation.

The Transit Industry is often called on to be the agent of change in the heavy-duty transportation field, especially when societal issues are involved. Clear examples of this industry's leading positions were in the implementation of Americans with Disabilities Act (ADA), implementation of CNG and LNG, use of hybrid vehicles, etc. Already the transit industry is exploring and may be formally called on, to be the lead test-bed in the use of renewable energy and synthetic fuels, such as Bio-Diesel from soybean/canola oil; synthetic fuels from different sources to include natural gas, coal and biomass; complementary solar energy for both bus and facilities. The need to understand these options is clear and it needs to be on a life-cycle (from planning through decommissioning) program-wide basis. Implementation programs are needed for activities that will lead to systematic, experience-based, long-term operational, functional, economic, etc. data. However, there are no such program guides available to the transit industry -- making it more difficult and more risky for the industry to consider these options.

There are several guides available that assist the industry in determining the cost and economic/environmental tradeoffs of novel fuels and technologies. Among these are TCRP Report 38, TCRP C-15, and the planned Project -- TCRP C-19. However, the transit industry is lacking a program guide that will assist the industry in considering all of the attributes of these "novel" options; make selection plans based on all of the attributes and assumptions; and help in the development of a comprehensive, agency-specific implementation and adoption plan. This outline proposes the development of a guide that will assist the industry in giving full consideration to these novel alternatives and help in the structuring and development of an effective implementation plan.

III. OBJECTIVE

The objective of this effort is to develop a program guide for the transit industry, which will enable the transit boards, executive level management, policy makers to fully consider and incorporate renewable energy, global warming, and energy independence into transit agency's fuel, energy, and environmental strategies and take the lead and show example in tackling these most important societal and environmental issues. The guide is to be a pragmatic tool designed to consider the unique operational requirements, decision-making processes, and business and operating environments of the transit industry.

IV. RESEARCH PROPOSED

The activities of this project should lead to the development of the following:

1) **A Topical Summary** -- Develop a summary document (a primer), which summarizes the salient elements of renewable energy, global warming, and energy independence. This document is to focus on the specific needs of the transit industry
decision maker and provide the level of detail required to get a first level understanding of the: technologies, economics, implementation issues, etc. Discuss the regulatory environment in place that affect the adoption of renewable fuels, greenhouse gas (GHG) measures, and energy independence measures. List the availability and applicability of incentives and punitive measures that influences adoption decisions.

2) A Status Assessment – Collect, review, and summarize available (published and unpublished) information on the current status of efforts to introduce renewable energy, reduce global warming, and increase energy independence through the use of renewable sources of energy, such as: bio-diesel, oxygenates for gasoline powered vehicles (limited use in transit), hydrogenated natural gas, synthetic fuels, etc.; and through non-fuel options (efficiency improvements, conservation measures, operational strategies, etc). Information sources may also be from outside the transit industry, such as the trucking and agricultural industry, the Department of Defense, and from international sources. The focus of this effort should be on activities that can be of benefit to the Transit Industry.

3) Anticipated Developments – This effort will not focus on the cost and technology issues, which are likely to be available from the TCRP C-1 and C-19 activities. Rather, it is designed to identify and review anticipated developments in the less visible but nonetheless important parameters such as: resources reliability, employee requirements, transitional and long-term impact on operations (e.g., the need for multiple fuel depots), staff performance (union issues), transit industry behavior (follow the leader, multiple paths), affordability, etc. This section should also define likely regulatory paths (scenarios), which are to address state, regional, and federal regulatory requirements. Likely incentive and punitive measures should also be noted. Interview a few engine manufacturers (Cummins and Caterpillar) and fuel suppliers (Shell, BP) about their views on Diesel engine efficiency improvements, renewable energy sources, future increase of fuel availability. Assess their comments in terms of its impact on Transit Industry.

4) Showcase Projects -- Identify, describe, and examine recent or ongoing projects renewable fuel projects and projects designed to reduce global warming or promote energy independence. Evaluate implementation and program issues associated with their adoption, and define obstacles and solutions used by the showcased projects.

5) Summary – the findings of the above four activities documented as a transit agency primer and should be summarized in an executive-level presentation. Also, present a draft outline of the proposed program guide for evaluation and comment by TRB.

6) Program Guide – Develop a program guide that could be used by the transit industry (at all different levels: board, executive level, policy makers) for considering and evaluating all of the attributes and issues associated with the transit industry’s use of renewable fuels, other GHG-reducing and energy independence options. This guide should be designed and structured to enable the development of agency-specific decisions and implementation plans based on the characteristics of the agency, the agency’s assumptions, and with appropriate consideration of all key attributes of the options (in addition to the traditional financial considerations). The program document should define a recommended regime for tracking the program, to include the measurement of costs, benefits, GHG emissions, other emissions, performance, maintenance, etc.

7) Test The Guide – Using the guide, prepare two case studies (analysis and plan) using real transit agency characteristics and assumptions. The case studies should demonstrate the practicality and functionality of the guide using some candidate renewable energy, GHG, or energy independence options (for example: diesel bus fleet being converted to B20 Diesel; use of certain energy conservation measures; use of renewable energy sources such a photovoltaic power at the depots). The guide should address: technical challenges, educational and training requirements, safety considerations, process changes (fueling, maintenance, etc.), performance and service risks, fuel availability/dependability, cost differences and potential opportunities to mitigate higher cost, if applicable; calculation of yearly reduction of petroleum based fuels and environmental impact; vehicle technical and performances issues; facilities modifications/upgrades. Obtain the review of the volunteer transit agencies and adjust the guide in accordance with their comments and guidance.

8) Develop an Impact Assessment – based on past adoption behavior and capability of the transit industry infrastructure, and understanding key parameters associated with the implementation process (such as: lead time, costs, benefits, impacts, and other general adoption requirements (engines, fueling infrastructure, etc.)), develop rate of adoption projections for each key option (each being a single-winner scenario). Based on these projections and for each key option, assess the transit industry’s impact (relative and absolute) on GHG emissions and reduced dependence from foreign sources of energy. Provide a cost/benefit assessment. Recommend major strategic directions and alternatives to the transit industry (as a whole) in addressing issues related to renewable energy, global warming and energy dependence.
V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $350,000

As a general guideline, the present cost for research usually averages approximately $150,000-$250,000 per professional staff-year. TCRP projects typically are in the $300,000-$500,000 range. A detailed budget should be developed when the final SOW is designed.

**Research Period:** 18 months

VI. URGENCY AND PAYOFF POTENTIAL

Global warming and renewable energy have been the center of attention in the majority of developed countries. Many efforts are underway to achieve stated goals in those countries. Similar efforts are being also legislated at state level here in the US. Currently this issue has come to the forefront of the attention of policy makers, automotive manufactures and energy suppliers, environmentalist organization and the public in general. The Transit Industry, as a leader in the past, it can again rise to the forefront of this huge environmental and quality of life challenge. It is not foreseen any direct financial benefit for the Transit Industry, but the indirect benefits are monumental and generations to come can enjoy its rewards.

Large scale conversion to renewable energy or renewable source energy can have positive effect on supply of petroleum based fuels and reduce their cost. So there might be an indirect financial payoff.

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

The recommended analysis fits well with FTA’s strategic research goals and TCRP strategic priorities. One of FTA’s strategic goals is (4) Protecting the Environment and Promoting Energy Independence. Significant number of questions raised in this strategic goal would also be researched and addressed in the submitted research topic.

The TCRP’s five established strategic priorities also mesh well with the recommended research topic since it addresses important energy sustainability and energy dependence issues which affect each single transit rider, community, organization.

VIII. RELATED RESEARCH

This project is a natural continuation of the anticipated TCRP C-19 project, TCRP Project C-15, and TCRP Report 38 completed in 1998. It is designed to take the informational contents of these studies or activities, along with other information, to develop a practical and actionable program document that will enable transit agencies to consider a broad set of criteria when considering fuel and technology choices designed to address and implement GHG and energy independence measures.

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This product is based on evaluating the available program activities and determining that in addition to the analytical documents and tools, transit agencies need program guidance and assistance to make decisions and implement programs. This is because GHG, energy independence, renewable energy sources and other potential measures represent options that non-standard and require systematic assistance in their evaluation and implementation.

XI. DATE AND SUBMITTED BY

Date: May 9, 2007
Submitted by: Frank Lonyai, LAMTA

Submit to:

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Transportation Research Board Problem Statement
Committee of Marketing and Fare Policy

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
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Washington, D.C. 20001
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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
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TCRP Problem Statement

PROBLEM TITLE

Improve transit ridership forecasts to determine optimum transit service levels

PROBLEM STATEMENT

Transit proponents cite numerous reasons to justify investment in transit - improve air quality, reduce greenhouse emissions, reduce or provide alternatives to congestion, reduce energy consumption, conserve land through transit supportive land use, spur economic activity, provide mobility and accessibility for individuals without access to an automobile. Transit critics counter that transit’s share of trips is too insignificant to make much of an impact on any of these issues and that transit’s declining share makes further investment wasteful. TCRP Project H-2 and H-15 quantify benefits of transit investment. TCRP Project H-32 is the most recent effort to articulate what it takes to increase transit ridership. This missing link is a tool that transit operators, advocates and other public policy makers can use to identify optimum levels of transit service in any community and to determine if investment in transit or transit supportive initiatives would be more cost effective than other approaches to achieve any one or more of the benefits listed above. It would also provide a road map for achieving the desired level of transit usage.

Transit demand models which are used for predicting ridership for major service improvements such as rail or BRT projects are frequently adjuncts to travel demand models designed for highway projects, have been frequently questioned as to their accuracy predicting transit ridership and are not suited to be a useful tool for transit managers seeking to determine appropriate service levels or potential transit market share.

OBJECTIVE

Create a software program that can identify transit ridership levels on a macro level in a community based on the prevalent external factors that influence transit uses (e.g. urban form, demographics, etc.) interacting with all possible individual and combinations of internal factors reflecting transit delivery. Internal factors include coverage, frequency, service span, pricing, methods of delivering transit information to prospective customers, in-vehicle and out of vehicle travel time, amenities, reliability and other measures of service quality. The program would answer questions including:

• Under optimum conditions assuming existing external factors are held constant, what is the maximum amount of ridership that can be achieved and what is needed to achieve it.
• How modifying internal aspects of transit delivery influence transit ridership to determine the optimum level of ridership.
• What benefits accrue at both maximum and optimum levels of ridership?

This program would be a tool to determine what actions need to be taken to achieve optimum transit usage in each community and the costs and benefits of accomplishing this. It should be
designed to aide in comparing transit investment options with do nothing and road investment options. (Note: This is intended for community wide transit service provision and not identifying specific corridor investments. Furthermore it should be adaptable of all types of communities large and small that can support general public transit service.)

A by product of this project is to improve existing demand models to more accurately predict transit ridership that generated by proposed capital projects.

RESEARCH PROPOSED

Expand upon the results of TCRP H-2, H-15 and H-32; Canadian experience (where per capita transit usage is triple US levels and transit market share is five times US levels), and other research to quantify relationship between external and internal influences on ridership and the benefits that accrue. Supplement with original research where needed, particularly seeking explanations for different levels in transit usage in comparable communities in the United States, and between other developed countries. The assumptions behind existing models that have a high reliability in projecting transit usage should also be studied.

ESTIMATED FUNDING AND RESEARCH TIME

$300,000; 18 months

URGENCY AND PAYOFF POTENTIAL

This study will answer what it takes for transit to play a significantly larger role in providing urban travel. It will enable any community to determine the maximum and optimum levels of transit ridership that can be achieved. This can provide effective rebuttal to critics who downplay transit due to low and declining market share by articulating what it takes to reverse this trend in the real world. More importantly it can assist efforts to increase transit ridership by focusing on what will generate the biggest payoffs.

Most important, this study can be used as a tool to determine if public and private funding that addresses any of the issues referred to in the problem statement, would be better spent investing in strategies that would increase transit ridership. This can be can be done at the community level and other governmental agencies such as the FTA and advocacy groups such as APTA or CTAA could use cumulative data from several communities to determine appropriate investment on regional, state or national levels.

RELATIONSHIP TO FTA VISION STRATEGIES and TCRP STRATEGIC PRIORITIES

FTA strategy: Increasing Ridership: This will provide a tool that can improve decision making to increase transit use.

TCRP priorities: Place the customer first. Efforts to increase ridership can only be achieved with placing the customer first. Specific strategies that do this will be identified in the study.

Enable transit to operate in a technologically advanced society. The products of this research will enable transit agencies better respond to changes in the community and customer needs.
RELATED RESEARCH


PERSON 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

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OUTLINE FOR TCRP PROBLEM STATEMENTS

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

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XI. DATE AND SUBMITTED BY:
Kathryn Coffel
June 14, 2007
Problem Statement

I. PROBLEM TITLE

The Other Side of Coordination – What Are the Barriers and Why Are They There?

II. RESEARCH PROBLEM STATEMENT

A recent GAO report identified more than 60 federal programs that provide funding for human service transportation. It seems that every study done over the past 30 years has indicated that there are few, if any, substantive barriers to coordination, and that “problems” are allegedly due to “attitudes” of State or local staff personnel and/or to real or perceived barriers attributable to statutes, regulations, and policy interpretations. In spite of this, transportation and even human service professionals continue to insist and give examples of the existence of many such “barriers” at the State and local level. Somewhere, there is a tragic disconnect between how the regulations are being written at the Federal level and how they are being executed at the local level. This research project would -- to the extent possible -- compile a listing of known and documented State and local laws, regulations, and policies, and their interpretations regarding coordination. Such a substantive, specific and comprehensive catalogue of actual regulatory barriers, compiled from sources directly involved with these experiences, will inform the national community and would give upper level State and federal authorities examples around which to issue further guidance and regulatory clarifications. Congress recently added new mandates for transportation coordination in SAFETEA-LU, and local systems and planners need more comprehensive tools to overcome the barriers that actually exist.

The impetus behind this project comes from the recent discovery (through the SAFETEA-LU coordinated planning process) that the statutory basis for California regulations that, for all practical purposes, prohibit public transit operators from being providers of Medicaid transportation throughout the State -- is in fact a “typo” in a law that was passed in 1982. Although this is hopefully an extreme example, it points to the likelihood that similar situations of both intended and unintended consequences exist all around the United States. If coordination between human service and public transit is ever going to take hold on a wide-spread basis, problems at the regulatory level must be identified and solved.

III. OBJECTIVE
Each State has its own “foibles” in encouraging or discouraging coordination of human service transportation and public transit. To date, no comprehensive compilation of these barriers – real and perceived – has been undertaken. Practitioners have been clear that they believe that they can learn from other States’ examples and successes in identifying way to deal with local issues.

The proposed project may also be a “crossover” with the J-5 Legal Issues program, which has already undertaken similar compilations, for example, of 13(c), ADA, and Charter Bus actions and determinations. To the extent feasible, cooperative funding and participation by that program is encouraged. However, it is noted that this project would be more complex in that it would require contact with multiple agencies in all 50 States and the Territories, rather than focusing on a primary information source such as FTA.

IV. RESEARCH PROPOSED

The project would begin with a review of existing literature on coordination successes and opportunities, particularly as they relate to “barriers,” and would identify instances where State actions actually encourage or foster coordination (a recent United We Ride document identifies Wisconsin as one such example).

The research would also investigate, to the extent possible “worst case scenarios” and unsuccessful attempts at coordination. It should include a legal research effort to identify and annotate existing laws, regulations, and departmental policies that hinder or work against coordination. In some cases, the information would be anecdotal, but should still be documented. Confidentiality of sources should be maintained, as appropriate.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $350,000 to $500,000 depending on the level of legal expertise required.

NOTE: This project is recommended to be considered for supplemental funding through the J-5 Legal Issues program.

Research Period: 24 months

VI. URGENCY AND PAYOFF POTENTIAL

This project would fill a significant missing gap in practitioners’ toolkits in dealing with coordination. The ability to learn from other States’ effort is one that practitioners have long been seeking.
VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES

In addition to being an invaluable asset to FTA’s work with United We Ride and the Coordination Council on Access and Mobility, this project would significantly contribute to two of the four FTA strategic research goals:
(1) Increasing Ridership
(2) Improving Capital and Operating Efficiencies

It would also enhance 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

Nothing like the proposed research is known to have been conducted in the past. The closest known example is documentation from the 1970s in federal Region IV, with Lee Alexander as the principal investigator, but this work focused primarily on federal programs.

Among the previous research that documents coordination benefits and opportunities, and identifies that relatively few barriers exist at the federal level include:

**Government Accountability Office:** “TRANSPORTATION DISADVANTAGED POPULATIONS: Some Coordination Efforts Among Programs Providing Transportation Services, but Obstacles Persist” (June 2003, 75 pages)

TCRP #B-27 Cost Benefit Analysis of Providing Non-Emergency Medical Transportation (completed)

TCRP #G-9 Human Services Transportation Cost Reporting to Facilitate Cost Sharing Agreements (currently underway)

TCRP #H-8 Using Public Transportation to Reduce the Economic, Social, and Human Costs of Personal Immobility (completed)

TCRP Synthesis #65: Transit Agency Participation in Medicaid Transportation Programs (completed)

Work conducted by/for “United We Ride” and the Coordinating Council on Access and Mobility
IX. PERSON(S) DEVELOPING THE PROBLEM

This problem statement was developed by members of TRB Committees AP060 (Paratransit) and AP055 (Rural & Intercity Bus Transportation).

X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This project was discussed and endorsed at the January 2007 meeting of the TRB Committee on paratransit (AP060). FTA staff present were enthusiastic about the opportunities presented by the project.

The proposed research has also been endorsed by TRB’s Rural Public & Intercity Bus Transportation (AP055) and by the APTA Access Committee.

XI. DATE AND SUBMITTED BY

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I. PROBLEM TITLE

Developing a Predictive Tool for Estimating Transit-Oriented Development Impacts

II. RESEARCH PROBLEM STATEMENT

The Major Capital Investment Program (New Starts) of the Federal Transit Administration (FTA) provides funding for transit projects across the nation based on the project’s ability to meet specific criteria set by Congress. While recognized in the criteria, the ability of projects sponsors to demonstrate cost-effectiveness impacts that result from land-use changes is somewhat limited. Potential benefits of a meritorious transit project extend beyond time and cost measures that are captured well in current user benefit calculations. In particular, many transit investments, such as streetcar, bring development that is induced by the mode and that results in fundamental changes in travel behavior that can provide dramatic benefits to an area. Transit-oriented development spurred by these transit modes results in neighborhoods that make fewer trips in motor vehicles and more trips on foot, bike and on transit. When more residents in a region live in this kind of neighborhood, more total trips (on all modes) can be accommodated with less congestion because more trips can be made without private motor vehicles adding to roadway congestion. Technical methods of accounting for the travel benefits that occur with transit-oriented development would help to solidify the project justification criteria for land-use and would provide technical backing for assertions that are currently included in project submittals.

The proposed research will gather data to identify land-use changes and development that has occurred with investments in transit systems and will further seek to quantify these changes in a manner that will allow project sponsors to move toward a consistent reporting measure that might be accepted for inclusion in the FTA’s calculation of cost effectiveness.

III. OBJECTIVE

The objective of this research is to identify and quantify the role that transit investment plays in development around transit projects, the extent to which this development encourages trip making that reduces reliance on vehicle trips and to highlight the benefit of transit-oriented development in the success of transit investments. This research may ultimately provide a method to measure the effects on the transportation system of a transit-oriented development pattern, which might be incorporated into FTA’s cost-effectiveness calculation.

IV. RESEARCH PROPOSED

The proposed research will consist of a literature search and a survey of transit-oriented development projects and trip making patterns in regions that have invested in capital projects where strong development has occurred around the transit investment. The research would include data and information collection regarding the benefits of development designed to encourage travel by alternative modes of transportation such as transit, walking and biking.
V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

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

**Research Period:** Twelve to 18 months.

VI. URGENCY AND PAYOFF POTENTIAL

The connection between transit and new development to produce land use patterns that are conducive to transit and non-motor vehicle trips is of great interest throughout the country. Many projects proceed partially based on this promise, but consistent, coherent, and nationally comparative data and methodologies are not yet well developed. In addition, project sponsors seeking funding through the federal New Starts and Small Starts programs face increasing difficulty in attempting to attribute quantifiable benefits to projects that result in positive transit-oriented development. Research and development of tools that will facilitate the ability to quantify these benefits will be extremely valuable in creating effective transit projects throughout the country. This additional information will greatly enhance the ability of project sponsors to develop good projects and will greatly assist the Federal Transit Administration and Congress as they evaluate and recommend transit projects throughout the nation.

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

The proposed research would support the FTA strategic goal of Mobility and Accessibility. It is hoped that the research will identify development and opportunities for development around transit projects that will lead to a transportation system that is accessible, integrated, efficient and offers flexibility of choice.

The proposed research would support the FTA strategic goal of Economic Growth and Trade by identifying the underlying development benefits that come from investment in transit systems. It would provide a means by which to explain the development impact of transit investments and would give insight to the development community about the benefits that are to be realized from investment in transit-oriented development.

The proposed research would support the FTA strategic goal of Quality Organization by adding the ability to expand on the insights into what makes a successful transit project. It will provide an analytical tool that may be used by the Federal Transit Administration and by Congress to assess the benefits of transit projects and will remove some of the subjectivity surrounding transit-oriented development benefits to New Starts and Small Starts projects.

The research would support the TCRP strategic priority to Continuously Improve Public Transportation. Researching and understanding the role that transit-oriented development has on public transportation will serve to highlight the benefits that can be gained by a multifaceted approach to investment in the “system” and will provide positive examples of how public transportation can be improved by a deliberate integration of development around projects to make them even more successful.

The research would also support the TCRP strategic priority to Flourish in the Multimodal Environment. A key to being able to flourish in a multimodal environment is gaining an understanding of the opportunities local areas have that will serve to increase the ability of people
to travel by alternative modes. Research into the development around transit projects and the impact that this development has on trip making will serve to meet this TCRP priority.

VIII. RELATED RESEARCH

National Cooperative Highway Research Program (NCHRP) Research Results Digest 294, “Transit-Oriented Development: Developing a Strategy to Measure Success” identifies and evaluates various indicators of the impacts of transit-oriented development, provides the results of a survey of transit-oriented development indicators, and identifies ten indicators that may be used to systematically monitor and measure the impacts of transit-oriented development.


IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

An internal TriMet team developed this problem statement. This team focuses on transit corridor planning and analysis of New Starts/Small Starts projects. The research proposed above is the result of internal discussions about how to quantify the multimodal travel benefits that have been seen in the Portland metropolitan area as a result of strong development around recent transit investments in the system.

XI. DATE AND SUBMITTED BY

Submitted by:

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on June 14, 2007.
Research Problem Statement for the Fiscal Year 2008 Transit Cooperative Research Program

I. PROBLEM TITLE

A Local Study for Transit Services on the Potomac and Anacostia Rivers

II. RESEARCH PROBLEM STATEMENT

The Nation needs a case study on the utility of ferry transit systems for high growth areas.

Due to the developmental waterfront projects that have or will occur along the Potomac and Anacostia rivers, and the numerous economic impacts regarding the highway and rail congestion along the I-95 / 395, I-495, and I–295 corridors; a study should be initiated to ascertain the feasibility of a Potomac / Anacostia passenger / car ferry transit service system to mitigate congestion and encourage economic growth for the city of Washington, D.C., and the states of Maryland and Virginia.

The City of Washington, DC began planning for a ferry system in 2005, while Not yet in place, it demonstrates partnership interest.

Congestion on America’s roads and railways presents a serious national problem. In fact, in 2003, Americans lost 3.7 billion hours and 2.3 billion gallons of fuel sitting in traffic jams. Overall, congestion costs America an estimated $200 billion a year and it continues to grow. Washington, DC is the best place to do a case study because of its proximity to water and because it is the fourth most congested city in the United States. The Travel Time Index (TTI) in the Washington area is over 1.51. This means...
that driving times during peak traffic hours are 51 percent longer than during off-peak
times.

With limited land available and the extremely high cost associated with expanding or
building our roads and rails, especially in the heavily populated areas that surround
most U.S. cities, we need to rapidly develop alternatives to shift some of this growing
burden off the roads and railways and on to less congested corridors.

III. OBJECTIVE

The goal of this project is to produce a clear and concise report that provides text and
graphics that illustrate best practices, benefits and impediments, as well as identifying
opportunities in the Washington D.C. Metropolitan area where ferry transit services
may be a solution to our growing development and congestion problems.

IV. RESEARCH PROPOSED

Recommend this study be a coordinated and developed partnership between
Washington, D.C., Maryland, and Virginia. Under this TCRP the research envisioned
would include a survey of potential transit facilities and ferry systems / operations, to
determine viable areas throughout the metro area for passenger and car ferry transit
services. The research would provide the benefits and impediments and best practices
realized with new ferry services including the required transit facilities.

This feasibility study would review the water alternative for:

- **Best practices**, such as best rate structure, best vessel / terminal
  arrangements, best vessel types, etc.
- **Benefits** such as increased transit capacity, reduced traffic congestion,
  environmental improvements, improved quality of life, impact of new baseball
  stadium and S.E. Federal Center development and transit demands in the
  Washington metropolitan area, and,
- **Impediments** placed by local and regional governments and Metropolitan
  Planning Organizations, experienced in the creation of a transit service in a high
  growth areas, consumer acceptance, technological, analysis of regulatory
  requirements, and others which proves relevant to ferry services.

The study should also identify any environmental, economic, safety, and mobility and
connectivity factors leading to the success of this type of transit / marine highway
operation. Further, the final report should also propose a transit ferry system size,
business plan, scope and operational description as well as a forecast of benefits.
Best practices and benefits and impediments realized by passenger and car services identified by this study will assist in planning an efficient transportation system to mitigate congestion and increase capacity on our National transit system. This will reduce: transportation costs including fuel costs, and emissions while improving the overall quality of life for the transportation consumer.

The research would further provide the local benefits, impediments and best practices associated with transit ferry operations and facilities. This will improve safety and security, increase mobility and connectivity, and provide efficient mobility of customers in the transit system.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** Recommend funding at $250,000 to conduct a comprehensive study.

**Research period:** Approximately one (1) year to complete the research including 3 months for review and revision of a draft final report.

VI. URGENCY AND PAYOFF POTENTIAL

Congestion on America’s roads in general and Washington, DC specifically is rapidly approaching crisis levels. Identifying solutions is critical to our immediate future and economic growth. A well thought out ferry system is mechanism which provides the immediate mitigation of congestion and a decrease in vehicular pollution in the metropolitan area.

The metropolitan area’s transportation growth and the need to meet mobility, and intermodal capability objectives place demands on our public transit systems. Current standard transit systems are aging and concepts are in need of upgrading. Transit must expand services and improve efficiency to meet the demands of growth and congestion in the Washington, D.C. commuting area.

Transit agencies are under continuous pressure to keep usage high and pricing low in order to provide effective service. New waterway innovations will increase rider ship and maximize the use of an effective transit system.

**RELATIONSHIP TO DOT/FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES**

The proposed research focuses on activities that are consistent with, and supportive of, DOT/FTA’s strategic research goals and TCRP strategic priorities. Following are the FTA strategic research goals that are being met with the project:
(1) **Reduced Congestion:** Use our people, our resources and expertise to help our partners at the state and local level to use their existing transportation networks better and to add capacity where it make sense, developing better policy choices for reducing congestion. This research project will further this goal by identifying new opportunities for reducing congestion and adding transportation capacity via transit ferry system.

(2) **Increasing Ridership:** Affordable, reliable, accessible, and efficient public transportation should be available to all Americans, as ridership is critical for realizing the economic, environmental, and mobility benefits of Federal investments. New concepts in ferry transit services will provide new options and opportunities increasing ridership on waterway transit system.

(3) **Improving Capital and Operating Efficiencies:** New ferry transit services may improve operating efficiencies and may add capacity to our transit systems. If best practices and impediments can be established early, they can be incorporated in construction efforts in a seamless manner. This will help FTA in assisting transit agencies contain the costs maintaining and expanding transit facilities and operating transit service.

(4) **Improving Safety, Security and Emergency Preparedness:** New and improved transit systems will add capacity and provide alternatives that can be called upon in emergency situations to safely evacuate passengers from an urban disaster. New publicly available research in this regard can raise the level of public awareness regarding ferry transit capabilities and facilitate emergency preparedness.

The TCRP has adopted five Strategic Priorities, which are being met in this proposal:

I. **Place the Transit Customer First**
The importance of the transit rider as well as the community at large will be served by improving transit ferries. This will directly result in better customer service.

II. **Enable Transit to Operate in a Technologically Advanced Society**
This TCRP will support public transportation to integrate state-of-the-art technology (new transit ferry systems) so that mobility and connectivity needs can be served as communities change and customer needs evolve.

III. **Continuously Improve Public Transportation**
This TCRP will support communities throughout the United States to continuously improve public transportation by increasing the “ease of ridership” making transit systems more user friendly.

IV. **Flourish in the Multimodal Environment**
This project will specifically help with intermodal flexibility, and community-based
planning opportunities offered by federal and other programs as it is specifically a multi-modal effort (highway and rail to waterway transit).

V. Revitalize Transit Organizations
Research and information on new transit ferry systems can help transit organizations "Work Better--Cost Less” by reducing congestion for customers.

VII. RELATED RESEARCH

Our research has indicated that there has not been a recent TCRP Project which focused on a local assessment of best practices, benefits, or impediments to the waterborne transit system. Similarly, there has not been recent research to identify new geographical areas where transit ferries would be a viable service.

Consider the April 2000 Virginia Department of Transportation study titled “Passenger Ferry Boat Feasibility Study,” in identifying ways to integrate ferry services into local public transportation systems.

VIII. PERSONS DEVELOPING THE PROBLEM

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IX. PROCESS USED TO DEVELOP THE PROBLEM STATEMENT

Maritime Administration staff did advance collaboration with Federal Transit personnel. Maritime Administration staff developed the TCRP after reviewing other TCRP proposals.

X. DATE AND SUBMITTED BY

Mr. Patrick Carlton  
Director, Office of Marine Highways and Passenger Services
June 15, 2007
I. PROBLEM TITLE

Comparative Analysis of the Morgantown PRT System.

II. RESEARCH PROBLEM STATEMENT

The most advanced automated transit system ever constructed in the world operates at the University of West Virginia in Morgantown. The Morgantown PRT is a completely automated, direct origin-to-destination transport system built in the 1970s and yet it remains unmatched anywhere in the world in terms of flexibility and automation. It carries over 2 million passengers a year and has completed over 110 million injury-free passenger miles (conventional transit would have injured about 100). Initial cost overruns and project delays have turned the US transportation community away from evaluating and considering such systems and comparing them with conventional systems. While the claims of personal rapid transit (PRT) advocates are highly controversial and hotly debated, the U.S. research community has failed to use the valuable knowledge available from over thirty years of operation of the Morgantown PRT to either validate or refute these claims. Meanwhile other countries are developing effective transportation systems based on the Morgantown principles. This is evidenced by the ULTra system under construction at Heathrow Airport, the 2getthere system operating in Amsterdam and the massive development program currently funded by Posco in Korea and Sweden.

Claims that PRT could reduce automobile use, energy consumption and point-of-use emissions while also increasing safety are more important now than ever. A comparison between this system, conventional transit, automobiles and modern PRT will provide transportation planners with vital information in their search for effective transportation solutions.

III. OBJECTIVE

Evaluate the effectiveness of the PRT concept by comparing the Morgantown PRT system to conventional transit systems such as bus and light rail as well as to automobiles and modern PRT in terms of service and cost. Based on this analysis, estimate the effectiveness of modern PRT systems such as are being deployed at Heathrow Airport. Provide comparative data that can be used by transportation professionals considering PRT for specific applications.

IV. RESEARCH PROPOSED

In addition to the PRT system, Morgantown, West Virginia also has a conventional bus system that can be studied for comparative purposes. This comparison will have the distinct advantage of being between two systems used by the same clientele. To this end it is proposed that the study be limited to that portion of the bus system serving essentially the same student/faculty/citizen base as the PRT system.

In order to verify the effectiveness of the Morgantown PRT system in solving inter-campus transportation problems a study of the likely cost and effectiveness of alternative solutions (such as road widening and bus rapid transit (BRT)) will be made. In addition, a review and comparison of transit and automobile solutions at other split campuses will be undertaken. This could include modes such as conventional bus with larger vehicles and longer headways, unconventional service with smaller vehicles and shorter headways, BRT or shuttles that operate within a dedicated right-of-way as well as light rail. Zip cars and other car-sharing services should also be evaluated and compared.

The Morgantown PRT system was built to primarily serve the students and, to this day, the ridership is comprised mainly of students with some usage by faculty and citizens. Since congestion and parking restraints force most students to use the system, it might not be a good indicator of unconstrained mode choice. However, it is believed that much can be learned regarding unconstrained mode choice from those citizens that do use the system and it is expected this will form an important part of the research that will help expand the usefulness of the study beyond university campus applications.

It is anticipated that much hard data (such as availability, wait and travel times, passenger miles traveled, safety, operating and maintenance costs) can be obtained from the extensive records kept on the PRT system. In addition, hard data on the PRT and conventional systems can be obtained by observation and measurement. However, mode choice is often based on perception and it will be important to also interview riders to obtain data on their perceptions. Previous research indicates that perceived PRT wait times are much longer than actual and it will be important to compare this differential with that
between actual and perceived waiting times for other modes. This work should also be extended to travel times since the non-stop nature of a PRT ride could result in significant differences in perception compared to other systems.

It has been speculated that overhead PRT guideways will meet with significant resistance in some locations. Previous work indicates that the Morgantown PRT overhead guideways are not generally perceived to be very negative except by relatively few observers. To attempt to value the perceived visual impact a workshop will be held involving riders and others who view or are impacted by the PRT system. The participants will be lead through a process wherein they determine which characteristics of the three Morgantown transportation systems (car, bus and PRT) they value most. In this way it should be possible to determine how concerns about visual impacts compare to other characteristics such as wait and trip times, comfort and sustainability.

A comparative analysis of the Morgantown PRT system with other systems under deployment that exhibit similar characteristics will provide useful data regarding the ability of these modern systems to improve upon any deficiencies of the Morgantown system. This analysis should include both the physical characteristics of conveyance, cost, infrastructure requirements and ownership models as well as the operating characteristics and service environment.

The data from the research described above will be presented to two or more expert working groups representing facilities such as universities and airports that would likely benefit from PRT-like systems and transportation professionals that typically consult to such facilities. The working groups will help in the development of recommendations for future use and implementation of PRT concepts including the types of environment that would most benefit. Potential benefits will be described and quantified and a methodology for promulgating this form of automated transit will be developed for those environments where it could efficiently provide mobility services.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

**Recommended Funding:** $300,000-$400,000.  
**Research Period:** 12 – 18 months.

VI. URGENCY AND PAYOFF POTENTIAL

Fifty years ago PRT was recognized as having enormous social and economic benefits. Unfortunately (perhaps because it was ahead of its time) the early projects faltered and PRT was given a bad name. Now modern forms of PRT are becoming available but there is still significant institutional resistance. Many fear being involved in the type of fiasco PRT became known for. In addition, understanding of PRT requires thinking along new lines – networks in place of corridors, many small vehicles in place of fewer large vehicles, computer control systems in place of drivers, etc. On the positive side there is now growing recognition that sustainability concerns require better alternatives to the automobile. It is vital that transportation planners be provided with data that will help them determine how PRT compares to other alternatives in terms of cost, right-of-way, level of service, mode split, energy use, emissions, etc.

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

This problem statement addresses the FTA strategic initiatives and the TCRP Strategic Priorities in the following manner:

- **Increasing Ridership.** Studies of theoretical PRT systems consistently indicate much higher mode share than conventional transit. This study will attempt to quantify this factor for modern PRT based on an actual PRT-like system.
- **Improving Capital and Operating Efficiencies.** The costs of the Heathrow PRT system indicate that PRT will cost much less to construct and operate than light rail. The data from this study will better enable planners to choose between PRT and other modes.
- **Improving Safety, Security and Emergency Preparedness.** With its 110 million injury-free passenger miles, Morgantown PRT has already proven PRT can improve transit safety by an order of magnitude. PRT avoids crowding in stations and on vehicles thus helping eliminate soft terrorist targets. If this study results in increased PRT use, transit safety and security will automatically be enhanced.
- **Protecting the Environment and Promoting Energy Independence.** This study will compare the energy use and emissions per passenger mile of the Morgantown PRT system with conventional transit and with modern PRT systems.
- **Place the Transit Customer First.** With its frequent stations, short wait times and on-demand, non-stop travel, PRT could provide transit that approaches the level of service of automobiles on un-congested roads.
- **Enable Transit to Operate in a Technologically Advanced Society.** PRT has lead the incorporation of state-of-the-art technology in transit. This study is intended to evaluate the results.
- **Continuously Improve Public Transportation.** This study will attempt to quantify the ability of PRT to improve public transportation.
Flourish in the Multimodal Environment. PRT could largely replace walking and shuttle buses as the mode used to connect other modes. The initial Heathrow project will connect an automobile parking lot to an airport terminal.

Revitalize Transit Organizations. If PRT truly can attract many more people from their cars, transit organizations will naturally be revitalized.
VIII. RELATED RESEARCH

Raney, S., et al “Morgantown People Mover: Updated Description” TRB, 2005
Young, S.E. “Back to the Future: Key Findings of the Morgantown, West Virginia Scanning Tour” TRB, 2005
Young, S.E., et al “Incremental Improvements to the Morgantown PRT” APM05, 2005

IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

This problem statement results from a suggestion by the Board of the Advanced Transit Association. Input was obtained from members of the Transportation Research Board’s Committee on Circulation and Driverless Transit, the Advanced Transit Association, University of West Virginia faculty, the Morgantown PRT staff, the City of Morgantown and others.

XI. DATE AND SUBMITTED BY

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TCRP PROBLEM STATEMENTS

I. PROBLEM TITLE

Rail and Bus Ridership Trend Modeling in U.S. Metropolitan Areas

II. RESEARCH PROBLEM STATEMENT

Transit has been the least demanded transportation mode in the U.S. for last few decades (Alam 2005). Its demand has been essentially constant since 1970 despite various government initiatives to increase patronage. Such initiatives include increased subsidy for the transit agencies and maintaining a relatively low fares (Taylor and Miller 2003). In 2001, transit contributed to only 2.1 percent of total trips in the nation while private vehicles, foot and bicycle, and other modes contributed to 85.8 percent, 9.9 percent and 2.2 percent, respectively (National Household Travel Survey 2001). Despite this minuscule market share of transit to the total national trips transit patronage has increased approximately seven percent between 1990 and 2000 (Pucher 2002).

There have been a number of studies explaining the determinants of transit ridership and its trends. Most of these have dealt with variables related to socio-economic conditions of the geographic units, local and state transit policies, sprawling of the service areas, access to automobile and such while they have ignored the agency-related variables. Nearly all of these studies have focused on a single geographic unit served by a single or multiple transit agencies. These studies cannot be used to generalize the demand functions of transit ridership for the whole nation or for a large regional division such as Northeast, Midwest, West, South or Southeast. Also, a lack of understanding prevails among the planners and policy makers regarding the rail ridership for the whole nation. There is a great need for further examination of the exact nature of the transit ridership (i.e., transit demand) functions in the whole nation. My study is an initiative towards that end.

III. OBJECTIVE

There is a gap in rail-related research pertaining to ridership as well as a gap in research pertaining to understanding ridership trends and causal factors. My research will bridge these gaps. Although the market share of transit is very low, typical transit users are the most disadvantaged groups of our society: the elderly, the disabled, the poor and the women. It is important to plan prudently and distribute the resources wisely for them. We need the exact demand functions of transit ridership for better planning. The objective of this study is to contribute to that end by taking corrective means of the pitfalls of the existing studies and add up to the current literature that can lead to proper planning and management of transit systems nationwide. My study will provide a better, bigger and comprehensive picture of the transit ridership in general, and rail and bus riderships in particular since these two are the major modes of the transit users. Thus the significance of my proposed study is both timely and creditworthy.
IV. RESEARCH PROPOSED

Proper understanding of the exact nature of transit ridership demand model is at the heart of transportation policy making and the success of transit agencies. Unfortunately, most of the existing studies have focused on a single or few transit systems or metropolitan areas to analyze the determinants of transit ridership change. Few studies that have focused on nationwide data have either failed to consider some important variables or weak methodologically. It is not possible to generalize for the whole nation from such studies. The proposed research aims to investigate the big picture of transit travel demand functions at national level. Using the data from Integrated National Transit Database Systems, U.S. Census Bureau, U.S. Bureau of Labor Statistics and other sources the study will attempt to correct for the pitfalls of existing studies and provide a comprehensive picture of rail and other transit ridership demand in the nation.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: I estimate the funds necessary to accomplish the objectives stated in Section III as approximately $200,000 per professional staff-year. The actual funds needed may be little over or below this estimated amount, which I’ll know when the project is approved.

Research Period: I estimate the period of time needed to complete the research, including 3 months for review and revision of a draft final report is 24 month.

VI. URGENCY AND PAYOFF POTENTIAL

As I have mentioned above, there is a gap in rail-related research pertaining to ridership as well as a gap in research pertaining to understanding ridership trends and causal factors. Given the high gas prices in recent years, increased air pollution caused by increased automobile use, increased energy loss and economic costs of using automobile, it is utmost important that the policy makers help auto users shift their habit and use transit. However, it is extremely important for the planners, policy makers and political leaders to get a clear and overall national picture of recent transit ridership demand and causal factors. My research is aimed at that direction, which will explore the national average transit ridership demand in last decade or so. My study will focus on both rail and bus transit. It will have direct payoff to the entire transportation industry and thereby the nation as a whole since the findings will help shape future transportation planning efforts including policy making. There are no institutional, political, or socio-economic barriers to implementation of the anticipated research products.

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

The proposed research falls under the first category of FTA strategic research goals, which is Increased Ridership. It also falls under the first category of TCRP Strategic Priorities, which is 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.

VIII. RELATED RESEARCH
There is little research that has dealt with similar topic. However, these studies are methodologically weak and/or did not include all relevant causal factors. Thus, these studies are not appropriate to generalize for the whole country. Thompson and Brown (2007) and Taylor and Miller (2003) are two recent studies that have focused on transit ridership at national level. However, these studies are attached to several weaknesses – both methodologically and in terms of using relevant causal factors. I am also working on a small research project that investigates transit ridership demand; however, it is not directed to explore the national ridership of rail and other modes. Rather, the scope of this study is limited to few metropolitan areas and excludes rail transit. Here comes the utmost need of a comprehensive study that will explore a clear picture of transit ridership in the whole nation – both rail and other modes.

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. However, I may involve other researchers depending on the needs at different stages of the research.

XI. DATE AND SUBMITTED BY

Dr. Bhuiyan M. Alam is an assistant professor of transportation planning in the Department of Geography & Planning at the University of Toledo, OH. He did his Ph.D. dissertation on transit planning, modeling and policy analysis. Currently, he is working on two more funded research projects and has submitted another proposal to model the rapid transit system in Southeast Michigan/Detroit metropolitan area.

Submission Date: 06/15/2007

References

TCRP PROBLEM STATEMENT

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 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
TCRP PROBLEM STATEMENT

I. PROBLEM TITLE
Transit-Oriented Development (TOD) Evaluations

II. RESEARCH PROBLEM STATEMENT
The people of California passed Proposition 1C in support of Transit-Oriented Developments (TODs). The Caltrans is currently working with partners to develop an evaluation methodology that allows for "post processing adjustments" to reflect the impact of TODs on the need for parking, transit ridership, non-motorized trips, and SOV ridership. The proposed study will investigate the impacts of TODs on alternatives to the SOV and examine the “Lessons Learned” and “Best Practices” associated with TOD planning and development. This problem is a national issue, and should be studied throughout the United States and not just in California.

III. OBJECTIVE
The ability to predict and document the impacts of TODs while: 1) increasing ridership of bus transit through increased convenience, 2) increasing the use of non-motorized travel modes through increased safety, comfort, and convenience, and 3) decreasing SOV use.

IV. PROPOSED RESEARCH
The research proposes to develop an evaluation methodology for TOD projects once implemented and operational. The proposed research will also include a nationwide review of TOD “Best Practices” which will be shared with TOD experts including the public and private sector interests.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $300,000

Research Period: 24-months

VI. URGENCY AND PAYOFF POTENTIAL
The proposed study introduces a new paradigm in local land use planning and zoning, integrating mixed-use commercial, business, and higher density residential land use designations, which embraces a transit-oriented, livable and walkable community philosophy. Payoff will result in mixed mobility options, improved air quality, decreased Vehicle Miles Traveled (VMT), and increased transit ridership.

VII. RELATIONSHIP TO FTA STRATEGIC GOALS AND POLICY INITIATIVES and TCRP STRATEGIC PRIORITIES
This project supports FTA Strategic Goals 1, 2, 4, as well as TCRP Strategic Priorities I, III, IV.

VIII. RELATED RESEARCH

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

California Department of Transportation (Caltrans)
Division of Research and Innovation
Strategic Research Process

XI. DATE AND SUBMITTED BY

Wesley S.C. Lum
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June 15, 2007
I. PROBLEM TITLE

Bridge the gap between Regional Travel-demand and Microsimulation models—An Evaluation Study

II. RESEARCH PROBLEM STATEMENT

Regional Travel-demand modeling has traditionally been limited to large-scale transportation projects of regional significance. However, there is an increasing demand for sensitivity to mode choice and regional travel in operational analyses of intersections and corridors.

Though improvements have been made in both Regional and Microsimulation models, the models are not calibrated/validated at the local corridor level for highway and transit volumes, and a gap exists between these areas of practice. This disparity is most apparent in transportation planning projects where a regional model is not receptive to the alternatives being considered, and where simulation of the multiple alternatives becomes exceedingly costly and time consuming. A technical bridge across this gap is needed for practitioners to address the growing interest in multi-modal connections, smart growth, integrated land use and transportation planning, context-sensitive design, and the bicycle/pedestrian environment.

Transportation planners need tools to measure level of service, including travel time by mode and person hours of delay; people throughput on buses and cars rather than just measuring vehicle counts/volume. The models have to be able to include the actual increase of people movement over vehicles. The models to date are not capable of modeling transit systems, which route vehicles in real time, or systems that adjust to the level of demand.

III. OBJECTIVE

Develop a methodology to bridge the gap between Regional travel-demand and Microsimulation models.

IV. RESEARCH PROPOSED

A tool needs to be developed to bridge the gap for practitioners to address the growing interest in multi-modal connections, smart growth, integrated land use and transportation planning, context-sensitive design, and the bicycle/pedestrian environment.

A tool needs to be developed to measure level of service, including travel time by mode and person hours of delay; people throughput on buses and cars rather than just measuring vehicle counts/volume. The model needs to be able to include the actual increase of people movement over vehicles.

To determine if such a model is needed or valuable, we suggest the research should focus on the Caltrans District 3 CMP/CSMP process just beginning. The CMP/CSMP is a groundbreaking planning process that requires looking at the interaction of the full corridor from all modes, several jurisdictions and larger land use issues, such as transit oriented development. Currently the process is cobbling together many different modeling methods and applications, depending on the situation. An independent study is needed to evaluate the modeling tools and processes to validate the decisions made and determine if a new model is needed to address this more global, comprehensive undertaking.

V. ESTIMATE OF THE PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding: $500,000

Research Period: Unknown
VI. URGENCY AND PAYOFF POTENTIAL

The California Transportation Commission (CTC) adopted Resolution CMIA-P-0607-02, which requires Planning Agencies that receive Proposition 1B: Corridor Mobility Improvement Account (CMIA) funds, to complete a Corridor System Management Plan (CSMP). As a component of the CSMP, Microsimulation modeling is required on the corridors. During the CSMP meetings, some agencies have reported that they are not going to have transit elements in their CSMP's because Microsimulation isn't a good tool to assess transit. This requirement is will most likely be implemented in other states in the near future, using California as the lead example.

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

The research highly supports three of the TCRP’s strategic priorities (II) Enable Transit to Operate in a Technologically Advanced Society, (IV) Flourish in the Multimodal Environment and (V) Revitalize Transit Organizations.

VIII. RELATED RESEARCH


Passenger Travel Demand Forecasting, Transportation in the New Millennium, Transportation Research Board Committee A1C02: Committee on Passenger Travel Demand Forecasting, http://onlinepubs.trb.org/onlinepubs/millennium/00083.pdf


IX. PERSON(S) DEVELOPING THE PROBLEM

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X. PROCESS USED TO DEVELOP PROBLEM STATEMENT

State Policy, Research and Capital Office Strategic Research Process Division of Mass Transportation California Department of Transportation (Caltrans)

XI. DATE AND SUBMITTED BY

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TCRP Problem Statement

PROBLEM TITLE

Develop a Manual for Planning Transit Service in New Development

PROBLEM STATEMENT

The need to incorporate transportation and land use planning and to design more transit friendly communities has become a hot issue in recent years. Several TCRP Projects are addressing various aspects of this issue. However there are deficiencies in current practice in most communities relating to planning for transit services into new development. Planning for transit service into greenfield development is usually reactionary and not handled in the same manner as planning for other public services and infrastructure such as public safety, streets and roads, water, and sewage. When transit operators are at the table, often only some but not all of the many aspects of transit planning are addressed. Funding mechanisms to sustain new transit service either does not exist, or if a development does generate additional revenue, often one or more of the following apply; revenue is inadequate, delayed in receipt or not discernable as being generated by the development. With an anticipated population growth of 100 million over the next several decades a large amount of greenfield development will occur. There is growing acknowledgement that new development models will be needed to minimize the environmental footprint and address other social needs.

Note: Many organizations including many transit agencies have published documents that include design guidelines on how best to accommodate transit. To produce a comprehensive document a synthesis of these guidelines should be included in the final product; the original research sought from this project is to focus on the areas that present the greatest challenge to transit operators. These challenges include how to determine if a proposed road system permits desired transit service design and provide meaningful recommendations for changes; how to plan a route network that is efficient, effective and integrated with what exists or will exist in adjacent areas and how to fund service expansion into new areas.

OBJECTIVE

Create a manual that can be used by transit systems, municipalities and developers containing methodologies for successful integration of transit service into new development. The outcomes of this project should enable transit systems to plan for service extensions in a manner analogous to planning street, sewer or water connections into new communities i.e. transit routes should be laid out in advance of approval of the specific plan for an area, fully integrated with existing and future transit services. Components of this manual include methodologies for laying out streets in a manner that allows for efficient and effective transit routing; methodologies for extending or establishing transit routes with efficient and effective route designs, minimizing the need for major route restructuring and allowing users of the new service the same ease of reaching destinations throughout the region as users of pre-existing services.
The second objective of this effort would be to develop funding strategies to sustain increased transit service into new development and to assure the timely receipt of those revenues so that transit service can be established soon after streets are complete and when the development is coming on line. The manual would document these strategies.

The third objective of the manual is to include transit support guidelines that could be used by transit operators, local governments and developers relating to the streets designated for transit service. Elements would include, but not necessarily be limited to: pedestrian access, pedestrian safety, roadway design, bus stop design and land use relationship to the transit streets. Several transit agencies have published documents that cover physical design issues related to the provision of transit service. However usually these documents exclude some of the elements necessary for making a development transit friendly. For example clear articulation of pedestrian access in all types of development is often omitted since it applies to parts of the development away from the transit stop or route. This section of the manual could be a synthesis of the best practices identified in these manuals in order to have a single source document that incorporates all aspects of transit service design as it relates to new development. If the synthesis identifies deficiencies, original research will be conducted to provide additional guidelines and standards.

RESEARCH PROPOSED

A cross section of transit systems would be examined to determine how planning bus routes for new development takes place and if agencies provide input in mapping street layout in new development. The advantages and disadvantages of each approach would be detailed. The research team may convene a panel of transit managers and planners (separate from the project team overseeing the project) to identify the challenges to planning of transit service expansion into new areas and to brainstorm new ideas that include integrating street layout with transit route design. Strategies or methodologies based on what is working or what appears could work would be developed and in funding allows field-tested at selected transit properties. All methodologies and strategies that could work would then be described including advice as to when they most likely would be effective.

A similar approach would be undertaken on the funding issue.

A complimentary synthesis effort would be undertaken to review documents that provide guidelines for land use integration, pedestrian access, transit friendly roadway design and transit amenities for inclusion in the third section of the manual. If this synthesis appears incomplete or inadequate in any area, further research will be conducted to produce a comprehensive documentation of all elements needed for optimizing transit use in any kind of land use or urban design pattern.

The research team may be able to use material gathered in the development of TCRP Projects B-06, H-04D and H-12 for the service design component of this project and TCRP H-7 may be useful in the preparation of the funding component. TCRP D-8 could be useful in addressing pedestrian safety issues.

ESTIMATED FUNDING AND RESEARCH TIME

$300,000; 24 months
URGENCY AND PAYOFF POTENTIAL

The United States is expected to grow by 100 million persons over the next few decades and most of this development will be greenfield development. However many brownfield and grayfield developments are similar to greenfield development due to a lack of existing transit services and/or the creation of totally new street networks. However transit service planning into new development is usually an afterthought, if considered at all. In order for transit to increase market share, and play a significant role as an alternative to traffic congestion, improve air quality reduce greenhouse gas emissions and provide mobility to those without access to an auto; it must be planned for and funded before construction of new development begins. Failure to do so will simply retain the status quo of severe suburban traffic congestion, worsening air quality and isolation of many individuals.

The synthesis element of this project would address transit friendly street design; urban form to assure easy, safe and pleasant pedestrian access to bus stops and urban densities needed to sustain minimal (service every 30 minutes) transit service in order to provide a single coherent document on transit service planning in new development. With a manual that can aid any size transit system, transit systems should have the tools needed to effectively incorporate transit service into all new development when the development comes on line. The manual will also be useful to local governments and developers, many of whom are seeking new development models that reduce the environmental footprint, address the aging population and other changes that favor greater transit use.

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

FTA Strategic Goals and Policy Initiatives: Ridership. Increase transit market share in new development and increase overall per capita ridership within metropolitan areas.

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 new development.

Continuously Improve Public Transportation. As regions grow, public transportation will be better equipped to grow with and serve new development.

RELATED RESEARCH

TCRP B-6, D-8, H-4, H-7, and H-12

PERSONS DEVELOPING THE PROGRAM

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PROCESS USED TO DEVELOP PROBLEM STATEMENT

Developed by group

DATE AND SUBMITTED BY

June 15, 2007

American Public Transpiration Association
Systems Management/Operations Planning Subcommittee
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Problem Statement

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.

Objective

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

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PROCESS USED TO DEVELOP PROBLEM STATEMENT

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

DATE AND SUBMITTED BY

June 15, 2007

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Problem Statement

PROBLEM TITLE

Research to improve the integration of bus transit and land development

PROBLEM STATEMENT

The integration of bus transit and land development is critical to efficient transportation systems and livable communities. There is a considerable amount of literature and ongoing research focused on rail transit and land use. Further research is needed on the impact of bus transit systems on land use and on the economic development of the adjoining area.

Bus transit is often not considered in the early planning for new developments or in urban redevelopment. In some cases, this can be due to poor planning processes but another reason may be that stakeholders do not believe bus transit can positively impact the proposed project. In addition to excluding bus transit planners from land development planning, advocates for good pedestrian environments are also often left out of early planning efforts.

Research on the relationships between bus transit service, pedestrian environments and land use is limited. There is anecdotal evidence that a good pedestrian environment and a well-integrated bus transit system improve the quality of life issues for residents lucky enough to live in such developments. Research that quantifies this impact is needed. If the advantages of bus transit and a good pedestrian network were better understood, this evidence could be utilized to improve the planning processes which currently overlook bus transit and pedestrian amenities as requisite infrastructure.

Over the past several years there have been many efforts to address these issues and there is an increasing amount of literature on the subject. TCRP Synthesis Project SH-08 published in 2006 reviewed the available literature and identified several areas where further research is needed.

OBJECTIVE

Conduct research necessary to advance the effective integration of bus transit with land development. Develop methods and measures to quantify the impacts on land development of well-planned pedestrian and bus transit networks.

RESEARCH PROPOSED

Research would be focused on tasks to quantify the advantages afforded to new and/or redevelopment projects by a good pedestrian network and the careful integration of bus transit to serve the development.

Methods to measure the impacts of bus service are needed to support future bus transit and land use coordination projects. The need for this research is becoming more urgent as the number of new Bus Rapid Transit (BRT) projects increase.
Regulations often require development projects to include provisions for automobile users. In a fewer number of cases, developers may be requested to provide for transit and bicycle access. Research is needed to determine how a planned bus service improvement may impact mode choice to the development. For example, if high frequency bus service will serve the development, how much of an impact will this have on the projected requirements for number of parking spaces or roadway improvements? There needs to be credible research that developers, lenders and municipalities can use to determine the trade-off between the various modes. The availability of this type of research would provide developers with further incentive to provide transit elements in the development.

The impact of the walking environment on acceptable walking distance is not well known. It is suspected that pedestrians are willing to walk further in pedestrian friendly environments than in environments hostile to walkers. It also follows that a greater number of walking trips will be made in pedestrian friendly environs. If this is the case, documentation would provide evidence that lower vehicular trip rates are achievable in pedestrian friendly environments. This would encourage expenditures to create pedestrian friendlier environments. A study to examine the impact of the environment on walking trips by trip purpose and trip length together with associated demographic characteristics is needed.

Specific research tasks include:

- Since both trip generation and mode split will determine the amount of parking and roadway expansion needed for new developments, conduct research to determine if mixed use development impacts trip generation.
- Investigate regulatory measures that require inclusion of bus transit and pedestrian amenities in new developments. Calculate the cost of these amenities versus the cost of automobile-related requirements.
- Conduct research on the effectiveness of current regulatory methods to include bus transit planners early in the planning process for either new or re-development projects.
- Research the impact of pedestrian environment and pedestrian amenities on the number, purpose and length of walking trips.
- Research vehicular trip rates in hostile pedestrian environments versus pedestrian friendly environments.

**ESTIMATED FUNDING AND RESEARCH TIME**

$300,000; 24 months

**URGENCY AND PAYOFF POTENTIAL**

Most development occurring in this country is greenfield development. Many brownfield and grayfield developments are similar to greenfield development due to a lack of existing transit services and/or the creation of totally new street networks. However transit service planning into new development is usually an afterthought, if considered at all. In order for transit to increase market share, and play a significant role as an alternative to traffic congestion, improved air quality and mobility to those without access to an auto; it must be planned for and funded before construction of new development begins. Failure to do so will simply retain the status quo of severe suburban traffic congestion, worsening air quality and isolation of many individuals.
The research recommended in this problem statement will provide information and data currently not available that will result in better decision making leading to better integration of transit in the land development process and ultimately increased ridership.

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

FTA Strategic Goals and Policy Initiatives: Ridership. Increase transit market share in new development and increase overall per capita ridership within metropolitan areas.

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 new development.

Continuously Improve Public Transportation. As regions grow, public transportation will be better equipped to grow with and serve new development.

RELATED RESEARCH

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

PERSONS DEVELOPING THE PROGRAM

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PROCESS USED TO DEVELOP PROBLEM STATEMENT

Developed by SH-08 panel committee.

DATE AND SUBMITTED BY

June 15, 2007

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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 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 has 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
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