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Administration

USDOT Federal Railroad Administration's Third Research Needs Workshop on Highway-Rail Grade Crossing Safety and Trespass Prevention: Volume I—Summary of Results

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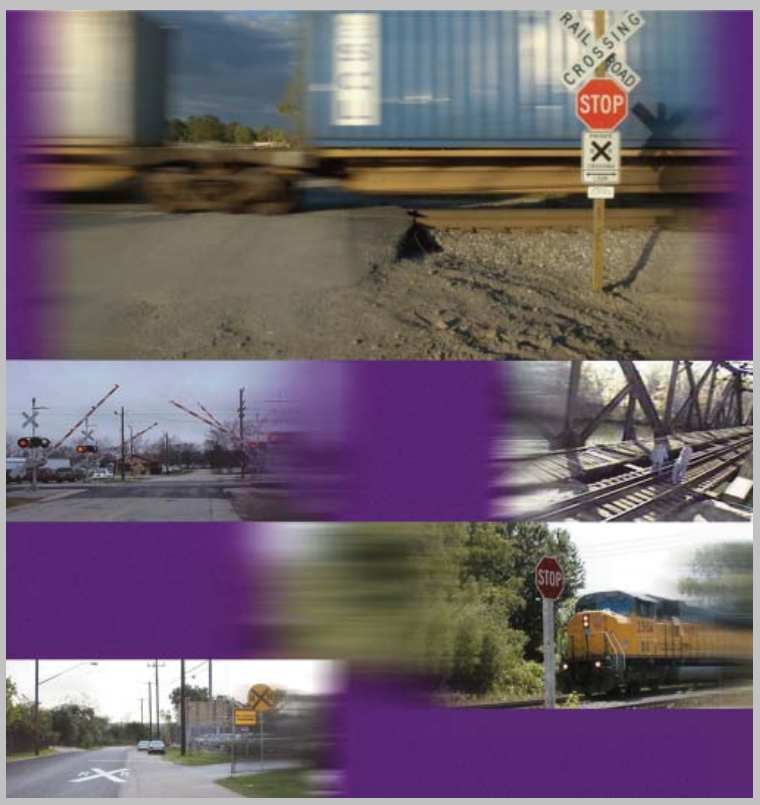

Safety of Highway Railroad Grade Crossings

DOT/FRA/ORD-10/01

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13. ABSTRACT (Maximum 200 words)
On July 14-16, 2009 the John A. Volpe National Transportation Center hosted the United States Department of Transportation (USDOT) Federal Railroad Administration's (FRA) Third Research Needs Workshop on Highway-Rail Grade Crossing Safety and Trespass Prevention (workshop). The primary purpose of this workshop was to bring together nationally and internationally recognized subject matter experts to collaborate, identify and prioritize specific research needs to facilitate the reduction of highway-rail grade crossing and trespass incidents and fatalities for incorporation into the strategic vision of FRA, other USDOT modes and their stakeholders. There were approximately 90 participants, including support staff, over the two-and-a-half day workshop, representing the Federal, State, and local governments, as well as railroads, transit agencies, labor unions, academia, non-profit organizations, and consultants.

The workshop was organized into six research needs areas and four cross-cutting areas by the Steering Committee's recommendation. This report (Volume I) provides specific information on all 80 research needs developed at the workshop, a discussion and analysis of these needs, balloting results, and details the top priority research needs, as identified by the workshop attendees.

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ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in)	=	2.5 centimeters (cm)
1 foot (ft)	=	30 centimeters (cm)
1 yard (yd)	=	0.9 meter (m)
1 mile (mi)	=	1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2)	=	6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2)	=	0.09 square meter (m^2)
1 square yard (sq yd, yd^2)	=	0.8 square meter (m^2)
1 square mile (sq mi, mi^2)	=	2.6 square kilometers (km^2)
1 acre = 0.4 hectare (he)	=	4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz)	=	28 grams (gm)
1 pound (lb)	=	0.45 kilogram (kg)
1 short ton = 2,000 pounds (lb)	=	0.9 tonne (t)

VOLUME (APPROXIMATE)

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1 tablespoon (tbsp)	=	15 milliliters (ml)
1 fluid ounce (fl oz)	=	30 milliliters (ml)
1 cup (c)	=	0.24 liter (l)
1 pint (pt)	=	0.47 liter (l)
1 quart (qt)	=	0.96 liter (l)
1 gallon (gal)	=	3.8 liters (l)
1 cubic foot (cu ft, ft^3)	=	0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3)	=	0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm)	=	0.04 inch (in)
1 centimeter (cm)	=	0.4 inch (in)
1 meter (m)	=	3.3 feet (ft)
1 meter (m)	=	1.1 yards (yd)
1 kilometer (km)	=	0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2)	=	0.16 square inch (sq in, in^2)
1 square meter (m^2)	=	1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2)	=	0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2)	=	1 hectare (ha) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gm)	=	0.036 ounce (oz)
1 kilogram (kg)	=	2.2 pounds (lb)
1 tonne (t)	=	1,000 kilograms (kg)
	=	1.1 short tons

VOLUME (APPROXIMATE)

1 milliliter (ml)	=	0.03 fluid ounce (fl oz)
1 liter (l)	=	2.1 pints (pt)
1 liter (l)	=	1.06 quarts (qt)
1 liter (l)	=	0.26 gallon (gal)
1 cubic meter (m^3)	=	36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3)	=	1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

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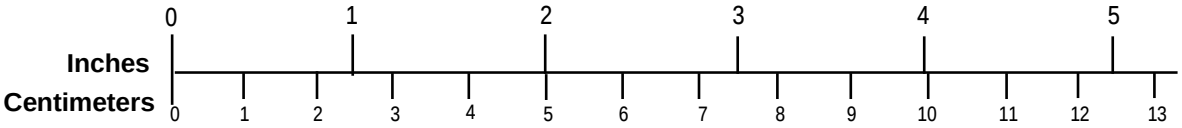

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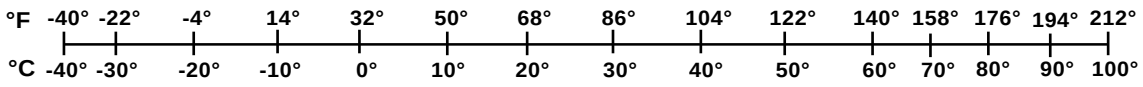

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The authors also wish to extend special thanks to all of the Steering Committee members for their partnering contributions to the successful planning and conduct of this research needs workshop. The Steering Committee members included the following:

Leonard W. Allen, III	FRA, Chair
William Browder	Association of American Railroads
Richard Campbell	Campbell Technology Corporation
Anya A. Carroll	Volpe National Transportation Systems Center
Debra Chappell	Volpe National Transportation Systems Center, Lead
Marco daSilva	Volpe National Transportation Systems Center
Daniel Di Tota	Operation Lifesaver Canada
Mike Flanigon	Federal Transit Administration
Deborah Freund	Federal Motor Carrier Safety Administration
Brian Gilleran	FRA
William Grizard	American Public Transportation Association
Steven Laffey	Illinois Commerce Commission
Leo Penne	American Association of State, Highway and Transportation Officials
Thomas Raslear, Ph.D.	FRA
Ronald Ries	FRA
Helen Sramek	Operation Lifesaver, Incorporated
Diane Wigle	National Highway Traffic Safety Administration
Terrell Williams	Federal Transit Administration
Guan Xu	Federal Highway Administration

John P. McGuiggin, Chief, Systems Engineering and Safety Division, USDOT Research and Innovative Technology Administration (RITA) John A. Volpe National Transportation Systems Center (Volpe Center), provided managerial direction and support for the workshop. Anya A. Carroll, National Expert, Multimodal Surface Transportation, Physical Infrastructure Systems Center of Innovation, Volpe Center, and Marco daSilva, Highway-Rail Grade Crossing and Trespass Research Program Manager, Systems Engineering and Safety Division, Volpe Center, provided overall direction for the workshop. Debra Chappell, Systems Engineering and Safety Division, Volpe Center, served as the Team Leader. Logistical support was provided by Patrick Bien-Aime, Steven Peck, Tashi Ngamdung, Adrian Hellman, Dan Kubaczyk, and Erica Squillacioti, of the Systems Engineering and Safety Division, Volpe Center. The team facilitators were Rachel Winkeller, Jeff Bryan, Aaron Jette, Suzanne Sloan, Rachael Barolsky, Cassandra Oxley, and David Damm-Luhr of the Volpe Center.

Mirna Gustave, Kalle Culotta, Craig Austin, Philip Thornton, Nathan Grace, and Tonya Miller, MacroSys Research Technology, provided Web site, Web streaming and onsite planning and logistical support and editorial services. Richard Gopen, MicroLan Systems, Inc. provided technical and logistical support for the Web streaming.

The authors wish to thank and acknowledge the contributions of all participants for their part in the successful development of the formal research needs.

Acronyms

AAR	Association of American Railroads
AASHTO	American Association of State, Highway and Transportation Officials
APTA	American Public Transportation Association
EPA	Education and Public Awareness
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GCM	Grade Crossing Modernization
GPS	Global Positioning System
HRGC	Highway-Rail Grade Crossing
HSR	High Speed Rail
HST	High Speed Train
II	Institutional Issues
ITS	Intelligent Transportation Systems
MBTA	Massachusetts Bay Transportation Authority's
MUTCD	Manual on Uniform Traffic Control Devices
NHTSA	National Highway Traffic Safety Administration
NTO	New Technology Opportunities
PTC	Positive Train Control
R&D	Research and Development
RE	Regulations and Enforcement
RITA	Research and Innovative Technology Administration
TOD	Transit Oriented Development
TP	Traffic Patterns
US DOT	United States Department of Transportation
Volpe Center	John A. Volpe National Transportation Systems Center
workshop	US DOT Federal Railroad Administration's Third Research Needs Workshop on Highway-Rail Grade Crossing and Trespass Prevention

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Executive Summary

On July 14–16, 2009, the United States Department of Transportation (USDOT) Research and Innovative Technology Administration's (RITA) John A. Volpe National Transportation Systems Center (Volpe Center) hosted the USDOT Federal Railroad Administration's (FRA) Third Research Needs Workshop (workshop) on Highway-Rail Grade Crossing Safety and Trespass Prevention. The primary purpose of the workshop was to bring together national and international subject matter experts to collaborate, identify and prioritize specific research needs related to technology, human factors, methodology, enforcement, and education to facilitate the reduction of highway-rail grade crossing and trespass incidents and fatalities for incorporation into the strategic vision of FRA, other USDOT modes, and their stakeholders.

A Steering Committee was nominated by FRA to assist with the structure and direction of the workshop, with a goal in mind to provide a diverse group of experts to address different perspectives of highway-rail grade crossing safety and trespass prevention. Members of the Steering Committee were composed of leaders of various USDOT agencies and their key partnering organizations (both public and private). A total of 77 representatives participated as delegates at the two-and-a-half day workshop. They included Federal, State, and local governments, as well as railroads, transit agencies, labor unions, academia, nonprofit organizations, and consultants, as shown in Table 1. Additionally, there were international participants from Canada, the United Kingdom (Great Britain and Ireland), and Taiwan (Republic of China).

Table 1. Distribution of Workshop Delegates by Organizational Type

Organization Type	Number of Delegates
Federal government	28
Highway agencies	6
Railroad	9
Transit	5
Industry	5
Consultants	6
University/academia	2
Unions	3
Nonunion organizations	6
International	7
Total	**77**

The first day, streamed live via Web access, included three high-level keynote speakers from the USDOT Office of the Secretary and the FRA. The messages from David Matsuda (former Acting Assistant Secretary for Transportation Policy[1]), Jo Strang (FRA Associate Administrator for Safety and Chief Safety Officer) and Magdy El-Sibaie (FRA Director of the Office of Research and Development) provided words of encouragement and collaboration on:

[1] Mr. Matsuda is currently the Deputy Administrator for the Maritime Administration (MARAD)

- the importance of research and development to improve safety and reduce trespass at grade crossings; and
- future considerations for grade-crossing safety of new projects such as high speed rail, as well as surveying past and current project successes and challenges

Speakers on the first day provided presentations regarding international activities and a socio-technical framework. Sixteen additional presentations provided current information over six topical areas during the general session of the first day.

During the second day of the workshop, the participants covered specific research needs related to the six topical areas to facilitate the reduction of highway-rail grade crossing and trespass collisions and fatalities. These topical, or research needs, areas were:

- Grade crossing modernization
- Traffic patterns
- New technology opportunities
- Regulations and enforcement
- Education and public awareness
- Institutional issues

The 77 delegates developed 80 research problem statements within the six groups. Each group was then tasked to identify the top five projects for their respective research needs area. This vetting process resulted in the identification of 33 top needs, as three groups had six top research topics instead of five. Each group was then tasked to identify the top five projects for their respective research needs area. This vetting process resulted in the identification of the top 33 research needs. An aggregate list of these needs was created and distributed to the attendees to provide their thoughts on a priority of all the projects generated at the workshop. A balloting process was then instituted to capture the delegates' thoughts on research need priorities.

A ballot containing the 33 top research needs identified by the working groups was developed and sent electronically to all 77 delegates for prioritization. A total of 51 delegates returned their ballots, which equates to return rate of over 66 percent.

Table 2 lists the prioritized research needs identified in the workshop, color coded per topic area for ease of discussion.

Table 2. Prioritized List of Top 33 Research Needs

Rank	Research Need	Title
1	TP-1	Application of Warning Devices/Treatments at High Speed Rail Crossings
2	GCM-1	Warning Device Minimum Requirement for 80-110 MPH Trains
3	TP-2	Highway Traffic Signal Pre-emption at Highway-Rail Grade Crossings
4	EPA-4	Evaluate Effectiveness and Potential Motorist & Pedestrian Signage and Treatments
5	GCM-4	Second Train Warning Devices for Pedestrian Crossings
6	NTO-5	Minimum Traffic Control Devices for High-speed Train (HST, formerly known as HSR) HRGC
7	GCM-3	Global Positioning Satellite (GPS)/Positive Train Control (PTC) Constant Warning Time
8	NTO-2	Pedestrian, Non-Motorized and Limited Mobility Treatments
9	II-2	Cost/Benefit analysis of Grade Crossing Improvements
10	NTO-1	Alternative Sensors and Warning Systems for Vital Applications
11	NTO-4	Effectiveness of LED Enhanced Grade Crossing Traffic Signs
12	RE-3	Photo Enforcement at HRGXs
13	TP-3	Effectiveness of Gates for Pedestrians
14	TP-5	Driver Decision Making At Complex Crossings
15	NTO-3	On-Track Vehicle Detection
16	RE-1	Data Needs for Proactive Enforcement
17	II-1	Establishment of a Railroad/Transit Data Clearinghouse
18	GCM-2	Flangeway Gap Solutions
19	TP-6	Review and Improvement of Hazard Indices and Accident Prediction Formulae
20	RE-2	Collecting and Analyzing Trespass Data
21	EPA-2	Evaluation of Existing Education and Outreach Strategies
22	EPA-3	Crossing Consolidation Education
23	GCM-5	Personal Detection Device for Railroad Workers
24	II-3	Synthesis to Evaluate How, When, and Where Human Perception Negatively Impacts Rail Safety
25	NTO-6	Enhanced Commercial Systems to Improve HRGC Safety
26	EPA-5	Evaluate the Effectiveness of Mobile Warning Devices When Approaching Grade Crossings
27	RE-4	No-Train-Horn Crossings
28	EPA-1	Evaluation of Social Media Outreach
29	II-6	Identify Opportunities to Make Legislation and Regulations Across Jurisdictions Compatible, Meaningful and Up-to-Date
30	TP-4	Signage at Roundabouts
31	II-5	Improved Effectiveness of Stakeholder Interaction
32	II-4	Institutionalize Evaluation as a Key component of Project/Program (countermeasure) Design and Implementation
33	RE-5	National Campaign for Targeted Seasonal Enforcement Programs

Key:

EPA – Education and Public Awareness
GCM – Grade Crossing Modernization
II – Institutional Issues
NTO – New Technology Opportunities
RE – Regulations and Enforcement
TP – Traffic Patterns

The Steering Committee for the workshop additionally selected four cross-cutting issue categories for use in this analysis. These were: human factors, transit-oriented communities, data requirements and high speed rail. The 80 research needs were reviewed for applicability to each of the cross-cutting areas. As can be expected from a review of current literature, the area of human factors applies to approximately 60 percent of all the research needs developed, similar to the distribution of the top research needs. Half of the research needs were also associated with the data requirements cross-cutting area.

Discussions during the final day of the workshop indicated the probability that some of the research needs could easily be merged. Some delegates even suggested merging certain research needs statements on their ballots. Therefore, the Volpe Center analyzed all of the research needs and created six research themes that capture common threads as listed below:

- High speed rail applications
- Pedestrian-oriented research needs
- Signal and sign effectiveness
- Sociotechnical systems research
- Evaluation of procedures and technology
- Development of infrastructure and procedures

Most research needs within the six themes exhibited mostly high urgency designations. Most research needs within the six themes were designated as new research under the field of "Research Status."

After reviewing the historical results, 1995 and 2003 workshops, as compared to the 2009 findings, it can be surmised that the body of stakeholders have identified two major concerns that have remained a priority over the past 15 years. Those two areas, "pedestrian-oriented" and "sociotechnical systems" research, remain a priority for the development of the next research agenda.

As evidenced by the priority needs established in this workshop, delegates continue to place high priority on the safety of highway-rail grade crossings, trespass prevention, and the railroad system in general. Many participants identified research needs that share the goal of reducing incidents and casualties.

Near-Term Research Agenda (3-5 years)

The highest priority research theme reflects the Obama Administration's current focus on the implementation of high speed rail nationwide. Main research activities under this theme include developing an updated risk model to effectively apply warning device treatments for high speed rail, and the development of federal guidance that supports the new method. The second-highest priority research theme identified pedestrian oriented issues. The main research activities under this theme include determining the effectiveness of current treatments, developing new treatments, and determining causality of trespass events. The activities would encompass physical conditions that exist at grade crossings, stations, and the rail network. Attention to nonmotorized forms of transportation is included in this research theme. These top two research themes can be considered as part of the near-term research agenda for FRA, USDOT, and all their stakeholders.

Midterm Research Agenda (5-10 years)

The ordered ranking of research themes included midterm implementation strategies of the research agenda. The main activities within the *Signal and Sign Effectiveness* theme included a determination of effectiveness of the current signals and signs, developing strategies for integration with enhanced communication platforms, and identifying education and enforcement opportunities to enhance safety. The next priority theme, *Sociotechnical Systems Research*, addresses system wide organizational activities and the need for enhanced information regarding incidents and human behavior. This theme includes activities addressing effectiveness of current regulations, effectiveness of enforcement of violations with the current judicial system, enhanced data sharing platforms and opportunities, and general research in driver and pedestrian behavior. Based on the categories of organizational effectiveness and enhanced information strategies, a 5–10 year research time frame is necessary to initiate and implement these research themes. Therefore, a midterm research agenda would be most appropriate.

Long-Term Research Agenda (10+ years)

In planning of a research agenda, it is often quite necessary to anticipate future requirements. The last two themes of research objectives, *Evaluation of Procedures and Technology* and *Development of Infrastructure and Procedures*, anticipate data-driven results from the previously identified near- and midterm research activities. These research themes include development of effective best practices for model laws to achieve consistent nationwide applications and development of physical infrastructure, technology, and/or procedures to enhance safety. Based on the need for data-driven results, a long research time frame is necessary to develop nationwide strategies. Therefore, a long-term research agenda would be most appropriate.

Past research efforts have brought about a better understanding of the design and operation of grade crossings and the relationship between highway rail and other transportation components. Work in the areas of high speed rail and pedestrian-oriented applications will be highly visible research issues over the next several years. The pedestrian-oriented theme, to include trespass research, is a relatively new initiative that can positively impact safety on the nationwide rail network. Workshop results, along with FRA strategic and action plans, will guide the identification of specific research projects. FRA and the Volpe Center anticipate that this document will be used by other USDOT modal administrations and their stakeholders to enhance safety and improve the effectiveness and capacity of our rail transportation network.

On the basis of workshop evaluation, and comments made during the workshop, an overwhelming consensus was that the workshop was a success.

1. Introduction

In the past 20 years, significant progress has been made in improving the safety of public highway-rail grade crossings. Even though both motor vehicle and train traffic have increased, collisions at grade crossings have declined by approximately 63 percent, fatalities by approximately 64 percent, and injuries by approximately 67 percent[2]. Trespass-related incidents have decreased by almost 9 percent, fatalities increased by approximately 4 percent, and injuries decreased by approximately 19 percent[2]. As these trends are mostly positive, the challenge is to continue to improve the safety of grade crossings as they represent a significant portion of the overall risk from highway and railroad operations. FRA also recognizes that these trends are due, in part, to the collaboration of numerous agencies and organizations with the common goal to reduce grade crossing incidents, fatalities and injuries. The goal is to continue this downward trend, especially when funds can be limited. Additionally, FRA has increased its efforts to reduce the number of trespass incidents, as the number of trespass fatalities now surpasses the number of fatalities at highway-rail grade crossings.

To facilitate this effort, The FRA sponsored the *US DOT Federal Railroad Administration's Third Research Needs Workshop on Highway-Rail Grade Crossing and Trespass Prevention* (workshop) as a forum to exchange ideas, concepts and strategic planning, thereby fostering communication and collaboration on research, development and implementation among its stakeholders and other modes within the USDOT. This 2½ day event was coordinated and hosted by the USDOT Research and Innovative Technology Administration (RITA) John A. Volpe National Transportation Systems Center (Volpe Center) in Cambridge, Massachusetts from Tuesday, July 14, 2009, to midday on Thursday, July 16, 2009.
The John A. Volpe National Transportation Systems Center (Volpe Center) provides technical support to FRA on all aspects of grade crossing safety and trespass research.

The first full day of the workshop included presentations from representatives of various multimodal organizations on highway-rail grade crossing safety and trespass issues covering 6 topic areas: Grade Crossing Modernization (GCM), Traffic Patterns (TP), New Technology Opportunities (NTO), Regulations and Enforcement (RE), Education and Public Awareness (EPA) and Institutional Issues (II). Participants spent the first day reviewing the current status of research with presentations on each topic area. Groups of delegates assigned to the six topic areas dedicated the second day of the workshop solely to the identification of intermodal highway-rail grade crossing and trespass prevention research needs. The second day was used to identify the research need topics based on the research needs and cross-cutting areas previously established by the workshop's Steering Committee. The third day encompassed a review of the research needs topics developed, followed by a summary presentation and an interactive discussion among the workshop participants. A priority ranking of the top research needs was completed by ballot and emailed to each of the workshop delegates after the workshop.

Following the adjournment of the workshop on July 16, 2009, attendees were given a tour of the Massachusetts Bay Transportation Authority's (MBTA) Silver Line Control Center and Transit Way. The Silver line is a state-of-the-art bus rapid service that connects downtown Boston to

[2] Collected from the FRA Office of Safety Analysis' Web-based database in October 2009.

various communities in the Greater Boston area, including Logan International Airport and the South Station transportation center.

This report documents the purpose, process, analyses, and results of the workshop sponsored by the FRA Office of Research and Development (R&D) and held at the Volpe Center. Volume II of this report includes additional information on the workshop agenda, discussions (captured by a court reporter for accuracy), correspondence, and forms.

1.1 Purpose

The purpose of the workshop was two-fold:

1. To provide FRA, other USDOT agencies, and their stakeholders with the status of current and future research needs in the areas of highway-rail grade crossing safety and trespass prevention, and
2. To gather the workshop attendees' concepts on research priorities. The supporting information for this workshop was formulated on a review of the Rail Safety Improvement Act of 2008 (Public Law 110-432), FRA's draft 2009 Strategic Plan, the 2003 Research Needs Workshop proceedings[3], and various international research programs.

1.2 Background

As one tool to champion safety along the railroad's right-of-way, FRA has hosted two other workshops to discuss research needs for highway-rail grade crossing safety and trespass. These workshops, held in 1994 and 2003, provided the USDOT and its partners an opportunity to exchange information, discuss needs and prioritize efforts in areas such as crossing improvement and closure, human factors, security and trespass prevention, data and geographical information systems, driver/public education and enforcement, and intelligent transportation systems (ITS) and positive train control (PTC). A general agreement has been reached by FRA's stakeholders and documented by previous workshop participants that this activity has proven beneficial to the transportation community, and has facilitated with cost-effective allocation of resources and strategic planning at the Federal, State, local and private organization levels.

Since the 2003 workshop, numerous research documents, traffic control devices, and legislative and policy documents have been generated. Most recently, the Rail Safety Improvement Act of 2008 and the Passenger Rail Investment and Improvement Act of 2008 were passed (Public Law 110–432). These documents included numerous short- and long-term items for the FRA to accomplish. Considering these activities, it was determined that it was necessary to convene a third workshop to review the highway-rail grade crossing (both public and private) and trespass mitigation activities by the US DOT and its partners since the 2003 workshop.

1.3 Organization and Conduct of the Workshop

To assist with the structure and direction of the workshop, a Steering Committee was nominated by FRA, with a goal to provide a diverse group of experts to address different perspectives of

[3] These documents can be found on the FRA Web site at http://www.fra.dot.gov/downloads/Research/ord0909-I.pdf and http://www.fra.dot.gov/downloads/Research/ord0909-II.pdf.

highway-rail grade crossing safety and trespass prevention. Members of the Steering Committee were composed of leaders of various USDOT agencies and their key partnering organizations (both public and private), as indicated in Table 3.

Table 3. Steering Committee Members

Committee Member	Organization
Leonard W. Allen, III	Federal Railroad Administration, Office of Research and Development, Chair
William Browder	Association of American Railroads
Richard Campbell	Campbell Technology Corporation
Anya A. Carroll	Volpe Center
Debra Chappell	Volpe Center
Marco daSilva	Volpe Center
Daniel Di Tota	Operation Lifesaver Canada
Mike Flanigon	Federal Transit Administration
Deborah Freund	Federal Motor Carrier Safety Administration
Brian Gilleran	Federal Railroad Administration, Office of Railroad Safety
William Grizard	American Public Transportation Association
Steven Laffey	Illinois Commerce Commission
Leo Penne	American Association of State, Highway and Transportation Officials
Thomas Raslear, Ph.D.	Federal Railroad Administration, Office of Research and Development
Ronald Ries	Federal Railroad Administration, Office of Railroad Safety
Helen Sramek	Operation Lifesaver, Incorporated
Diane Wigle	National Highway Traffic Safety Administration
Terrell Williams	Federal Transit Administration
Guan Xu	Federal Highway Administration

The Steering Committee's goal for this activity was to bring together a wide range of views of Federal researchers, representatives of highway safety, law enforcement, rail and transit industry, management and labor, academia, and consultants.

The Steering Committee agreed that it was necessary to inform invitees and participants of historical perspectives of research, current research activities, and research that may impact the development of High Speed Rail in the United States. The committee identified six topical, or research needs areas. They were:

- Grade crossing modernization: this area focuses on the identification and evaluation of conventional and enhanced systems at or near highway-rail grade crossings. The research in this area lays a foundation for the development of innovative technologies, methodologies and countermeasures with a potential high return for research, development and implementation.

- Traffic patterns: this area focuses on a better understand the highway traffic pattern and its impact on highway-rail grade crossing safety and railroad infrastructure. The research in this area will support the need to plan and implement efficient rail corridors and highway/pedestrian geometric features to reduce congestion and delay, thereby increasing throughput of the railroad and highway networks.

- New technology opportunities: this area targets various innovative technologies and technology transfer opportunities to test for applicability (and, if deemed a valuable tool, implementation) within the rail infrastructure. The research in this area will allow for the development and/or assessment of techniques or technologies that reduce incidents along the railroad rights-of-way, as well as enhance congestion mitigation of the rail's infrastructure.

- Regulations and enforcement: this area focuses on the review and analysis of current regulations, policies, and programs to enhance safety along the railroad rights-of-way. The research in this area will facilitate standardization of regulation and enforcement efforts nationwide, potentially resulting in a reduction of the violation and incident rates.

- Education and Public Awareness: this area targets the communication aspect of highway-rail grade crossing safety and trespass prevention. The research in this area will be to decrease the number of grade crossing and trespass incidents, fatalities and injuries.

- Institutional Issues: this area focuses on the successes and challenges related to planning and implementing programs at the industry, local, State and national levels. The research will provide agencies/organizations with decisionmaking concepts and methodologies to embrace and implement as a means to update and advance safety programs comprehensively and cost effectively.

These areas are summarized in Table 4. Additionally, the Steering Committee also identified four cross-cutting areas, as shown in Table 5, which would be addressed in the workshop. These cross-cutting areas were:

- Human factors: a multidisciplinary field devoted to optimizing human performance and reducing human error. It incorporates the methods and principles of the behavioral and social sciences, engineering, and physiology.

- Transit-oriented communities: development of commercial space, housing, services, and job opportunities close to public transportation, thereby reducing dependence on automobiles. Transit Oriented Developments (TODs) are typically designed to include a mix of land uses within a quarter-mile walking distance of a transit stop or core commercial area.

- Data requirements: a procedure, method, or identification of information that would allow a better understanding of the precursors, actual events, and aggravating factors that affect the causes and severity of incidents at highway railroad grade crossings or trespass events.

- Efforts related to high speed rail—a type of passenger rail transport that operates significantly faster than the normal speed of rail traffic, typically above 79 mph train speed.

The Steering Committee also designated six team leaders to direct delegates in the analysis and discussion of the research needs provided for each of the six working groups, one for each research needs area. These team leaders are listed in Table 6.

Table 4. Workshop Research Needs Areas

Research Needs Areas
Grade crossing modernization (CGM)
Traffic patterns (TP)
New technology opportunities (NTO)
Regulations and enforcement (RE)
Education and public awareness (EPA)
Institutional issues (II)

Table 5. Workshop Cross-Cutting Areas

Cross-cutting areas
Human factors
Transit-oriented communities
Data requirements
Efforts related to High Speed Rail

Table 6. Workshop Topic Area Team Leaders

Topic Area	Team Leader	Organization
GCM	Brian Gilleran	FRA Office of Railroad Safety
TP	Anya Carroll	Volpe
NTO	Rick Campbell	Campbell Technology Corp.
RE	Deborah M. Freund	FMCSA
EPA	Helen Sramek Daniel Di Tota	Operation Lifesaver Operation Lifesaver Canada
II	Steven Laffey	Illinois Commerce Commission

The Steering Committee nominated 15 speakers and presenters to provide up-to-date research information and research progress in the six topic areas for the workshop as detailed in Table 7. FRA also scheduled three keynote speakers to welcome the attendees and to provide some insight on FRA's vision in the areas of highway-rail grade crossing safety and trespass mitigation. Jo Strang, FRA's Associate Administrator for Safety and Chief Safety Engineer, and

Dr. Magdy El-Sibaie, FRA's Director of Research and Development, provided keynote speeches. David Matsuda[4], Acting Assistant Secretary of Transportation Policy accepted FRA's invitation to provide words of encouragement on behalf of the USDOT's Office of the Secretary. To provide additional perspectives relevant to the workshop's purpose, Aidan Nelson, of Community Safety Partnerships, Ltd., provided a presentation on international efforts, and Dr. Jordan Multer, of the Volpe Center, provided a presentation on human factors research needs based on a sociotechnical framework. Sixteen additional presentations provided current information over the six topical areas during the general session of the first day. For those who could not physically attend or were otherwise interested in the workshop, the Volpe Center provided a Web access option for the first day's presentations and discussions.

Table 7. Speakers for Research Needs Topic Areas

Topic	Speaker Name	Organization
GCM	David Peterson	Union Pacific Railroad
	Paul O'Brien	Utah Transit Authority
TP	Mark Morrison	Wisconsin Department of Transportation
	Gerard J. Ruggiero	Massachusetts Bay Transportation Authority
	Lorraine M. Pacocha	
NTO	Brent Ogden	AECOM
	John Shurson	Burlington Northern Santa Fe Railway Company
	Dan Guerrero	Metrolink Los Angeles
RE	Robert (Bob) Redmond	FMCSA
	LTC. Ralph D. Mitchell, Jr.	Louisiana State Police
	Jack C. Hanagriff	Houston Police Department
EPA	Annette Lapkowski	Florida Department of Transportation
	Suzanne M. Horton	Volpe Center
	Daniel Di Tota*	Operation Lifesaver Canada
II	John Shurson	Burlington Northern Santa Fe Railway Company
	Karen M. Marshall	American Association of Suicidology
	Ronald E. Ries*	FRA Office of Railroad Safety

*** Steering Committee member**

To ensure positive participation and feedback, the Steering Committee limited attendance at the workshop to nominated delegates. The Steering Committee developed a list of 277 invitees to the workshop. Of those, a total of 77 accepted the invitation and participated as delegates at the workshop, representing the Federal, State, and local governments, as well as railroads, transit agencies, labor unions, academia, nonprofit organizations, and consultants, as shown in Table 8. Additionally, international participants were from Canada, the United Kingdom (Great Britain and Ireland), and Taiwan (Republic of China).

During the second day of the workshop, the 77 workshop delegates met in designated working groups and joined in an analytical process to define research needs for highway-rail crossing safety and trespass prevention issues. Each working group was then responsible for determining

[4] Mr. Matsuda is currently the Deputy Administrator for Maritime Administration (MARAD).

the characteristics of the identified research needs for each concentration area and setting their priority. Table 9 shows the number of participants assigned to each of the workshop working groups. The working groups developed a total of 80 research problems. Each group was then tasked to identify the top five projects for their respective research needs area. This vetting process resulted in the identification of 33 top needs, as three groups had six top research topics instead of five.

Table 8. Distribution of Registered Participants by Organizational Type

Organizational Type	Number of Participants
Federal government	28
Highway agencies	6
Railroad	9
Transit	5
Industry	5
Consultants	6
University/academia	2
Unions	3
Total	**77**

Table 9. Distribution of Delegates by Topic Area

Topic Area	Number of Participants
GCM	15
TP	13
NTO	15
RE	13
EPA	11
II	10
Total	**77**

The third day of the workshop, Thursday, July 16, 2009, was dedicated to reviewing the top 33 research needs developed and prioritized by the six topical area groups. It consisted of presentations delivered by the team leaders summarizing the selected research problem statements from each group. Additionally, a discussion was held to discuss the prioritization of these areas, and the potential to group statements together, and the needs and benefits of the research needs areas. Formal transcriptions of the presentations and discussion that took place on the third day and are available within Volume II of this final report.

1.4 Workshop-Related Documents

The workshop's registration Web site housed Web links with various documents and Web sites of interest related to highway-rail grade crossing safety and trespass prevention. These documents and links were provided to the participants to acknowledge current and past research

efforts, as well as informing them with information in advance of the workshop. The Volpe Center provided the below listing of documents/Web links to the participants on the workshop Web site's section containing information for attendees:

- 2003 Highway-Rail Grade Crossing Safety Research Needs Workshop: Volume I—Summary of Results: http://www.fra.dot.gov/downloads/Research/ord0909-I.pdf
- 2003 Highway-Rail Grade Crossing Safety Research Needs Workshop: Volume II—Appendices: http://www.fra.dot.gov/downloads/Research/ord0909-II.pdf
- Federal Railroad Administration: http://www.fra.dot.gov
    - Railroad Accident/Incident Reporting System: http://safetydata.fra.dot.gov/OfficeofSafety/
    - Human Factors Program: http://www.fra.dot.gov/us/content/1910
    - Risk Reduction Program: http://www.fra.dot.gov/us/content/2029
- Federal Transit Administration (FTA): http://www.fta.dot.gov
- Federal Motor Carrier Safety Administration (FMCSA): http://www.fmcsa.dot.gov
- Federal Highway Administration (FHWA): http://www.fhwa.dot.gov
    - Manual on Uniform Traffic Control Devices (MUTCD): http://mutcd.fhwa.dot.gov
- John A. Volpe National Transportation Systems Center: http://www.volpe.dot.gov
- Research and Innovative Technology Administration: http://www.rita.dot.gov
- National Highway Traffic Safety Administration (NHTSA): http://www.nhtsa.dot.gov
- Transportation Research Board Committee AHB60 (Highway-Rail Grade Crossings): http://www.attventure.com/trb/
- March 18, 2009 Statement by Secretary of Transportation Ray LaHood before the U.S House of Representatives Committee on Appropriations, Subcommittee on Transportation, Housing and Urban Development, and Related Agencies http://appropriations.house.gov/Subcommittees/sub_tranurb.shtml
- DOT Information related to the American Recovery and Reinvestment Act of 2009 (Recovery Act): http://www.dot.gov/recovery/
- 2008 Rail Safety and Amtrak Legislation: Overview, Highlights and Summary: http://www.fra.dot.gov/us/content/2172
- Operation Lifesaver (USA): http://www.oli.org
- Operation Lifesaver (Canada): http://www.operationlifesaver.ca/
- American Association of State, Highway and Transportation Officials: http://www.transportation.org
- American Public Transportation Association (APTA): http://www.apta.com
- Association of American Railroads (AAR) : http://www.aar.org
- National Committee on Uniform Traffic Control Devices: http://www.ncutcd.org
- American Railway Engineering and Maintenance-of-Way Association: http://www.arema.org

1.4.1 USDOT Federal Railroad Administration Web Page

As part FRA's effort to share information more effectively with all of its stakeholders and DOT partners, various documents and those related to the workshop, including the first and third days' presentations and other shared materials, were posted online through the FRA's Web site.

USDOT FRA's Third Research Needs Workshop on Highway-Rail Grade Crossing Safety and Trespass Prevention – Interim Summary Report

OPENING REMARKS

- David Matsuda, Acting Assistant Secretary for Transportation Policy
  USDOT
- Jo Strang, Associate Administrator for Railroad Safety and Chief Safety Officer
  FRA
- Dr. Magdy El-Sibaie, Director, Office of Research and Development
  FRA

GENERAL SESSION PRESENTATION

- *Level Crossing Needs: Thoughts from Overseas*
  Aidan E. C. Nelson, Co-Director
  Community Safety Partnerships, Ltd. (United Kingdom)

WORKSHOP PARTICULARS

- John McGuiggin, PE, PMP
  Chief, Systems Engineering and Safety Division, Volpe Center

HUMAN FACTORS: A RESEARCH NEEDS CROSS-CUTTING AREA

- *Applying a Sociotechnical Framework for Improving Safety at Highway-Railroad Grade Crossings*
  Jordan Multer, Ph.D., Manager, Rail Human Factors Program, Volpe Center

GRADE CROSSING MODERNIZATION

- *Accessibility Issues at Highway-Rail Grade Crossings*
  David Peterson, Senior Manager, Industry and Public Projects
  Union Pacific Railroad
- *Education and Analysis—Highway-Rail Grade Crossings in the Modern World*
  Paul O'Brien, Rail Service General Manager, Utah Transit Authority

TRAFFIC PATTERNS

- *Roundabouts at or Near Highway-Rail Grade Crossings*
  Mark Morrison, Grade Crossing Safety Engineer, Wisconsin Department of Transportation
- *The Massachusetts Bay Transportation Authority: Lessons Learned*
  Gerard J. Ruggiero, WSO-CSS, Deputy Director of Safety
  Massachusetts Bay Transportation Authority, Safety Department
  Lorraine M. Pacocha, Senior Project Coordinator
  Massachusetts Bay Transportation Authority, Design and Construction Department

NEW TECHNOLOGY OPPORTUNITIES

- *Queue-Cutter Signals at Highway-Rail Grade Crossings*
  Brent Ogden, Vice President, AECOM

- *Effectiveness of LED Signs at Passive Crossings*
  John Shurson, Assistant Director of Public Projects, Burlington Northern Santa Fe Railway Company
- *Warrants for Pedestrian Treatments at Highway-Rail Grade Crossings*
  Dan Guerrero, Director of Communications and Signals, Metrolink Los Angeles

REGULATION AND ENFORCEMENT

- *Commercial Driver's License Program*
  Robert (Bob) Redmond, Senior Transportation Specialist
  Federal Motor Carrier Safety Administration
- *Enforcement Issues at Highway-Rail Grade Crossings*
  LTC. Ralph D. Mitchell, Jr., Patrol Commander, Louisiana State Police
- *Safety and Enforcement: A Local and Regional Perspective*
  Jack C. Hanagriff, Senior Police Officer,
  Houston Police Department, Neighborhood Protection Corps

EDUCATION AND PUBLIC AWARENESS

- *New Outreach Technologies: Florida Operation Lifesaver's Perspective*
  Annette Lapkowski, Rail Operations Administrator,
  Florida Department of Transportation
- *Public Education and Enforcement Research Study (PEERS)*
  Suzanne M. Horton, Operations Research Analyst, Volpe Center
- *Operation Lifesaver Data Collection – Power of the Internet*
  Daniel Di Tota, National Director, Operation Lifesaver, Canada

INSTITUTIONAL ISSUES (PANEL DISCUSSION)

- John Shurson, Assistant Director of Public Projects
  Burlington Northern Santa Fe Railway Company
- Karen M. Marshall, Program Development Director
  American Association of Suicidology
- Ronald E. Ries, Staff Director
  Highway-Rail Grade Crossing and Trespasser Prevention Division
  Federal Railroad Administration, Office of Railroad Safety

WORKING GROUP TOP FIVE SUMMARIES (DELIVERED BY THE TEAM LEADERS)

- Grade Crossing Modernization – Brian Gilleran
- Traffic Patterns – Anya A. Carroll
- New Technology Opportunities – Rick Campbell
- Regulation and Enforcement – Deborah M. Freund
- Education and Public Awareness – Helen Sramek and Daniel Di Tota
- Institutional Issues – Steve Laffey

RESEARCH NEEDS DISCUSSION AND PRIORITIZATION

- Facilitator: Anya A. Carroll, National Expert, Multimodal Surface Transportation Physical Infrastructure Systems Center of Innovation, Volpe Center

1.5 Report Organization

Volume I of this report presents the research needs workshop format, Steering Committee activities, delegate selection and distribution among the working groups, the top 33 research needs prioritized by the topical area groups and then ranked by the responding delegates, analysis of the top 33 needs, review of all research needs developed and analysis and consolidation of like needs creating a formalized list of research ideas as determined by FRA and the Volpe Center. Volume II provides supporting materials and presentations that were delivered at the workshop. Appendix A includes a complete list of workshop attendees. Appendix B provides the workshop agenda, correspondence, sample research needs forms, and priority of research needs ballot. Appendix C provides presentations that were given on the first day of the workshop. Appendix D contains provides the rules of engagement presentation delivered on the morning of day two, the team leaders' summary presentation from day three, and the summary presentation of all 33 top research needs. Appendix E provides a transcript from the final day of the workshop, as well as discussions and closing remarks. Appendix F contains all of the one-page research need statements for all 80 of the identified research needs.

2 Top Research Needs Identified

The identification of research needs was initiated on the first day with two to three presentations given to the workshop attendees in each topic area. On the second day of the workshop, Marco daSilva, Program Manager for the Highway Rail Grade Crossing Safety and Trespass Prevention Research at the Volpe Center, provided guidance to the attendees on the Rules of Engagement for the second day's brainstorming activities. The attendees then broke out into working groups to brainstorm on research needs across the six topic areas. At the end of the second day, each working group had a list of their top research needs to present to all of the workshop participants.

2.1 Working Group Assignments

Each attendee was assigned to one of the six working groups, one for each topic area. Each attendee was given the opportunity to select up to three preferred working groups during the registration process. The assignments were based on the attendees' preferences selected during the registration process. Even though some adjustments were made to keep the groups balanced, all attendees were assigned to one of the three groups they had selected. Each group was staffed with a seasoned facilitator and at least one team assistant, both of whom were Volpe Center staff members.

The attendees then broke out into their working groups in separate areas within the Volpe Center facilities. Each breakout area was equipped with all the accouterments and creature comforts necessary for the delegates to brainstorm research ideas on behalf of the FRA sponsors.

The brainstorming process within the working groups created a multitude of great ideas that were then discussed by each group and consolidated into a formal list of ideas. One group reported they had as many as 70 original brainstorming ideas that were eventually consolidated into 24 research categories. These categories were then discussed by subgroups within each group and they provided specific details for the formal research needs statements. This individual group eventually formulated 16 formalized research needs statements for review by the group. The groups then conducted internal prioritization to provide all workshop delegates with their top five or six research need selections for presentation on the third day of the workshop. The team leader for each group provided the summary of these top needs to all delegates on the morning of the third day of the workshop.

2.2 Working Group Top Research Needs

The six working groups developed a total of 80 research needs statements (as discussed later in Section 3) across the six topic areas during the second day of the workshop. Information listed on the research need statement form included the following:

1. Research needs area
2. Research topic area/number
3. Title
4. Project statement
5. Cross-cutting areas
6. Relationship to current research

7. Potential benefit(s) of identified research need area
8. Research need urgency
9. Cost of research
10. Potential organization(s) to conduct research
11. Ease of implementation
12. Other comments

Each group was also tasked to identify the top five projects for their respective research needs area. This vetting process resulted in the identification of 33 top needs, as three groups had six top research topics instead of five. Table 10 shows the distribution of the 33 research needs categorized by topic area. All of these top research needs are shown in

Table 11, and then followed by the 33 research needs' one-page forms developed by the working groups. The top 33 research needs developed at the workshop were uniformly formatted for ease of analysis. The distribution over the topical areas is shown in Figure 1 below.

Table 10. Distribution of Top 33 Research Needs by Topic Area

Topic Area	Number of Top Research Needs
GCM	5
TP	6
NTO	6
RE	5
EPA	5
II	6
Total	33

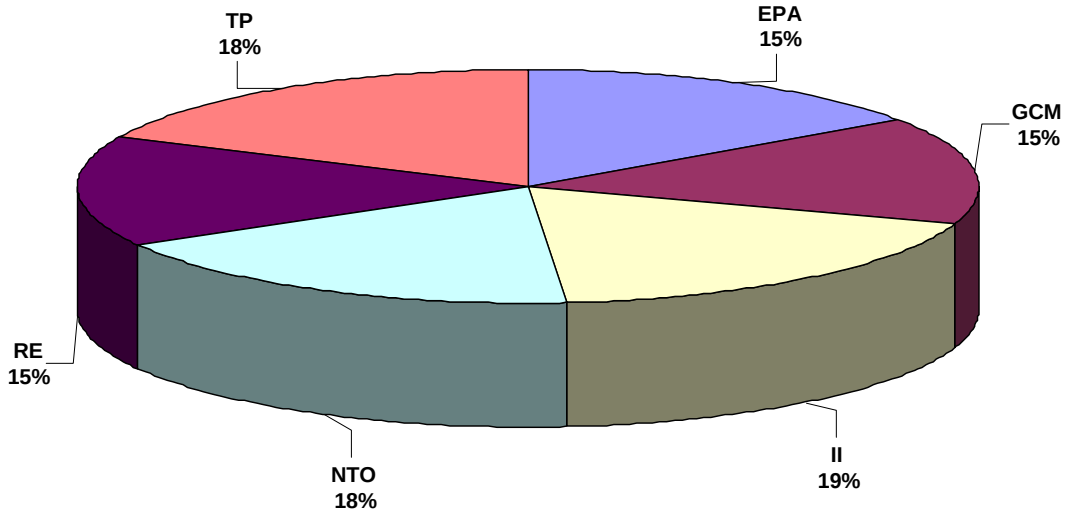

Figure 1. Distribution of Top 33 Research Needs by Topic Area

Table 11. Top 33 Research Needs Developed

Number	Title
GCM-1	Warning Device Minimum Requirement for 80-110 MPH Trains
GCM-2	Flangeway Gap Solutions
GCM-3	Global Positioning Satellite (GPS)/Positive Train Control (PTC) Constant Warning Time
GCM-4	Second Train Warning Devices for Pedestrian Crossings
GCM-5	Personal Detection Device for Railroad Workers
TP-1	Application of Warning Devices/Treatments at High Speed Rail Crossings
TP-2	Highway Traffic Signal Pre-emption at Highway-Rail Grade Crossings
TP-3	Effectiveness of Gates for Pedestrians
TP-4	Signage at Roundabouts
TP-5	Driver Decision Making At Complex Crossings
TP-6	Review and Improvement of Hazard Indices and Accident Prediction Formulae
NTO-1	Alternative Sensors and Warning Systems for Vital Applications
NTO-2	Pedestrian, Non-Motorized and Limited Mobility Treatments
NTO-3	On-Track Vehicle Detection
NTO-4	Effectiveness of LED Enhanced Grade Crossing Traffic Signs
NTO-5	Minimum Traffic Control Devices for High-speed Train (HST, formerly known as HSR) HRGC
NTO-6	Enhanced Commercial Systems to Improve HRGC Safety
RE-1	Data Needs for Proactive Enforcement
RE-2	Collecting and Analyzing Trespassing Data
RE-3	Evaluation of Photo Enforcement at railroad grade crossings
RE-4	No Train Horn Crossings
RE-5	National Campaign for Targeted Seasonal Enforcement Programs
EPA-1	Evaluation of Social Media Outreach
EPA-2	Evaluation of Existing Education and Outreach Strategies
EPA-3	Crossing Consolidation Education
EPA-4	Evaluate Effectiveness and Potential Motorist & Pedestrian Signage and Treatments
EPA-5	Evaluate the Effectiveness of Mobile Warning Devices When Approaching Grade Crossings
II-1	Establishment of a Railroad/Transit Data Clearinghouse
II-2	Cost/Benefit analysis of Grade Crossing Improvements
II-3	Synthesis to Evaluate How, When, and Where Human Perception Negatively Impacts Rail Safety
II-4	Institutionalize Evaluation as a Key component of Project/Program (countermeasure) Design and Implementation
II-5	Improved Effectiveness of Stakeholder Interaction
II-6	Identify Opportunities to Make Legislation and Regulations Across Jurisdictions Compatible, Meaningful and Up-to-Date

Key:

GCM – Grade Crossing Modernization
TP – Traffic Patterns
NTO – New Technology Opportunities
RE – Regulations and Enforcement
EPA – Education and Public Awareness
II – Institutional Issues

2.2.1 Grade Crossing Modernization

This area focuses on the identification and evaluation of conventional and enhanced systems at or near highway-rail grade crossings. The research in this area lays a foundation for the development of innovative technologies, methodologies, and countermeasures with a potential high return for research, development, and implementation.

Table 12 identifies the workshop attendees responsible for identifying the research needs in the GCM topic area.

Table 12. Grade Crossing Modernization Team

Name	Organization
Brian Gilleran (Team Leader)	FRA, Office of Railroad Safety
Rachel Winkeller (Facilitator)	Volpe Center
Steve Peck (Assistant)	Volpe Center
Erica Squillacioti (Assistant)	Volpe Center
Leonard Allen	FRA, Office of Research and Development
William Barringer	Norfolk Southern Corporation
Ed Boni	Interactive elements Incorporated
Mark Ciurej	Brotherhood of Railroad Signalmen
Jessica Franklin	Texas Transportation Institute
Frank Frey	Massachusetts Department of Public Utilities
Paul O'Brien	Utah Transit Authority
Ed O'Connor	Massachusetts Operation Lifesaver
David Peterson	Union Pacific Railroad
Phillip Poichuck	Transport Canada
Scott Windley	U.S. Access Board
Paul Worley	North Carolina Department of Transportation

Table 13 includes a list of the top five research needs identified, analyzed, and evaluated by the GCM working group. A one-page research need statement for each of these GCM items follows.

Table 13. Grade Crossing Modernization Top Research Needs

Topic No.	Research Need Title
GCM-1	Warning Device Minimum Requirement for 80-110 MPH Trains
GCM-2	Flangeway Gap Solutions
GCM-3	Global Positioning Satellite (GPS)/Positive Train Control (PTC) Constant Warning Time
GCM-4	Second Train Warning Devices for Pedestrian Crossings
GCM-5	Personal Detection Device for Railroad Workers

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-1
3. Title	Warning Device Minimum Requirement for 80-110 MPH Trains
4. Project Statement	Research and determine warning device requirements for high-speed corridors in the 80-110 mph range.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors X Transit-oriented Communities ___ Data Requirements X High Speed Rail
6. Relationship to Current Research	X New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Clarity of regulatory requirements
8. Research Need Urgency	X High __ Medium __ Low
9. Cost of Research	__ High >$500K X Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Volpe, Highway Agencies
11. Ease of Implementation If medium or difficult, list key implementation issues.	X Easy __ Medium __ Difficult Issues:
12. Other Comments	Trespassing considerations? (improved trespasser abatement)

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-2
3. Title	Flangeway Gap Solutions
4. Project Statement	Flangeway gaps at level grade crossings are a problem for wheel chair users as well as bicyclists and other non-motorized vehicles with small or narrow wheels. A material needs to be researched that would fill the gap and withstand rail cars without derailment. Weather factors would also need to be addressed. Research and develop an effective treatment for rails or rail crossings so that pedestrians using wheelchairs may cross tracks without risk of entrapment.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	X Human Factors X Transit-oriented Communities ___ Data Requirements X High Speed Rail
6. Relationship to Current Research	X New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Improve safety for all users of crossings
8. Research Need Urgency	X High __ Medium __ Low
9. Cost of Research	X High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Volpe, AAR, TTC
11. Ease of Implementation If medium or difficult, list key implementation issues.	X Easy __ Medium __ Difficult Issues: Easy to implement in new construction and alterations once material is identified.
12. Other Comments	Injuries and fatalities have occurred from people with disabilities getting their front casters stuck.

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-3
3. Title	Global Positioning Satellite (GPS)/Positive Train Control (PTC) Constant Warning Time
4. Project Statement	Develop lower cost constant warning time system. (more cost effective) Would the use of GPS be less expensive, cost effective
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements X High Speed Rail
6. Relationship to Current Research	X New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	More likely to be used/implemented
8. Research Need Urgency	X High __ Medium __ Low
9. Cost of Research	X High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Volpe, Highway Agencies, Railroads
11. Ease of Implementation If medium or difficult, list key implementation issues.	X Easy __ Medium __ Difficult Issues: If it is cheap, it is easy.
12. Other Comments	Potential to use in other areas.

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-4
3. Title	Second Train Warning Devices for Pedestrian Crossings
4. Project Statement	Develop and recommend universal active warning devices to let pedestrians know if a second train is approaching Pedestrians and Motorists. Standardized through MUTCD.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities X Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__ New X Supplemental (list organization & title of current research) Transport Canada Report on Second Train Warning Signs; LAMTA Report on Second Train Warning Active Devices, etc.
7. Potential Benefit(s) of Identified Research Need Area	Prevent fatalities
8. Research Need Urgency	X High __ Medium __ Low
9. Cost of Research	__ High >$500K X Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Volpe, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	X Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-5
3. Title	Personal Detection Device for Railroad Workers
4. Project Statement	Develop a type of personal protection device using GPS/PTC technology that a railroad employee could wear to warn of approaching trains. Device could be used not only at RR crossings but anywhere on the right of way.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	X Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New X Supplemental (list organization & title of current research) Railway worker protection system FRA R&D FTA Right-of-way protection (PROTRAN—employee, railway, train devices—set wayside train detectors or train based detectors that notify personnel)
7. Potential Benefit(s) of Identified Research Need Area	Safety – reduce/eliminate roadway worker injury and deaths
8. Research Need Urgency	X High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA (coordinate with FTA)
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	FTA – is developing a PROTRAN safety system (not GPS based) Limitations to GPS technology – tunnels & canyons (connectivity issues)

2.2.2 Traffic Patterns

This area focuses on a better understanding of the highway traffic pattern and its impact on highway-rail grade crossing safety and railroad infrastructure. The research in this area will support the need to plan and implement efficient rail corridors and highway/pedestrian geometric features to reduce congestion and delay, thereby increasing throughput of the railroad and highway networks.

Table 14 lists the delegates responsible for identifying the research needs in the TP topic area.

Table 14. Traffic Patterns Team

Name	Organization
Anya Carroll (Team Leader)	Volpe Center
Jeff Bryan (Facilitator)	Volpe Center
Patrick Bien-Aime (Assistant)	Volpe Center
Jim Krieger	Canadian Pacific
Carolyn Cook	FRA, Office of Railroad Safety
Shou-Ren Hu	National Cheng Kung University, Taiwan
Chip Frazier	HDR, Inc.
Oi Kei Ng	University of Waterloo, Canada
John Mitchell	Massachusetts Bay Commuter Rail
Brann Greager	Jacobs Consulting
Daniel LaFontaine	Transport Canada
Mark Morrison	Wisconsin DOT
Lisandra Garay-Vega	Volpe Center

Table 15 includes a list of the top six research needs identified, analyzed, and evaluated by the TP working group. A one-page research need statement for each of these TP items follows.

Table 15. Traffic Patterns Research Needs

Topic No.	Research Need Title
TP-1	Application of Warning Devices/Treatments at High Speed Rail Crossings
TP-2	Highway Traffic Signal Preemption at Highway-Rail Grade Crossings
TP-3	Effectiveness of Gates for Pedestrians
TP-4	Signage at Roundabouts
TP-5	Driver Decision Making At Complex Crossings
TP-6	Review and Improvement of Hazard Indices and Accident Prediction Formulae

1. Research Needs Area	Traffic Patterns (TP)
2. Research Topic Area/Number	TP-1
3. Title	Application of Warning Devices/Treatments at High Speed Rail Crossings
4. Project Statement	Determine adequate warning devices for High Speed Rail up to 110 mph. Determine or evaluate whether or not existing types of warning devices are adequate for use on HSR corridors. Above 79 mph, should different devices be required and at what speeds? Recommend treatments for pedestrian traffic at HSR crossings. Identify pathway crossing treatments for HSR crossings.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors _X_ Transit-oriented Communities __ Data Requirements _X_ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (list organization & title of current research) FRA R&D reports on the effectiveness of HSR warning devices; NCDOT, etc.
7. Potential Benefit(s) of Identified Research Need Area	Standardize treatments for more effective and efficient design Reduce likelihood of incidents at HSR crossings
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FHWA, AASHTO, FRA, TRB,
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _x_ Medium __ Difficult Issues: Broad scope of dealing with HSR between stakeholders.
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 2
3. Title	Highway Traffic Signal Pre-emption at Highway-Rail Grade Crossings
4. Project Statement	Assess best practices nationally to determine proper application or use of traffic signal preemption at highway-rail grade crossing. Determine proper use of advanced pre-emption versus simultaneous pre-emption. Review equipment (hardware and software), particularly on the traffic signal controller side, to ensure those devices can adequately perform pre-emption as intended. Also assess best practices of field reviewing pre-emption. Research accident reports to identify "hot spots" (high incident areas) and factors relevant to pre-emption.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors _X_ Transit-oriented Communities _X_ Data Requirements _X_ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Reduce incidents More efficient traffic management
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 3
3. Title	Effectiveness of Gates for Pedestrians
4. Project Statement	Need to test the effectiveness of various gate treatments for pedestrians and passenger stations, commuter rail crossings in transit oriented development and freight rail crossings Gather information for development of warrants
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors _X__ Transit-oriented Communities ___ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	__X_ New _ __ Supplemental (list organization & title of current research) Effectiveness of devices in pedestrian brochure published by FRA Jan. 2008
7. Potential Benefit(s) of Identified Research Need Area	Learn effectiveness of having pedestrian treatment inside versus outside of gate mechanisms and other gate treatments at stations and transit oriented developments
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe Center
11. Ease of Implementation If medium or difficult, list key implementation issues.	_ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 4
3. Title	Signage at Roundabouts
4. Project Statement	Evaluate alternatives for advanced warning signs within or in close proximity to roundabouts. Need to develop an advanced warning sign(s) for a crossing located within 100 feet of the yield line at a roundabout. There is currently no equivalent series of signs to the W10-2, 3, & 4 for crossings in close proximity to roundabouts. A sign also needs to be developed for situations where the rail line runs directly through a roundabout. Review body of existing literature in international examples.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors _X_ Transit-oriented Communities ___ Data Requirements _X_ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	National standard signage for MUTCD
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_x_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 5
3. Title	Driver Decision Making at Complex Crossings
4. Project Statement	Close proximity between rail/tracks and complex intersection such as roundabouts and multiple access roads near RRX. Driver must divide attention and make decision in a short period of time. Purpose: Better understanding of driver performance and information needed in order to provide means to reduce driver error. Expected outcome: Input design process and safety review and enhancements
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Reduce driver confusion and information overload Reduce driver error and improve safety and mobility
8. Research Need Urgency	_X_ High __ Medium _ _ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	USDOT in coordination with local DOTS (FRA)/Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues:
12. Other Comments	Potential to combine with grade crossing modernization and new technology opportunities

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 6
3. Title	Review and Improvement of Hazard Indices and Accident Prediction Formulae
4. Project Statement	New methods for evaluating the system safety performance of crossings are needed. The API calculation has become less valuable as the majority of crossings with high train and traffic volumes have been signalized or grade-separated. The risk of a low-volume crossing is not fully reflected in the current evaluation standard, and the API calculation may indicate crossings for upgrade that do not warrant signalization. A standardized evaluation method should be established for multiple agency use.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	A holistic evaluation method will help state agencies to select crossings that most deserve improvements.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K _ _ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	TRB or AASHTO
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Complexity of issue
12. Other Comments	

2.2.3 New Technology Opportunities

This area targets various innovative technologies and technology transfer opportunities to test for applicability (and, if deemed a valuable tool, implementation) within the rail infrastructure. The research in this area will allow for the development and/or assessment of techniques or technologies that reduce incidents along the railroad rights-of-way, as well as enhance congestion mitigation of the rail's infrastructure.

Table 16 identifies the delegates responsible for identifying the research needs in the NTO topic area.

Table 16. New Technology Opportunities Team

Name	Organization
Rick Campbell (Team Leader)	Campbell Technology Corporation
Aaron Jette (Facilitator)	Volpe Center
Debra Chappell (Assistant)	Volpe Center
Dan Kubaczyk (Assistant)	Volpe Center
Paul Chaput	Brotherhood of Locomotive Engineers and Trainmen
Andy Davis	Quixote Transportation Safety
Bill Grizard	APTA
Dan Guerrero	SCRRA/Metrolink
Bob Hoffman	CSX
Vijay Kohli	Fulcrum Corporation
Brent Ogden	AECOM
Dick Pew	BBN Technologies
Tom Potter	Reno A&E
John Sharkey	Campbell Technology Corporation
Sesto Vespa	Transport Canada
Michelle Yeh	Volpe Center

Table 17 lists the top six research needs identified, analyzed, and evaluated by the NTO working group. A one-page research need statement for each of these NTO items follows.

Table 17. New Technology Opportunities Research Needs

Topic No.	Research Need Title
NTO-1	Alternative Sensors and Warning Systems for Vital Applications
NTO-2	Pedestrian, Nonmotorized and Limited Mobility Treatments
NTO-3	On-Track Vehicle Detection
NTO-4	Effectiveness of LED Enhanced Grade Crossing Traffic Signs
NTO-5	Minimum Traffic Control Devices for HST (formerly known as HSR) Highway-Rail Grade Crossings (HRCG)
NTO-6	Enhanced Commercial Systems to Improve HRGC Safety

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-1
3. Title	Alternative Sensors and Warning Systems for Vital Applications
4. Project Statement	• Perform an evaluation to determine what sensors will be reliable, maintainable and cost-effective. • Perform an evaluation on the communication system • Warning system display will require human factors study.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Improve safety and security
8. Research Need Urgency	_X_ High) ___ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-2
3. Title	Pedestrian, Non-Motorized and Limited Mobility Treatments
4. Project Statement	• Identify and evaluate the effectiveness of new and existing technology on active and passive warnings (in conjunction with barriers and channelization, including 2nd train and variable speed approaches) on the basis of: o Human detection/recognition and compliance o Cost to install and maintain o Energy efficiency o Reliability • Develop guidance for the design of: o Sidewalk, pathways and station approaches o Line of route approaches o Quiet Zones
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors _X_ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Improve Safety
8. Research Need Urgency	_X_ High ___ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe, Contractor, States
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-3
3. Title	On-Track Vehicle Detection
4. Project Statement	Identify and research detection alternatives for on-track vehicles that transverse highway-rail grade crossings
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Safety Crossing integrity
8. Research Need Urgency	_X_ High ___ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-4
3. Title	Effectiveness of LED Enhanced Grade Crossing Traffic Signs
4. Project Statement	Current retroreflective traffic control signs at grade crossings need to be more conspicuous to compete with driver inattention and distractions from ambient lighting and signage. Evaluation of the effectiveness of LED enhanced signs is needed. This includes STOP, YIELD, Crossbuck and DO NOT STOP ON TRACK signs. Evaluation to include conspicuity, 24/7 operation vs. train or vehicle activation, 24/7 vs. nighttime only, driver behavior and compliance
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Reduction of violations and crashes
8. Research Need Urgency	____ High _X_ Medium ___ Low
9. Cost of Research	___ High >$500K ___ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA, University, Contractor, Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-5
3. Title	Minimum Traffic Control Devices for HST (formerly known as HSR) HRGC
4. Project Statement	Research is intended to develop the risk management model to evaluate the effectiveness of 4QG vs. physical barrier gates on HST corridors. The model should include train speed, type of rail equipment, AADT (vol. per lane), and roadway speed at a minimum
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements _X_ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Essential piece of information for traffic control policy decisions
8. Research Need Urgency	_X_ High ___ Medium ___ Low
9. Cost of Research	___ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Volpe, University
11. Ease of Implementation If medium or difficult, list key implementation issues	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-6
3. Title	Enhanced Commercial Systems to Improve HRGC Safety

4. Project Statement	• Integrate HRGC inventory into GPS maps
	  o Identify at-grade vs. grade separated HRGC
	  o Identify humped crossings (comm. vehicles)
	• How do we implement with GPS unit mfgs?
	• Require this info in buses, comm. vehs and hazmat (vehicles requiring a CDL license)

5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors _X_ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Improved road user behavior at HRGC
8. Research Need Urgency	_X_ High (very valuable) ___ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FMCSA; Contractor
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	Provide in 2010 once the inventory is updated.

2.2.4 Regulations and Enforcement

This area focuses on the review and analysis of current regulations, policies, and programs to enhance safety along the railroad rights-of-way. The research in this area will facilitate standardization of regulation and enforcement efforts nationwide, potentially resulting in a reduction of the violation and incident rates.

Table 18 lists the delegates responsible for identifying the research needs in the RE topic area.

Table 18. Regulations and Enforcement Team

Name	Organization
Deborah Freund (Team Leader)	Federal Motor Carrier Safety Administration
Suzanne Sloan (Facilitator)	Volpe Center
Adrian Hellman (Assistant)	Volpe Center
Richard Brown	TRANSPO Industries
Lou Frangella	FRA
Jack Hanagriff	Houston Police Department
Dan Lauzon	Brotherhood of Locomotive Engineers and Trainmen
Gina Melnik	Volpe Center
LTC Ralph Mitchell	Louisiana State Police
Dr. Thomas Raslear	FRA, Office of Research and Development
Robert Redmond	FMCSA
Gerald Ruggiero	MBTA
James Sottile	PVB Consulting Group
Guan Xu	FHWA

Table 19 lists the top five research needs identified, analyzed, and evaluated by the RE working group. A one-page research need statement for each of these RE items follows.

Table 19. Regulations and Enforcement Research Needs

Topic No.	Research Need Title
RE-1	Data Needs for Proactive Enforcement
RE-2	Collecting and Analyzing Trespassing Data
RE-3	Evaluation of Photo Enforcement at railroad grade crossings
RE-4	No Train Horn Crossings
RE-5	National Campaign for Targeted Seasonal Enforcement Programs

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/ Number	RE-1
3. Title	Data Needs for Proactive Enforcement
4. Project Statement	There is a need to work with a cross section of stakeholders (including HRGX researchers, local law field-enforcement and administrative officers) to determine the data elements needed to enable proactive enforcement efforts. There is a particular need to inform the upcoming Grade Crossing Inventory Update. A need also exits to automate many of the data searches and sorts from FRA, railroad, and highway databases to lessen the burden on law enforcement and other safety practitioners to pinpoint hotspots and target enforcement opportunities. The data would be used to determine the opportunities for more targeted enforcement and to assess the quantitative effectiveness of actions implemented.
5. Cross-cutting Areas	___ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Short term benefits in reduction of violations, crashes.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA/Volpe, International Assn. of Chiefs of Police
11. Ease of Implementation	__ Easy _X_ Medium __ Difficult Issues: Partly contingent on inventory update; gathering information is relatively straightforward; more challenging to get information from railroad; potentially more challenging to get disparate databases coordinated (GX 32 and other datums).
12. Other Comments	

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/Number	RE-2
3. Title	Collecting and Analyzing Trespassing Data
4. Project Statement	Upgrade existing trespasser data collection to include sufficient definitions of the term "trespassed." Provide effective guidelines for mode laws for consistent nationwide application.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities _X__ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Provide useful and sufficient data to develop and identify trespasser problems/issues that will further provide development of model law for local and state adoption.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	RITA/Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/Number	RE-3
3. Title	Evaluation of Photo Enforcement at railroad grade crossings
4. Project Statement	Study the benefits of traffic safety and evaluate the effectiveness of photo enforcement in reducing crossing violations by motorists. Also, develop model laws, guidelines, and procedures to provide standardized applications nationwide.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities _X__ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Actual data to verify that sustained, increased enforcement does in fact chance motorist behavior and develop public acceptance for photo enforcement.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA, NHTSA, IACP, NCHRP, TRB
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues:
12. Other Comments	Could be combined with other model law guideline research.

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/Number	RE-4
3. Title	No Train Horn Crossings
4. Project Statement	Each highway approach to every public and private highway-rail grade crossing within a quiet zone is required to have a no-train-horn advance warning sign. Although each sign is required to conform to the standards in the MUTCD, increased signage may be required to adequately warn certain drivers. Can increased signage counter balance the lack of a train horn? Should there be regulatory guidance necessary?
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors _X__ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Enhanced motorist awareness of no-train-horn crossing—an "expected" audible warning may not be available.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues	_X_ Easy __ Medium __ Difficult Issues: Development of sign, review by NUTCD, rulemaking by FHWA to modify W10-1, and posting of a new sign.
12. Other Comments	

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/ Number	RE-5
3. Title	National Campaign for Targeted Seasonal Enforcement Programs
4. Project Statement	Issues/challenges: Many highway safety concerns (seat belts, drunk driving, child safety seats) have seasonal targeted outreach and enforcement programs. There is no analogous program for HRGX safety and trespass prevention activities. Purpose: Raise awareness of HRGX and trespass prevention. Outcome: Increase officer awareness and precision of enforcement practices.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	__X_ Human Factors ___ Transit-oriented Communities __X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	See above.
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	NHTSA, OLI, IACP, AAMVA, AAA, other organizations with successful public awareness campaigns.
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium X__ Difficult Issues: Funding will be a challenge in time of limited resources.
12. Other Comments	

2.2.5 Education and Public Awareness

This area targets the communication aspect of highway-rail grade crossing safety and trespass prevention. The research in this area will be to decrease the number of grade crossing and trespass incidents, fatalities and injuries.

Table 20 lists the delegates responsible for identifying the research needs in the education and public awareness (EPA) topic area.

Table 20. Education and Public Awareness Team

Name	Organization
Helen Sramek (Team Leader)	Operation Lifesaver (OLI)
Daniel Di Tota (Team Leader)	OL Canada
Rachael Barolsky (Facilitator)	Volpe Center
Tashi Ngamdung (Assistant)	Volpe Center
Tarah Harkins	CSX Transportation
Annette Lapkowski	Florida Department of Transportation
Cliff Strayton	CSX Transportation
Alvin Richardson, Sr.	Amtrak
Suzanne Horton	Volpe Center
Hadar Rosenhand	Volpe Center
Richard Towle	FRA, Office of Railroad Safety
Lorraine Pacocha	MBTA

Table 21 lists the top five research needs identified, analyzed, and evaluated by the EPA working group. A one-page research need statement for each of these EPA items follows.

Table 21. Education and Public Awareness Research Needs

Topic No.	Research Need Title
EPA-1	Evaluation of Social Media Outreach
EPA-2	Evaluation of Existing Education and Outreach Strategies
EPA-3	Crossing Consolidation Education
EPA-4	Evaluate Effectiveness and Potential Motorist & Pedestrian Signage and Treatments
EPA-5	Evaluate the Effectiveness of Mobile Warning Devices When Approaching Grade Crossings

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-1
3. Title	Evaluation of Social Media Outreach
4. Project Statement	Use of new media applications offers the opportunity to reach a broader audience with minimum resources. Traditional outreach has a limited audience. There is a need to identify, assess, and test the effectiveness of social media (i.e., internet tools, social networking sites, text messages, email, and podcast) as an outreach tool for public rail safety education. Survey and testing should include numerous users and absorption of message.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	X__ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Collection of data that has never before been utilized or captured. Improve targeting of future educational efforts. Better utilization of limited resources. Innovative method to further reduce grade crossing and trespass incidents.
8. Research Need Urgency	X__ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Academia, Consultants, Research firms
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-2
3. Title	Evaluation of Existing Education and Outreach Strategies
4. Project Statement	It continues to be difficult to quantify the role that education plays in preventing incidents on active rail lines. It is crucial to assess the impact and effectiveness of existing education and outreach strategies in changing public behavior. This research should explore media message styles, methods, locations, et cetera that are most appropriate for age groups or other demographics and attitudinal characteristics.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Identify effective current education methods to better target intended audience. Further reductions in grade crossing and trespass incidents.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Academia, consultants, research firms
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Collection of data Designing research study
12. Other Comments	This was proposed in 1995 and 2003. 2003 RNW page 68.

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-3
3. Title	Crossing Consolidation Education
4. Project Statement	Currently, many communities are unaware of the benefits of public/private partnerships regarding grade crossing consolidation and grade separation funding. Research is needed to determine effective methods to educate community leaders in this area.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements _X_ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Increased community safety. Forges better partnerships. Long-term safety benefits. Mutual benefit among cross-sectional groups (FRA, industry, community, DOT, law enforcement, etc.).
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	Industry and labor
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	Links to new and innovative public outreach methods.

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-4
3. Title	Evaluate effectiveness and potential motorist & pedestrian signage and treatments
4. Project Statement	Current signage may be misunderstood or overlooked by motorist and pedestrian traffic. Research should assess the effectiveness of existing and potential new driver and pedestrian signage/treatments on or around railroad tracks and station platforms including: • identification of distractions (i.e., mp3 players, visual pollution/sign saturation, cell phones) • examination of pedestrian signage needs versus motorist signage needs • testing of existing and new signage/treatments (e.g. pavement LEDs, colored pavement, etc.) • identification of best designs for consideration in MUTCD.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors _X_ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Further reductions in motorist and pedestrian grade crossing and trespass incidents. Increased motorist and pedestrian awareness of public rail safety. Improved compliance to signs.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FHWA partnership
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues: Design of new signage, changes in signage, MUTCD compliance.
12. Other Comments	

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-5
3. Title	Evaluate the effectiveness of Mobile Warning Devices when approaching grade crossings
4. Project Statement	Current signage may be misunderstood or overlooked by motorist and pedestrian traffic. Utilization of current technology (i.e., cell phones, GPS, PDAs, etc.) as mobile warning devices can offer additional alerts. The potential exists to offer a cost-effective alternative to traditional upgrade of warning systems. Research the effectiveness of mobile warning devices as means to alert drivers and pedestrians within close proximity of active rail lines. Determine if warning/alerts are received and effective.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors _X_ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Active warning alert. Reduction in collisions at crossings. Long term benefit to general public and industry.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Integration with existing equipment. The challenge to using this technology includes driver distraction.
12. Other Comments	Related to DPE-02-2003 page 66.

2.2.6 Institutional Issues

This area focuses on the successes and challenges related to planning and implementing programs at the industry, local, State and national levels. The research will provide agencies/organizations with decisionmaking concepts and methodologies to embrace and implement as a means to update and advance safety programs comprehensively and cost effectively.

Table 22 lists the delegates responsible for identifying the research needs in the II topic area.

Table 22. Institutional Issues Team

Name	Organization
Steven Laffey (Team Leader)	Illinois Commerce Commission
David Damm-Luhr (Facilitator)	Volpe Center
Marco daSilva (Assistant)	Volpe Center
William Browder	Association of American Railroads
Ian Lake	Railway Safety Commission (Ireland)
Jay Holman	Union Pacific
Karen Marshall	American Association of Suicidology
Jordan Multer	Volpe Center
Ronald Ries	FRA, Office of Railroad Safety
Joy Schaad	Chicago Metropolitan Agency for Planning
John Shurson	Burlington Northern Santa Fe Railway Corporation

Table 23 lists the top six research needs identified, analyzed, and evaluated by the second working group. A one-page research need statement for each of these second group items follows.

Table 23. Institutional Issues Research Needs

Project No.	Research Need Title
II-1	Establishment of a Railroad/Transit Data Clearinghouse
II-2	Cost/Benefit Analysis of Grade Crossing Improvements
II-3	Synthesis to Evaluate How, When, and Where Human Perception Negatively Impacts Rail Safety
II-4	Institutionalize Evaluation as a Key component of Project/Program (countermeasure) Design and Implementation
II-5	Improved Effectiveness of Stakeholder Interaction
II-6	Identify Opportunities to Make Legislation and Regulations Across Jurisdictions Compatible, Meaningful and Up-to-Date

1. Research Needs Area	Institutional Issues (II)
2. Research Topic Area/Number	II-1
3. Title	Establishment of a railroad/transit data clearinghouse
4. Project Statement	Development of a framework/architecture for integrating existing databases (e.g., Federal, States, local, industry, and insurance) to provide a more complete and robust source of information on risk management and mitigation to the surface transportation industry. Centralized, searchable
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Better information sharing. Better identification of issues. Improved safety of operations. Improved consistence. Faster translation of research into practice. Improved ability to track of trends.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	TRB, USDOT
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Institutional Issues (II)
2. Research Topic Area/Number	II-2
3. Title	Cost/benefit analysis of grade crossing improvements
4. Project Statement	Developing examples of how to conduct cost/benefit analyses of federally funded grade crossing improvements under the Section 130 Program. Best practices review to establish recommended procedures for quantitatively evaluating improvements.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (various, including NCDOT)
7. Potential Benefit(s) of Identified Research Need Area	Making more efficient use of Federal funds. Informs decisionmaking for policy implementation.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FHWA, FRA, States
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Institutional Issues (II)
2. Research Topic Area/Number	II-3
3. Title	Synthesis to evaluate how, when, and where human perception negatively impacts rail safety
4. Project Statement	A synthesis to evaluate how, when, and where human perception negatively impacts safety. Identify what perceptions need adjusting because of extent of impacts to rail safety: • The impact of sensationalizing suicide reporting by the media. • Local authorities, media and general public not understanding the difference between pedestrians and trespassers. • Lack of public awareness about dangers of trespassing on railroad right-of-way.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Reduced intentional deaths on rail ROW. Reduced trespassing and unintentional deaths and injuries.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Institutional Issues (II)
2. Research Topic Area/Number	II-4
3. Title	Institutionalize evaluation as key component of project/program (countermeasure) design and implementation
4. Project Statement	Build "evaluation" into the planning stage of a project—so you can evaluate whatever you implement ("plan to evaluate" is built into the project). Quantitative evaluation to identify high payback effective interventions and key factors in success. Case studies and best practices?
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X__ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Ability to adjust mid-course to improve design and implementation. Identify and Maximize potential benefit. Informs future program decisions.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	AASHTO, AAR, APTA, FRA, TRB, AREMA
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Adds cost in the short-term, resistance due to being potential culture change for some organizations.
12. Other Comments	

1. Research Needs Area	Institutional Issues (II)
2. Research Topic Area/Number	II-5
3. Title	Improved effectiveness of stakeholder interaction
4. Project Statement	Role definition and best practices for communication and coordination among diverse stakeholders (e.g. regulators, railroads, locals, districts, standards setting bodies) for rail safety initiatives. Special attention to: o regional/local planning o crossing closures o pedestrian crossings o trespass o private crossings o Land development (research to get recommended regs, standards, and practices to address issues relating to land development for cooperative decision making that affect grade crossing and/or rail ROW).
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Improved effectiveness of stakeholder interaction. Improved efficiency. Greater clarity on ownership of and roles and responsibilities for orphan issues (e.g., pedestrian crossings, trespass, private crossings). Highlighting conflicting mandates/goals/objectives and requirements for reconciliation.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	USDOT
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues: Diverse group of stakeholders with entrenched interests and well defined positions.
12. Other Comments	

1. Research Needs Area	Institutional Issues (II)
2. Research Topic Area/Number	II-6
3. Title	Identify opportunities to make legislation and regulations across jurisdictions compatible, meaningful and up to date
4. Project Statement	Identify what the purpose of the original legislation or regulation was. Does the problem still exist? Is the original legislation or regulation still relevant? Do other types of legislations or regulations conflict (noise abatement, air quality…) and to what extent? How consistent is the approach across jurisdictional boundaries? Has the original legislation created new problems or unintended consequences?
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors _X__ Transit-oriented Communities ___ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Streamlining of project implementation. Fewer and more effective laws and regulations. Reduction of legislative conflict.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues: Legislative and regulatory inertia, long lead times and powerful coalitions needed.
12. Other Comments	

2.3 Review of Cross Cutting Areas

As previously discussed, the Steering Committee for the workshop additionally selected four cross-cutting issue categories for use in this analysis. These were: human factors, transit-oriented communities, data requirements and high speed rail. These category descriptors are provided below:

- Human factors: a multidisciplinary field devoted to optimizing human performance and reducing human error. It incorporates the methods and principles of the behavioral and social sciences, engineering, and physiology.
- Transit-oriented communities: development of commercial space, housing, services, and job opportunities close to public transportation, thereby reducing dependence on automobiles. TODs are typically designed to include a mix of land uses within a quarter-mile walking distance of a transit stop or core commercial area.
- Data requirements: a procedure, method or identification of information that would allow a better understanding of the precursors, actual events and/or aggravating factors that affect the causes and severity of incidents at highway railroad grade crossings or trespass events.
- High speed rail and efforts related: a type of passenger rail transport that operates significantly faster than the normal speed of rail traffic, typically above 79 mph train speed.

Subsection 2.3.1 provides information on the distribution of research needs by the cross-cutting areas. This analysis is followed by the other criteria related to the one-page form discussed in Chapter 2, as shown in Table 24. The remaining analyses include the following data fields and particular designations of those fields by the delegates.

Table 24. Research Needs Statement Data Field Categories

Research Status		**Research Needs Urgency**			**Cost of Research**			**Potential Researcher**					**Ease of Implementation**		
New	Supplemental	High	Medium	Low	High (< $500K)	Medium ($150K-$500)	Low (< $150)	Federal	Highway/Regional Agency	Railroad	Consultants	Academia/ Other Org.	Easy	Medium	Difficult

The following subsections are provided to illustrate the trends in the delegation's development of research needs as formally submitted.

2.3.1 Review of Cross-cutting Areas

The top 33 research needs were reviewed for applicability to each of the cross-cutting areas as well as reviewing multiple categories of cross-cutting relationships. Figure 2 reviews the

number of research needs by individual cross-cutting areas. The delegates selected multiple categories of cross-cutting relationships and, therefore, each need maybe counted under multiple categories. As can be expected from a review of current literature, the area of human factors applies to approximately two-thirds of all the research needs developed.
[LEN: in the figure lowercase the "o" in Transit-Oriented and remove hyphen in "High-Speed Rail"]

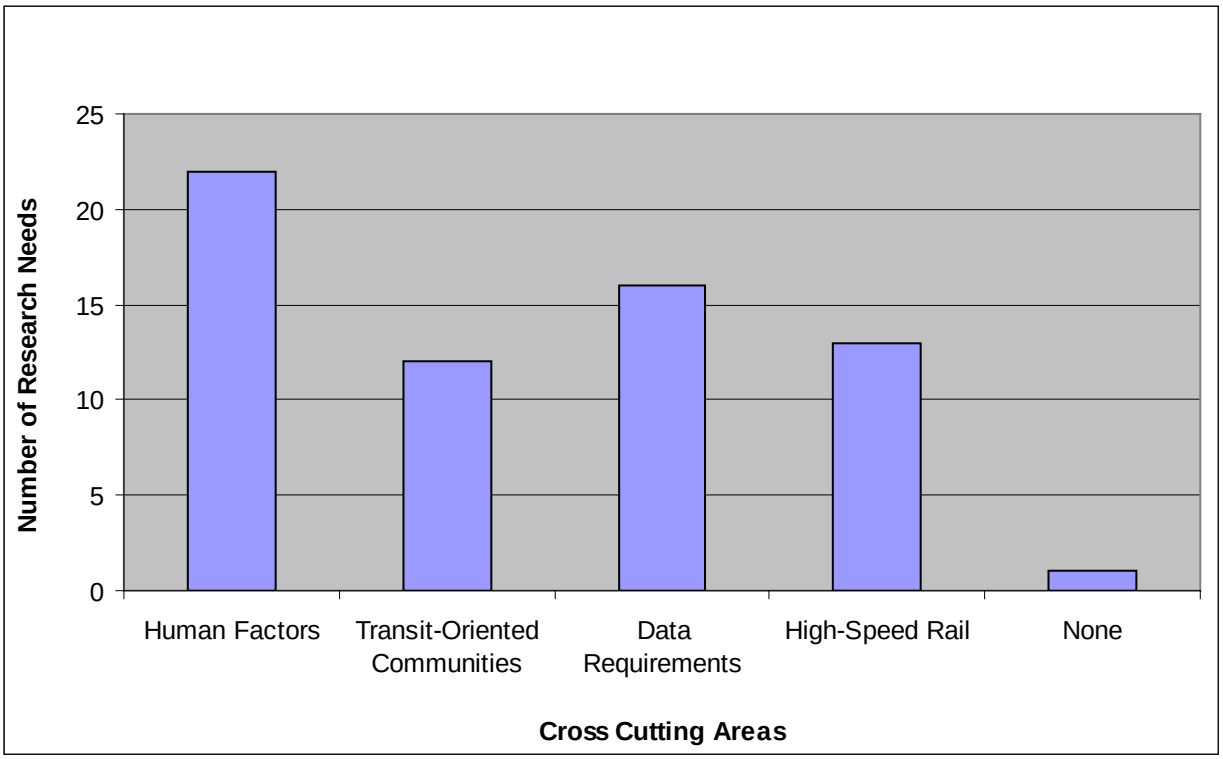

Figure 2. Distribution of Top 33 Research Needs by Cross Cutting Area Applicability

As stated above, multiple categories could have been selected for a research need by the delegates with regard to cross-cutting affiliations. Figure 3 below distributes each of the top 33 research needs by multiple categorizations of these areas. As shown in the figure, one research need has no cross-cutting designation, 11 have one area designated, 11 more have two areas designated, and 10 have three designated. No research need had all four cross-cutting areas designated. The research need that did not have a designation was titled II-5 Improved Effectiveness of Stakeholder Interaction. The authors' recommend that it should be considered within the human factors area based on human interaction between stakeholders.

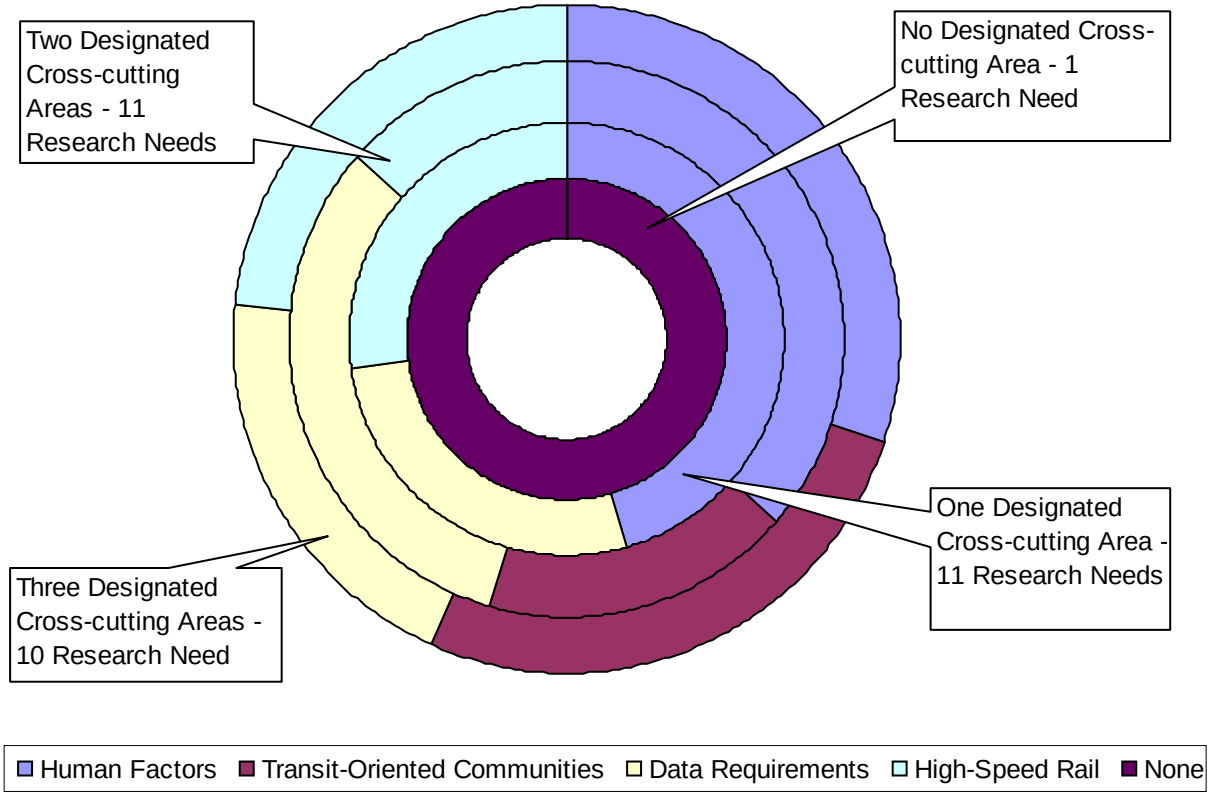

Figure 3. Concentric Graph of Top 33 Research Needs with Multiple Cross-cutting Issues

2.3.2 Research Status

As shown in Figure 4, 29 of the top 33 research needs were designated at new research initiatives, while the remaining four were designated as supplemental to existing research activities.

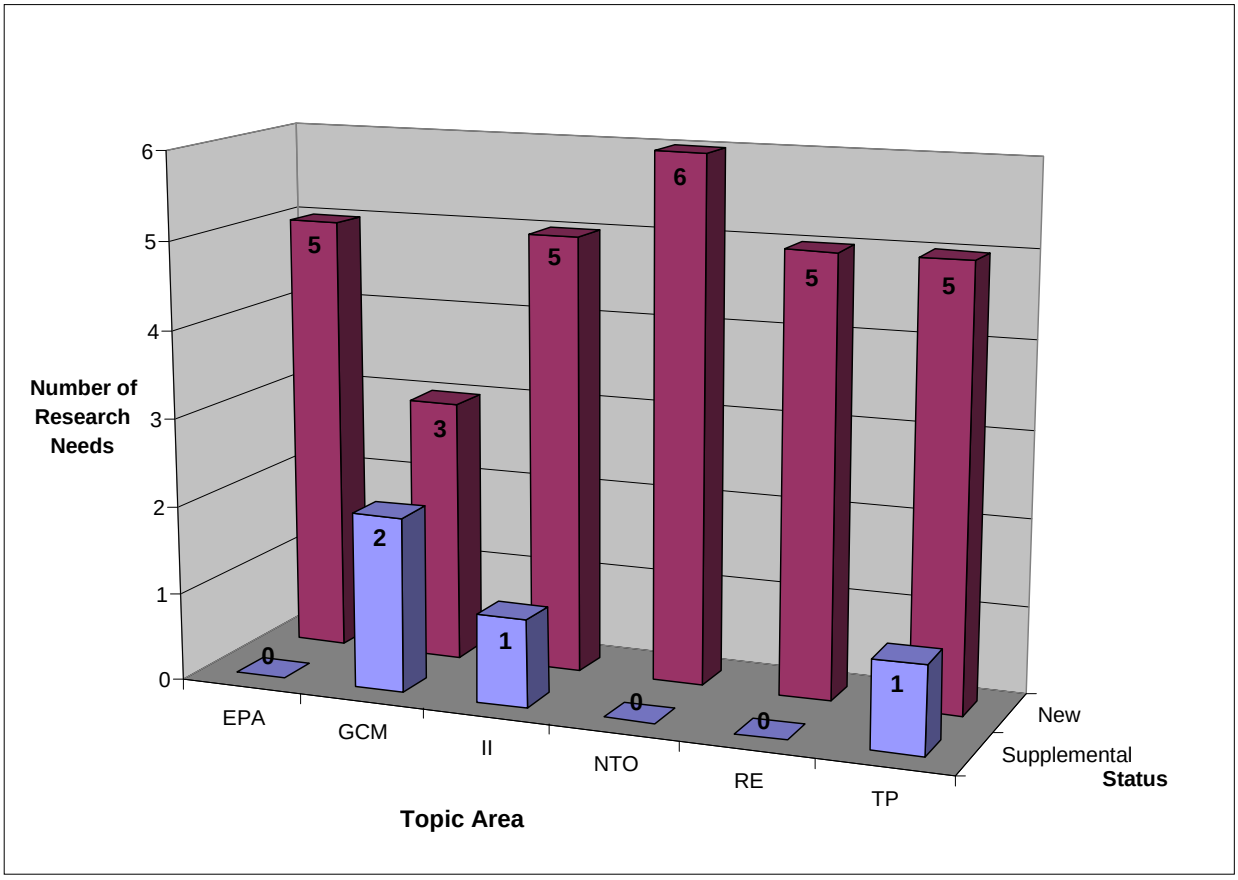

Figure 4. Top Research Needs Distributed by Group and Research Status

2.3.3 Review of Urgency Distributions

As shown in Figure 5 most of the research needs developed are considered by the delegates as highly urgent activities. Levels of urgency were used to determine the level of criticality of the research need. The levels were: high priority, medium priority (strong consideration), and low priority (closely monitored for future action). As seen in Figure 5, half of the groups designated all of their top research needs as high urgency.

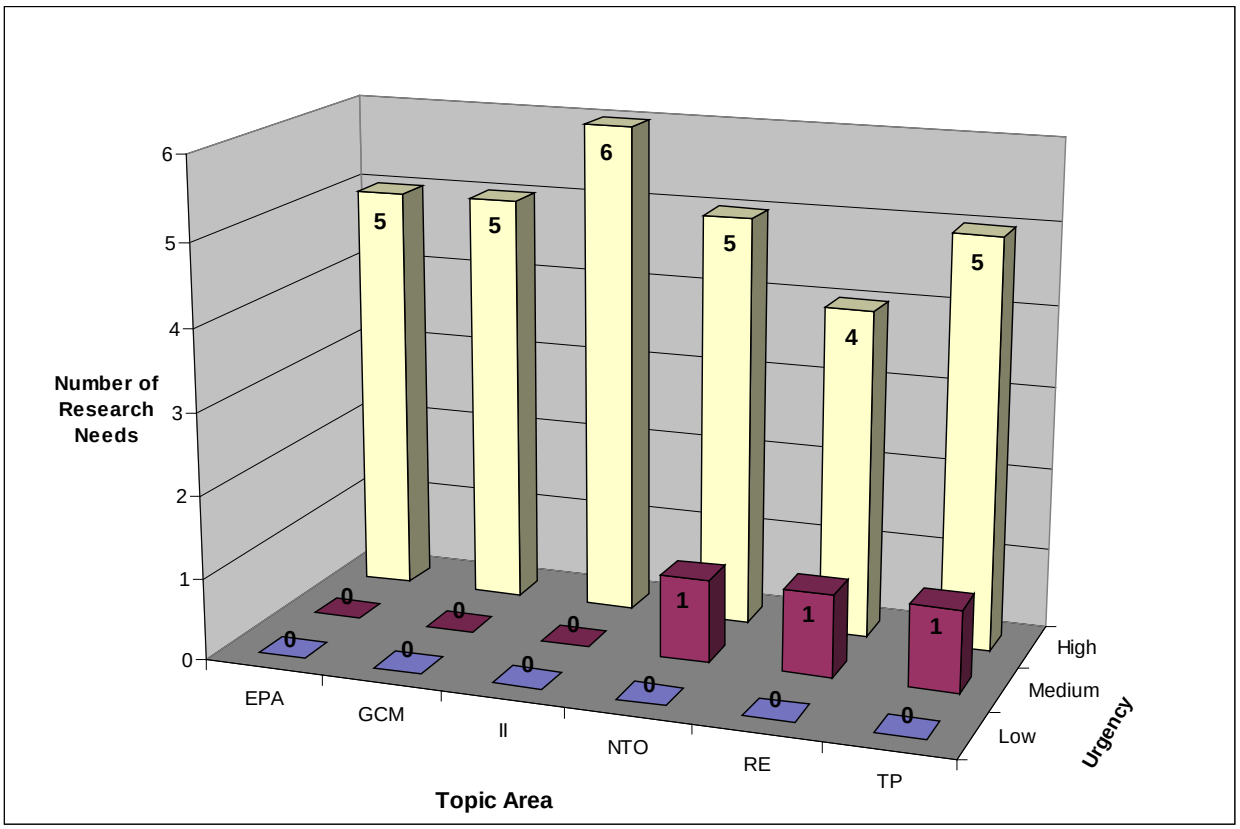

Figure 5. Top Research Needs Distributed by Group and Urgency of Research Need

2.3.4 Review of Cost Distributions

As shown in Figure 6, approximately 60 percent of the research needs developed were considered by the delegates as medium cost, which was defined as ranging from $150,000 to $500,000. Most of the TP top research needs were estimated to be high cost, which was defined as being over $500,000. Only four of the 33 top needs were identified as low cost, meaning that they were estimated to cost under $150,000 to conduct.

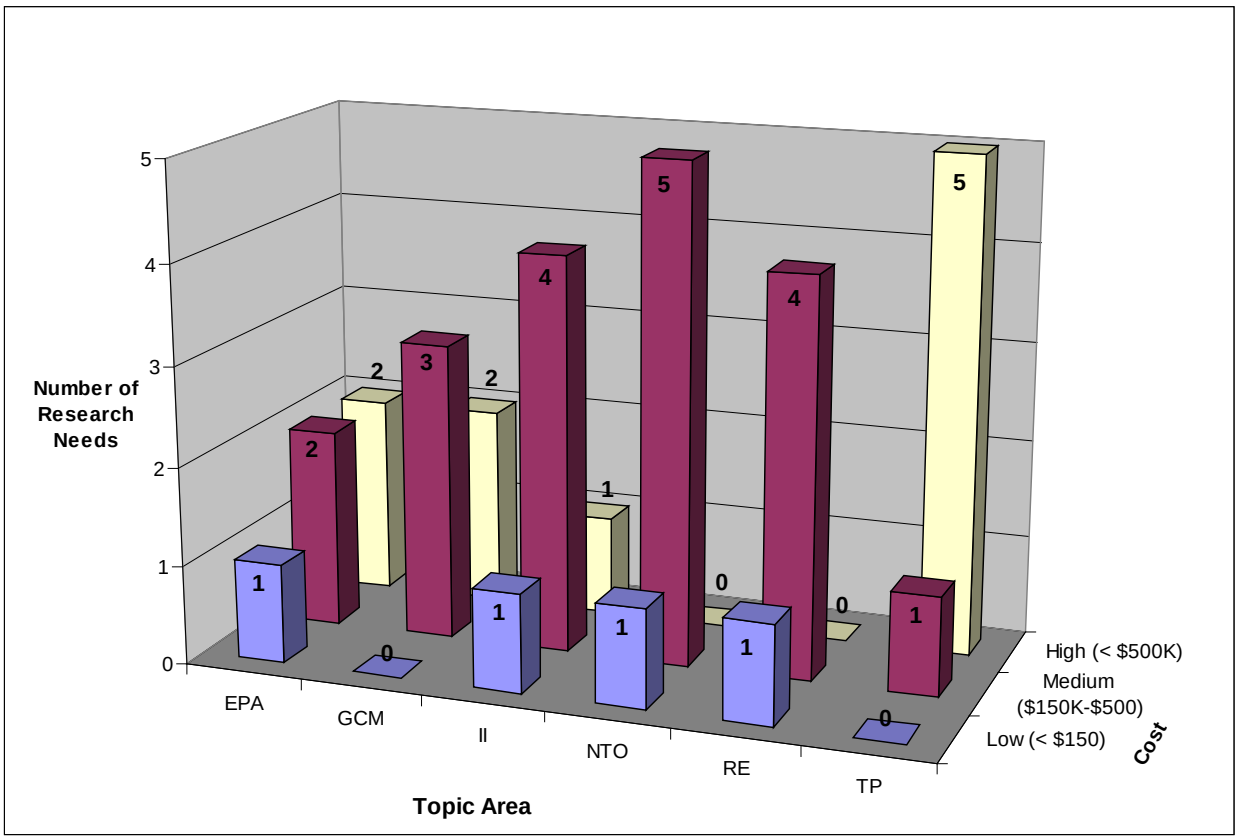

Figure 6. Top 33 Research Needs Distributed by Group and Cost

2.3.5 Review of Implementation Probability Distribution

Figure 7, approximately one-half of the top research needs were labeled as easy to implement. All of the GCM research needs were designated as easy to implement. Overall, approximately 20 percent of the top research needs were labeled as difficult to implement.

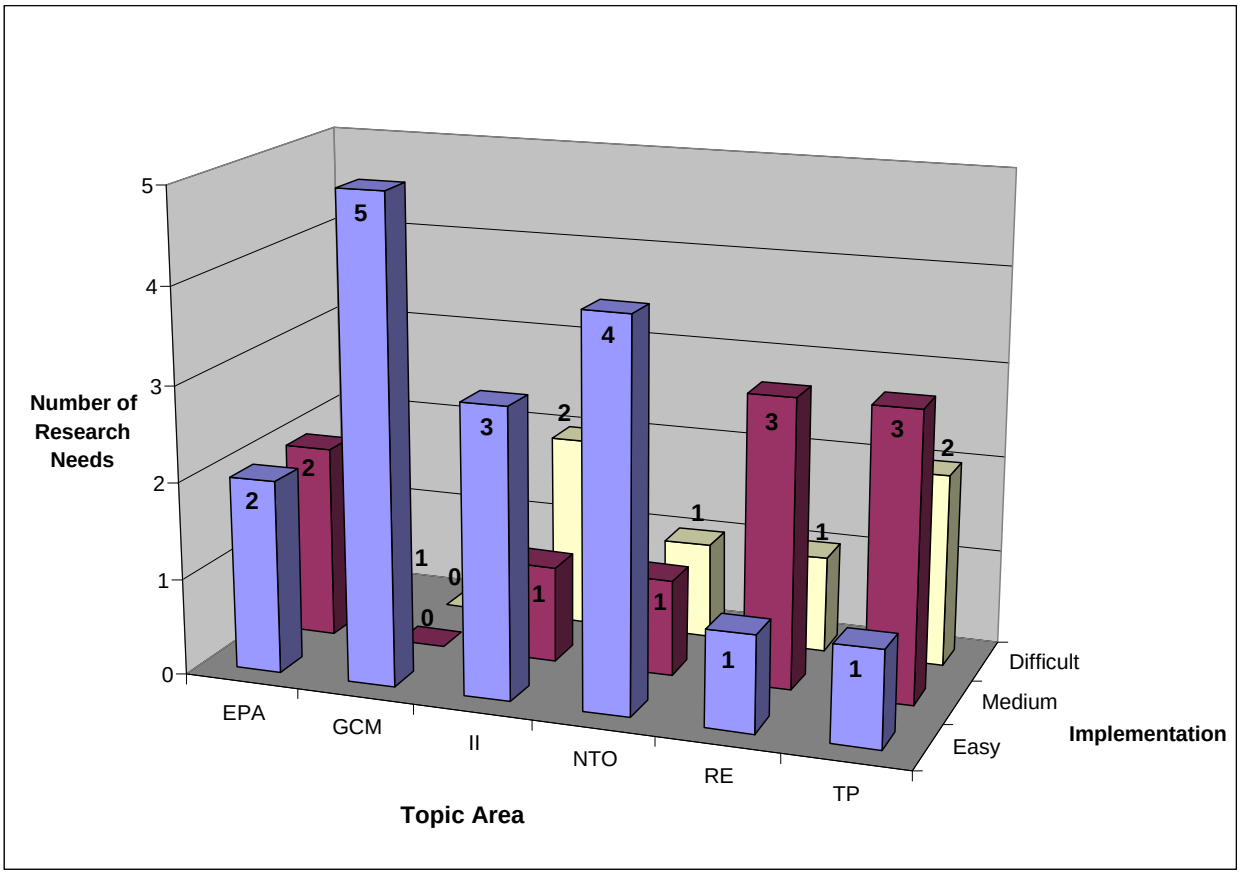

Figure 7. Top 33 Research Needs Distributed by Group and Ease of Implementation

2.4 Summary of Ballot Results

An aggregate list of the 33 top research needs was created and distributed to the attendees to provide their thoughts on a priority of all the projects generated at the workshop. A balloting process was then instituted to capture the delegates' thoughts on research need priorities.

A ballot containing the 33 top needs identified by the working groups was developed and sent electronically to all 77 delegates for prioritization. The research needs statements developed by the working groups for each need was also attached for their reference. The voting was done via prioritization of the 33 needs. Each delegate ranked the needs on the ballot form from "1" for greatest priority down to "33" for least priority. A total of 51 delegates returned their ballots, which equates to a return rate of over 66 percent. The delegates' prioritization information for each research need was then aggregated and averaged to provide a score for that need, which represented that needs average priority based on the delegate ballots. It should be noted that five delegates returned partial prioritization ballots, one identifying only their top 7, another identifying their top 8, and the other three providing priority information on their top 10, 13, and 26. These ballots were included in the aggregate analysis since each research need's information was averaged over the number of total entries in the ballots for that research need.

The balloting process resulted in a prioritized list of the top 33 research needs across all topic areas.

Table 25 lists the prioritized research needs identified in the workshop, color coded per topic area for ease of discussion.

Table 25. Prioritized List of Top 33 Research Needs

Rank	Research Need	Title
1	TP-1	Application of Warning Devices/Treatments at High Speed Rail Crossings
2	GCM-1	Warning Device Minimum Requirement for 80-110 MPH Trains
3	TP-2	Highway Traffic Signal Pre-emption at Highway-Rail Grade Crossings
4	EPA-4	Evaluate Effectiveness and Potential Motorist & Pedestrian Signage and Treatments
5	GCM-4	Second Train Warning Devices for Pedestrian Crossings
6	NTO-5	Minimum Traffic Control Devices for High-speed Train (HST, formerly known as HSR) HRGC
7	GCM-3	Global Positioning Satellite (GPS)/Positive Train Control (PTC) Constant Warning Time
8	NTO-2	Pedestrian, Nonmotorized and Limited Mobility Treatments
9	II-2	Cost/Benefit Analysis of Grade Crossing Improvements
10	NTO-1	Alternative Sensors and Warning Systems for Vital Applications
11	NTO-4	Effectiveness of LED Enhanced Grade Crossing Traffic Signs
12	RE-3	Photo Enforcement at HRGXs
13	TP-3	Effectiveness of Gates for Pedestrians
14	TP-5	Driver Decision Making At Complex Crossings
15	NTO-3	On-track Vehicle Detection
16	RE-1	Data Needs for Proactive Enforcement
17	II-1	Establishment of a Railroad/Transit Data Clearinghouse
18	GCM-2	Flangeway Gap Solutions
19	TP-6	Review and Improvement of Hazard Indices and Accident Prediction Formulae
20	RE-2	Collecting and Analyzing Trespass Data
21	EPA-2	Evaluation of Existing Education and Outreach Strategies
22	EPA-3	Crossing Consolidation Education
23	GCM-5	Personal Detection Device for Railroad Workers
24	II-3	Synthesis to Evaluate How, When, and Where Human Perception Negatively Impacts Rail Safety
25	NTO-6	Enhanced Commercial Systems to Improve HRGC Safety
26	EPA-5	Evaluate the Effectiveness of Mobile Warning Devices When Approaching Grade Crossings
27	RE-4	No-train-horn Crossings
28	EPA-1	Evaluation of Social Media Outreach
29	II-6	Identify Opportunities to Make Legislation and Regulations Across Jurisdictions Compatible, Meaningful and Up-to-Date
30	TP-4	Signage at Roundabouts
31	II-5	Improved Effectiveness of Stakeholder Interaction
32	II-4	Institutionalize Evaluation as a Key Component of Project/Program (countermeasure) Design and Implementation
33	RE-5	National Campaign for Targeted Seasonal Enforcement Programs

2.5 Discussion, Analysis and Summary Trends of Top Needs

This section reviews the ability to aggregate similar research needs statements into summary themes. Discussions during the final day of the workshop indicated the probability that some of the research needs could easily be merged. Some delegates even suggested merging certain research needs statements on their ballots. Therefore, the Volpe Center analyzed the top 33 research needs and created five research themes that capture common threads as summarized below. All 33 top research needs were utilized in this analysis.

2.5.1 Aggregate Research Themes of the Top Needs

All 33 top research needs were reviewed and categorized into the five themes below. Each individual research need may have multiple connections to the five themes created. However, the Volpe Center staff objectively assigned each research need to its most relevant research theme. This was accomplished by review of each research need's specific language associated with the "project statement" data field. The ordered list below is based on average ranking of all of the research needs statements within each research theme.

The five themes are described with annotated research needs statements below:

- High Speed Rail Applications:
  Determine adequate warning devices for High Speed Rail.
  TP1 and GCM1 are ranked 1st and 2nd in the delegates' prioritization and are both supported by NTO-5, which was ranked 6th, and TP6, which was ranked 19th.
  - TP-1 Application of Warning Devices/Treatments at High Speed Rail Crossings
  - GCM-1 Warning Devices Minimum Requirements for 80–110 MPH Trains
  - NTO-5 Minimum Traffic Control Devices for High Speed Train Highway-Rail Grade Crossing (HRGC)
  - TP-6 Review and Improvement of Hazard Indices and Accident Prediction Formulae

- Pedestrian-oriented research needs:
  Research to assess effectiveness of existing and potential new pedestrian signage and treatments.
  - EPA-4 Evaluate Effectiveness and Potential Motorist & Pedestrian Signage and Treatments
  - GCM-4 Second Train Warning Devices for Pedestrian Crossings
  - NTO-2 Pedestrian, Non-Motorized and Limited Mobility Treatments
  - TP-3 Effectiveness of Gates for Pedestrians
  - GCM-2 Flangeway Gap Solutions
  - RE-2 Collecting and Analyzing Trespass Data (for the pedestrian component of trespass data)
  - TP-1 (caveat – High Speed Rail Applications was primary theme)

- Signal and Sign effectiveness:
  Additional or enhanced signals and signs to provide more effective warning to the users.
  - Signal:
    - TP-2 Highway Traffic Signal Pre-emption at Highway-Rail Grade Crossings

        - GCM-4 Second Train Warning Devices for Pedestrian Crossings
        - NTO-4 Effectiveness of LED Enhanced Grade Crossing Traffic Signs
        - EPA-5 Evaluate the Effectiveness of Mobile Warning Devices When Approaching Grade Crossings
    - Sign:
        - RE-4 No-train-horn Crossings
        - TP-4 Signage at Roundabouts
        - EPA-4 (caveat – Pedestrian-oriented Research was primary theme)

- Sociotechnical Systems Research:
  Identification of risk factors involving trains, motorists, and pedestrians.
    - TP-5 Driver Decision Making At Complex Crossings
    - RE-1 Data Needs for Proactive Enforcement
    - II-1 Establishment of a Railroad/Transit Data Clearinghouse
    - EPA-3 Crossing Consolidation Education
    - II-3 Synthesis to Evaluate How, When, and Where Human Perception Negatively Impacts Rail Safety
    - II-5 Improved Effectiveness of Stakeholder Interaction
    - RE-5 National Campaign for Targeted Seasonal Enforcement Programs

- Evaluation of Procedures and Technology:
  Provide effective best practices for model law development to achieve consistent nationwide applications.
    - Technology:
        - GCM-3 GPS/PTC Constant Warning Time
        - NTO1 Alternative Sensors and Warning Systems for Vital Applications
        - NTO6 Enhanced Commercial Systems to Improve HRGC Safety
    - Procedures:
        - II-2 Cost/Benefit analysis of Grade Crossing Improvements
        - RE-3 Photo Enforcement at HRGXs
        - EPA-2 Evaluation of Existing Education and Outreach Strategies
        - EPA-1 Evaluation of Social Media Outreach
        - II-6 Identify Opportunities to Make Legislation and Regulations Across Jurisdictions Compatible, Meaningful and Up-to-Date
        - II-4 Institutionalize Evaluation as a Key component of Project/Program (countermeasure) Design and Implementation

Further analysis will be conducted and presented in Subsection 3.5 to include the 47 supplemental research needs developed by the delegates.

3 Discussion and Analysis of Research Topics Identified

This chapter examines all 80 research needs developed by the delegates during the second day of the workshop. Chapter 2 summarized and analyzed the top 33 research needs presented by the team leaders and prioritized by the delegates via balloting. This chapter will provide documentation on the remaining 47 supplemental research needs developed and provide salient information on the analysis of all needs with regard to the established data fields on the one-page research needs statement form provided by the Volpe Center.

The formalized list of all research needs developed is found in Table 26 and is divided by the six topical areas of interest described in Chapter 2. The research needs' tiles, highlighted in grey, have been provided in Chapter 2 of this report. As can be seen in the Table, the group entitled Institutional Issues (II) had no additional needs developed. Table 26 is followed by the one-page formal research needs statements of the remaining 47 research needs not presented in Chapter 2. It should be noted that all research needs statements are also contained in Appendix F of Volume II of this report.

Table 26. All Research Needs

Research Need	Title
EPA-1	Evaluation of Social Media Outreach
EPA-2	Evaluation of Existing Education and Outreach Strategies
EPA-3	Crossing Consolidation Education
EPA-4	Evaluate Effectiveness and Potential Motorist & Pedestrian Signage and Treatments
EPA-5	Evaluate the Effectiveness of Mobile Warning Devices When Approaching Crossings
EPA-6	Evaluation of New Media
EPA-7	Effectiveness of Drivers Educations
EPA-8	Analysis of trespass patterns using GPS technology
EPA-9	Drivers Educations–Computer Based Training
EPA-10	Development of Near Miss Data System (Pilot)
EPA-11	Addressing Complacency of Frequent Crossing Users
EPA-12	Confidential Close Call Reporting System
EPA-13	Trespassing Behavior Analysis
EPA-14	Evaluating existing and potential driver signage and treatment effectiveness
GCM-1	Warning Device Minimum Requirement for 80-110 MPH Trains
GCM-2	Flangeway Gap Solutions
GCM-3	Global Positioning Satellite (GPS)/Positive Train Control (PTC) Constant Warning Time
GCM-4	Second Train Warning Devices for Pedestrian Crossings
GCM-5	Personal Detection Device for Railroad Workers
GCM-6	Channelization at Pedestrian Crossings
GCM-7	Skewed Angle Pedestrian Crossings

Research Need	Title
GCM-8	Humped / High Profile Crossing Approaches
GCM-9	System to Monitor and Assess Existing Warning Devices
GCM-10	Develop Lower Cost Warning Devices for HSR
GCM-11	In-vehicle Warning System
GCM-12	Automated Vehicle (Automobile) Stopping System
GCM-13	Best Practices / Model Specifications for Ideal Crossing
GCM-14	Surface Material Performance–Entire Crossing
GCM-15	Best Practices for Crossing Surfaces
GCM-16	Investigate Alternative Warning Devices at Ped/Pathway Crossings
GCM-17	Lower Cost, Lower Volume User-activated Crossings
GCM-18	Low Cost Pedestrian 4-Quad Gates
II-1	Establishment of a Railroad/Transit Data Clearinghouse
II-2	Cost/Benefit analysis of Grade Crossing Improvements
II-3	Synthesis to Evaluate How, When, and Where Human Perception Negatively Impacts Rail Safety
II-4	Institutionalize Evaluation as a Key component of Project/Program (Countermeasure) Design and Implementation
II-5	Improved Effectiveness of Stakeholder Interaction
II-6	Identify Opportunities to Make Legislation and Regulations Across Jurisdictions Compatible, Meaningful and Up-to-date
NTO-1	Alternative Sensors and Warning Systems for Vital Applications
NTO-2	Pedestrian, Nonmotorized and Limited Mobility Treatments
NTO-3	On-Track Vehicle Detection
NTO-4	Effectiveness of LED Enhanced Grade Crossing Traffic Signs
NTO-5	Minimum Traffic Control Devices for High-speed Train (HST, formerly known as HSR) HRGC
NTO-6	Enhanced Commercial Systems to Improve HRGC Safety
NTO-7	Signals Near Grade Crossings
NTO-8	Lower Cost Active and Passive Warning Systems
NTO-9	Use of Wayside Horns at HRGC on HST lines
NTO-10	Remote Health Monitoring and Regulatory Relief
NTO-11	Grade Crossing Safety Effectiveness Evaluation
NTO-12	Use of PTC in HRGC Applications
NTO-13	Use of Supplemental Surveillance at HRGC on HST Lines
NTO-14	Evaluate alternative power options for remote sensing
NTO-15	Standard Traffic Signals at Highway-Rail Grade Crossings
RE-1	Data Needs for Proactive Enforcement
RE-2	Collecting and Analyzing Trespassing Data
RE-3	Evaluation of Photo Enforcement at railroad grade crossings
RE-4	No-train-horn Crossings
RE-5	National Campaign for Targeted Seasonal Enforcement Programs

Research Need	Title
RE-6	Grade Crossing Crash data Analysis
RE-7	Effectiveness of Various Types of Civil Penalties: HRGX Violations
RE-8	Judicial Education
RE-9	Motorist Expectations: Train and Crossing Operations
RE-10	Impact of Locomotive Horn Rule Implementation
RE-11	Quiet Zone Regulations and Signage
TP-1	Application of Warning Devices/Treatments at High Speed Rail Crossings
TP-2	Highway Traffic Signal Pre-emption at Highway-Rail Grade Crossings
TP-3	Effectiveness of Gates for Pedestrians
TP-4	Signage at Roundabouts
TP-5	Driver Decision Making At Complex Crossings
TP-6	Review and Improvement of Hazard Indices and Accident Prediction Formulae
TP-7	Driver Reaction to Active Advance Warning Signs and Variable Message Signs
TP-8	Driver Compliance with "Do Not Stop on Tracks" Sign
TP-9	Driver Behavior at Crossings with Mix Train Traffic
TP-10	Impact Of Storage Information Sign on Long-Wheel Base Vehicle Use
TP-11	Railroad Signals Through Roundabouts
TP-12	Identify Barriers to Crossing Consolidation Implementation
TP-13	Method for Estimating Traffic Volumes at Grade Crossings Where Counts Are not Available
TP-14	Review of Current GIS Methods and Data for “Hot Spot” Analysis
TP-15	Investigate Safety Performance of Grade Crossings Using Microsimulation
TP-16	Best Methods for Linkage/Sharing of Crossing Data, Traffic Data, and Collision Data Among Stakeholders (Agencies, Industry, and Public)

3.1 Remaining Research Needs Statements by the Six Topical Areas

This section provides the documentation on the remaining 47 supplemental research needs developed within the six working groups.

3.1.1 Grade Crossing Modernization

This area focuses on the identification and evaluation of conventional and enhanced systems at or near highway-rail grade crossings. The research in this area lays a foundation for the development of innovative technologies, methodologies and countermeasures with a potential high return for research, development and implementation.

Table 27 includes a list of the 13 supplemental research needs identified by the GCM working group. A one-page research need statement for each of these GCM items follows.

Table 27. Grade Crossing Modernization Supplemental Research Needs

Topic No.	Research Need Title
GCM-6	Channelization at Pedestrian Crossings
GCM-7	Skewed Angle Pedestrian Crossings
GCM-8	Humped/High Profile Crossing Approaches
CGM-9	System to Monitor and Assess Existing Warning Devices
CGM-10	Develop Lower Cost Warning Devices for HSR
GCM-11	In-vehicle Warning System
CGM-12	Automated Vehicle (Automobile) Stopping System
GCM-13	Best Practices / Model Specifications for Ideal Crossing
GCM-14	Surface Material Performance–Entire Crossing
GCM-15	Best Practices for Crossing Surfaces
GCM-16	Investigate Alternative Warning Devices at Ped/Pathway Crossings
GCM-17	Lower Cost, Lower Volume User-activated Crossings
GCM-18	Low Cost Pedestrian 4-Quad Gates

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-6
3. Title	Channelization at Pedestrian Crossings
4. Project Statement	Study and research the effectiveness of swing gates, “zee” style fencing leading up to the tracks and other related channelization structures.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (list organization & title of current research) CPUC documents Z-gates (not effectiveness) Other places implemented – effectiveness not categorized.
7. Potential Benefit(s) of Identified Research Need Area	Reduce the wide open area of a pedestrian crossing into small specific area designed to transport pedestrians smoothly.
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-7
3. Title	Skewed Angle Pedestrian Crossings
4. Project Statement	Identify and recommend the maximum skewed angle for a pathway/sidewalk approaching the tracks.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Greatly reduce the number of incidents, accidents, and fatalities when wheels get hung up on the skewed flangeway.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	If #2 (Flangeway Gap) is addressed, then #7 (skewed angle) becomes less important.

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-8
3. Title	Humped / High Profile Crossing Approaches
4. Project Statement	Due to the variability in truck and trailer design, investigation is needed to determine if W10-5 warning sign should have a supplemental plaque to categorize severity of profile.
5. Cross-Cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X__ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (list organization & title of current research) Possible NTSB accident report FRA LIDAR project
7. Potential Benefit(s) of Identified Research Need Area	Providing operators with advance information of high profile crossings could avoid potential catastrophic derailments.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	NCHRP
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Will require road authority to survey approaches in order to classify hump severity.
12. Other Comments	The DOT inventory form has a field for humped crossings. This could be used by operators to identify routes.

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area / Number	GCM-9
3. Title	System to Monitor and Assess Existing Warning Devices
4. Project Statement	Study and develop an effective process to assess and monitor the age and condition of older warning devices and components, and manage a replacement or upgrading program to maximize safety with scarce funding resources. Best practices for States and RRs.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors _X__ Transit-oriented Communities _X__ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Reduce maintenance costs and failure rates. Reduce interruption to train operations. Efficient use of scarce funding.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA Office of R&D, States, Railroads
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Determine age or performance standard for older devices (failure rate or maintenance calls to field).
12. Other Comments	

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-10
3. Title	Develop Lower Cost Warning Devices for HSR
4. Project Statement	At private crossings where train speeds or volumes will not accept manual locking gates, develop active warning devices that may include recycled active devices or components, and that may provide a simpler level of warning at the private crossing (no constant warning time). Lower cost than current systems used at public crossings.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors _X__ Transit-oriented Communities ___ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Enhanced safety at private crossings that do not depend on a crossing user to lock it after use, etc.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA through broad agency agreement.
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Property owners responsibilities (establish). Maintenance responsibilities (establish).
12. Other Comments	

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-11
3. Title	In-vehicle Warning System
4. Project Statement	Develop and evaluate an in-vehicle warning system that indicates to the motorist that a train is coming. The device would use GPS to determine whether or not the vehicle is going to cross the grade crossing. It would also use a signal from the railroad wayside equipment which would indicate whether or not a train is approaching.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s)..	_X_ Human Factors ___ Transit-oriented Communities ___ Data Requirements _X_ High Speed Rail
6. Relationship to Current Research	_X_ New __ Supplemental (list organization & title of current research) A number of in-vehicle warning systems have been tried
7. Potential Benefit(s) of Identified Research Need Area	Collision avoidance
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe, FHWA, NHTSA
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues: The in-vehicle device could use existing GPS Navigation system to keep down implementation cost. Coordinate with NHTSA would be needed to implement. Institutional barrier.
12. Other Comments	Difficult to implement–institutional barrier. Size and variability of vehicle fleet.

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-12
3. Title	Automated Vehicle (automobile) Stopping System
4. Project Statement	Develop an in-vehicle control system to stop a highway vehicle from entering the highway-rail intersection when a collision is predicted. System should have signal from wayside system (train), GPS in-vehicle that integrates with acceleration and braking of vehicle
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s)..	_X__ Human Factors ___ Transit-oriented Communities ___ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	__ New _X__ Supplemental (list organization & title of current research) FHWA, JPO work Stop Sign Collision Avoidance
7. Potential Benefit(s) of Identified Research Need Area	Positive collision avoidance
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe, auto industry, AAR
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	Build off FHWA and RITA/JPO ITS work (Cooperative Intersection Collision Avoidance Systems, Vehicle Track Interaction, Integrated Vehicle-Based Safety Systems, IntelliDrive). Partial technology exists.

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-13
3. Title	Best Practices/Model Specifications for Ideal Crossing
4. Project Statement	More local governments and developers are upgrading crossings to accommodate growth and traffic. This specification would provide example of a best practice crossing installation as related to contain types of rail lines. Would place condensed recommendations of TWG 2003 Crossing document in one place. Estimating Tool
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s)..	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (list organization & title of current research) Add-on to 2002 TWG Crossing document.
7. Potential Benefit(s) of Identified Research Need Area	Freight and integrity rail passenger lines Commuter rail Other rail transit
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	TRB / IDEA
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Determine classes/types of rail lines with stakeholders. Condemning down existing specs, w/o diluting.
12. Other Comments	Would include signal/surface and corridor (closure) best practices.

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-14
3. Title	Surface Material Performance – Entire Crossing
4. Project Statement	Compile performance data for crossing surfaces to established life cycles and costs of different surface types.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors _X__ Transit-oriented Communities ___ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (list organization & title of current research) Some States have conducted individual research.
7. Potential Benefit(s) of Identified Research Need Area	Better crossing surfaces can increase safety.
8. Research Need Urgency	__ High __ Medium _X_ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	TRB, FRA, NCHRP, TCRP, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-15
3. Title	Best Practices for Crossing Surfaces
4. Project Statement	Guidelines to provide crossing surface material. Study methods used to keep grade crossings surfaces durable, maintain drainage runoff to prevent track fouling, and levels consistent to alleviate humps. Compilation of best practices compilation - document & finding research – not field demo.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research) AREMA, Grade Crossing Handbook (not to extent desired) Gerry Rose (University of Kentucky), Some States.
7. Potential Benefit(s) of Identified Research Need Area	Allows for cost savings of crossing maintenance.
8. Research Need Urgency	__ High __ Medium _X_ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe, AREMA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-16
3. Title	Investigate Alternative Warning Devices at Ped/Pathway Crossings
4. Project Statement	Investigate the effectiveness of passive and active warning devices at pedestrian pathway at grade crossings.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New __X_ Supplemental (list organization & title of current research) Multiple Agencies have compiled info but did evaluate effectiveness. Many States have conducted research–limited findings.
7. Potential Benefit(s) of Identified Research Need Area	Improve warning devices for use at pathway crossings.
8. Research Need Urgency	__ High __ Medium _X_ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	NCHRP
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Might require adoption of new warning devices in MUTCD by FHWA.
12. Other Comments	

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area/Number	GCM-17
3. Title	Lower Cost, Lower Volume User-activated Crossings.
4. Project Statement	Develop low cost private crossing controlled-access equipment, such as locking gates that cannot be operated in a train is an approach.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors _X__ Transit-oriented Communities ___ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Enhanced safety for transit systems and railroads on lines with lower train volumes, lower train speeds, or lower traffic volumes.
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA / Broad Agency Announcement
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Needs to be simple to use. Needs to verify that it is closed and locked.
12. Other Comments	

1. Research Needs Area	Grade Crossing Modernization (GCM)
2. Research Topic Area / Number	GCM-18
3. Title	Low Cost Pedestrian 4-Quad Gates
4. Project Statement	Develop low cost, four quad gates for pedestrian crossings similar to those installed in Bregenz, Austria. The gates should reflectorized and a chain link fence should extend at least 50 feet in each direction to prevent going around the gates.
5. Cross-Cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New __X_ Supplemental (list organization & title of current research) Similar system is installed
7. Potential Benefit(s) of Identified Research Need Area	Protects pedestrians
8. Research Need Urgency	__ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	A similar system is installed in Bregenz, Austria. See attached photos.

3.1.2 Traffic Patterns

This area focuses on a better understand the highway traffic pattern and its impact on highway-rail grade crossing safety and railroad infrastructure. The research in this area will support the need to plan and implement efficient rail corridors and highway/pedestrian geometric features to reduce congestion and delay, thereby increasing throughput of the railroad and highway networks.

Table 28 includes a list of the ten supplemental research needs identified by the TP working group. A one-page research need statement for each of these TP items follows.

Table 28. Traffic Patterns Supplemental Research Needs

Topic No.	Research Need Title
TP-7	Driver Reaction to Active Advance Warning Signs and Variable Message Signs
TP-8	Driver Compliance with "Do Not Stop on Tracks" Sign
TP-9	Driver Behavior at Crossings with Mix Train Traffic
TP-10	Impact Of Storage Information Sign on Long Wheel Base Vehicle Use
TP-11	Railroad Signals Through Roundabouts
TP-12	Identify Barriers to Crossing Consolidation Implementation
TP-13	Method for Estimating Traffic Volumes at Grade Crossings Where Counts Are not Available
TP-14	Review of Current GIS Methods and Data for "Hot Spot" Analysis
TP-15	Investigate Safety Performance of Grade Crossings Using Microsimulation
TP-16	Best Methods For Linkage/Sharing of Crossing Data, Traffic Data, and Collision Data Among Stakeholders (Agencies, Industry, and Public)

1. Research Needs Area	Traffic Patterns (TP)
2. Research Topic Area/Number	TP-7
3. Title	Driver Reaction to Active Advance Warning Signs and Variable Message Signs
4. Project Statement	Signs and variable message sign. Issue: Provide advance warning and information to highway users. EX train presence and or vehicle stopped at crossings queue at crossing approach.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors _X__ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Examine feasibility and application of its technology at rail road crossings. Purpose: Provide options/alternatives to users. Provide alternative for traffic management.
8. Research Need Urgency	__ High __ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP-8
3. Title	Driver Compliance with “Do Not Stop on Tracks” Sign
4. Project Statement	Compare current “Do Not Stop on Tracks” sign with Canadian sign and active “Do Not Stop on Tracks” sign. Purpose: Effectiveness of each sign. Evaluation with focus group. Field evaluation.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Determine better alternative Review and if required revise warrants
8. Research Need Urgency	__ High _x_ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 9
3. Title	Driver Behavior at Crossings with Mix Train Traffic
4. Project Statement	Need to understand driver behavior at crossings used by freight and passenger trains with variable speed Purpose: to evaluate driver behavior at crossings with trains of different speeds Drivers will have higher compliance at crossings with only high speed trains
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	__x_ Human Factors __x_ Transit-oriented Communities ___ Data Requirements _x__ High Speed Rail
6. Relationship to Current Research	_x__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	
8. Research Need Urgency	_x_ High __ Medium __ Low
9. Cost of Research	_x_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe, TTI
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _x_ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 10
3. Title	Impact Of Storage Information Sign on Long-Wheel Base Vehicle Use
4. Project Statement	New signs have recently been implemented at warning highway users of restricted storage space between tracks and nearby intersection. . Before and after survey of drive behavior . Inventory of alternate signs across world . Evaluation of signs
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities ___ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	• Effectiveness of signs • Possible improvement • Possible alternative warning systems.
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K X__ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 11
3. Title	Railroad Signals Through Roundabouts
4. Project Statement	Determine types of active warning devices to be used when a rail line runs through a roundabout. Need to determine location of devices with respect to roundabout approaches and the circular roadway and how they are to operate. Review body of existing literature in international examples.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_x_ Human Factors _x_ Transit-oriented Communities _x_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_x_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Standardized warning devices used in roundabouts Improve traffic management Standardize user interaction with trains in roundabouts
8. Research Need Urgency	_x_ High __ Medium __ Low
9. Cost of Research	_x_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA, ASSHTO, TRB
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _x_ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 12
3. Title	Identify barriers to crossing consolidation implementation
4. Project Statement	FRA has performed research & developed guidance for consolidation (including grade separation & closure) of railroad crossings. The goal of this project is to determine what are the challenges to implementing this guidance and to provide a path forward for implementing them.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New __X_ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	The project should smooth and speed up the decision-making process for crossing consolidation. Benefits should be short-term and will generally be for state agencies.
8. Research Need Urgency	__ High __ Medium _X_ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 13
3. Title	Method for estimating traffic volumes at grade crossings where counts are not available
4. Project Statement	State agencies use accident prediction formulae that rely on traffic volume values in order to prioritize crossing improvements. Traffic volume data at crossings is routinely unavailable or out-of-date. In the absence of current traffic counts, a method will be developed to estimate traffic volumes based on other criteria, such as nearby traffic volumes, roadway characteristics, and impacts of a nearby crossing, etc.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Standardized methods for estimating traffic volumes at railroad crossings should improve the quality of the prioritization process. State agencies would benefit.
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Consultant or academia
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Complexity of the problem; methodological issue probably involved.
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 14
3. Title	Review of current GIS Methods and data for “hot spot” analysis
4. Project Statement	Review and describe the use of GIS technology in identifying safety “hot spots” in the rail mode.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	State-of-the-art methods will be made available for use by various agencies to remedy safety problems. Benefits will be long-term.
8. Research Need Urgency	__ High __ Medium _X_ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 15
3. Title	Investigate safety performance of grade crossings using microsimulation
4. Project Statement	The industry currently uses statistical methods to evaluate safety performance of grade crossings. The potential use of microsimulation for safety evaluation should be investigated. This method would allow consideration of various scenarios, such as traffic flow response to shared corridor rail operations (for example).
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities _X__ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Microsimulation is a cost-effective method for stakeholders to evaluate the impact of environments and users on grade crossing safety performance and operation.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	TRB, AASHTO, and academia
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues: Development of new microsimulation methods, including calibration and validation, would require significant effort and real-world data.
12. Other Comments	

1. Research Needs Area	TP
2. Research Topic Area/Number	TP - 16
3. Title	Best methods for linkage/sharing of crossing data, traffic data, and collision data among stakeholders (agencies, industry, and public)
4. Project Statement	Data involving railroad crossings currently resides in numerous disconnected databases, within a variety of agencies and companies. Data completeness is an issue for most databases, and depends on the data owner. Improved methods and tools for sharing data among stakeholders should be investigated and piloted.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Availability of current, accurate, and complete data supports good decisions for any stakeholder considering options for safety improvements, consolidations, or traffic separation. Benefits will be long-term.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues: Sharing data among disparate organizations is a difficult proposition that includes institutional and technical challenges.
12. Other Comments	

3.1.3 New Technology Opportunities

This area targets various innovative technologies and technology transfer opportunities to test for applicability (and, if deemed a valuable tool, implementation) within the rail infrastructure. The research in this area will allow for the development and/or assessment of techniques or technologies that reduce incidents along the railroad rights-of-way, as well as enhance congestion mitigation of the rail's infrastructure.

Table 29 lists the nine supplemental research needs identified by the NTO working group. A one-page research need statement for each of these NTO items follows.

Table 29. New Technology Opportunities Supplemental Research Needs

Topic No.	Research Need Title
NTO-7	Signals Near Grade Crossings
NTO-8	Lower Cost Active and Passive Warning Systems
NTO-9	Use of Wayside Horns at HRGC on HST lines
NTO-10	Remote Health Monitoring and Regulatory Relief
NTO-11	Grade Crossing Safety Effectiveness Evaluation
NTO-12	Use of PTC in HRGC Applications
NTO-13	Use of Supplemental Surveillance at HRGC on HST lines
NTO-14	Evaluate alternative power options for remote sensing
NTO-15	Standard Traffic Signals at Highway-Rail Grade Crossings

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-7
3. Title	Signals Near Grade Crossings
4. Project Statement	• Analyze crash data to determine impact of signalized intersection proximity on crash rates • Identify effectiveness of and warrants for use of o Preemption (alone) o Preemption with active DO NOT STOP ON TRACKS sign o Preemption with pre-signal o Queue cutter or active DO NOT STOP ON TRACKS sign • Identify recommended practice addressing: o Min-max clear storage distance for pre-signals and queue cutters o Identify known problems with each device potentially limiting effectiveness of treatments and countermeasures o Identify key design features such as timing plans and signal indications
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New _X_ Supplemental (list organization & title of current research) – TCRP Report 69
7. Potential Benefit(s) of Identified Research Need Area	Addresses the most critical factors causing collisions – recurrent queues across tracks
8. Research Need Urgency	_X_ High (very valuable) ___ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues: Deals with application of readily available existing technology
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-8
3. Title	Lower Cost Active and Passive Warning Systems
4. Project Statement	• Develop technologies that are adaptable • Communication systems that are easily deployable and fail safe • Detect train and convey to road user • Define life-cycle cost elements
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New X Supplemental (list organization & title of current research) Canada, UK, other countries
7. Potential Benefit(s) of Identified Research Need Area	Safety Benefactors - Highway agencies, communities
8. Research Need Urgency	_X_ High (very valuable) ___ Medium ___ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Volpe, FRA, contractors
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	Would improved technologies help since the last time this was researched?

1. Research Needs Area	New Technology Opportunities (NTO)
2. Research Topic Area/Number	NTO-9
3. Title	Use of Wayside Horns at HRGC on HST lines
4. Project Statement	• Does the speed of the train above 80 mph mandate the use of wayside horns? • Is the locomotive horn an effective warning device at speeds greater than 80 mph?
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities ___ Data Requirements _X_ High Speed Rail
6. Relationship to Current Research	X New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Increased safety at HRGC on HST lines
8. Research Need Urgency	_X_ High (very valuable) ___ Medium ___ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Volpe, University
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	Look at TC research

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-10
3. Title	Remote Health Monitoring and Regulatory Relief
4. Project Statement	• Identify reliability requirements for data elements that can be monitored and have the potential to be used for regulatory relief • Help build case for regulatory relief from manual periodic inspection for those elements • Research and gather experimental/historical data to determine and justify proper level on regulatory relief from 30-day inspections at sites equipped with 7/24 monitoring. Use a few different sites on monitoring options or assessments
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	X New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Improved safety Reduced inspection manual inspection costs
8. Research Need Urgency	_X_ High (very valuable) ___ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Regulatory and industry acceptance.
12. Other Comments	

1. Research Needs Area	New Technology Opportunities (NTO)
2. Research Topic Area/Number	NTO-11
3. Title	Grade Crossing Safety Effectiveness Evaluation
4. Project Statement	Evaluate the generic data element needs to determine the effectiveness and compliance of new grade crossing treatments and warning devices. Identify what are most valuable to collect to understand grade crossing safety.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	X New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Consistency of data reporting Increased safety Reduced costs
8. Research Need Urgency	__ High (very valuable) _X__ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: Industry and government coordination.
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-12
3. Title	Use of PTC in HRGC Applications
4. Project Statement	Integrate PTC into IEEE 1570 for traffic signal preemption, blocked crossing, alternate route messaging
5. Cross-utting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	X New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Improved safety, preemption Operation and mobility
8. Research Need Urgency	__ High (very valuable) _X__ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Joint AREMA Committees 36 and 39
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	Integrates ITS required protocol/interface into PTC system.

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-13
3. Title	Use of Supplemental Surveillance at HRGC on HST lines
4. Project Statement	• Should supplemental surveillance at HRGC be required where train speeds are 80 mph or greater? How should the information be used; o tied into PTC and cab display for speed reduction or train stop o securing the crossing for the duration of the approach o reducing the collision risk/severity • Identify surveillance technologies and trade-offs o Video o Loops o Radar o IR o Other?
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements _X_ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Increased safety at HRGC on HST corridors
8. Research Need Urgency	__ High (very valuable) _X__ Medium ___ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-14
3. Title	Evaluate alternative power options for remote sensing
4. Project Statement	Research is needed to identify and evaluate alternatives to commercial electrical power for remote sensing locations.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Enables use of remote sensing in areas where remote sensing would not otherwise be possible
8. Research Need Urgency	__ High (very valuable) ___ Medium _X__ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA/FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	NTO
2. Research Topic Area/Number	NTO-15
3. Title	Standard Traffic Signals at Highway-Rail Grade Crossings
4. Project Statement	Perform human factors study to determine the effectiveness of standard traffic control signals versus current active flashers and effect on driver behavior/compliance
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Better driver compliance with signals Lower installation cost Lower maintenance cost/transfer to city traffic engineers
8. Research Need Urgency	__ High (very valuable) ___ Medium _X__ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	FHWA, University
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	New low energy LEDs allow for less power consumption on batteries and better reliability not previously attainable.

3.1.4 Regulations and Enforcement

This area focuses on the review and analysis of current regulations, policies, and programs to enhance safety along the railroad rights-of-way. The research in this area will facilitate standardization of regulation and enforcement efforts nationwide, potentially resulting in a reduction of the violation and incident rates.

Table 30 lists the six supplemental research needs identified by the RE working group. A one-page research need statement for each of these RE items follows.

Table 30. Regulations and Enforcement Supplemental Research Needs

Topic No.	Research Need Title
RE-6	Grade crossing crash data analysis
RE-7	Effectiveness of Various Types of Civil Penalties: HRGX Violations
RE-8	Judicial Education
RE-9	Motorist Expectations: Train and Crossing Operations
RE-10	Impact of Locomotive Horn Rule Implementation
RE-11	Quiet Zone Regulations and Signage

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area / Number	RE-6
3. Title	Grade crossing crash data analysis
4. Project Statement	The purpose of the research is to collect and study/analyze national crossing crash data to identify major causes of HRGX crashes (gate violations, deficient controls, geometric conditions, etc.). The result of the study would allow policy to focus on most effective enforcement management practices which would lead to most effective results. This would also help state/local agencies to identify safety improvement countermeasures and to identify any needed enhancement of current laws and regulations.
5. Cross-Cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities _X__ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Improve HRGX data collection for USDOT crossing databases, as well as analysis and practices. Improve HRGX safety countermeasures (traffic control, geometric improvements, policy enforcement, practice and results, education, and strategy.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA, NCHRP, TRB, NHTSA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues: Data collection, if current database provides insufficient data for the study.
12. Other Comments	

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/Number	RE-7
3. Title	Effectiveness of Various Types of Civil Penalties: HRGX Violations
4. Project Statement	Challenge: Are monetary penalties the only possible method? What about non-monetary penalties (license suspension, public service, etc.)? What are the relative effectiveness levels? Purpose: To determine enforcement methods that are more cost-effective in terms of time and money; also to determine potential deterrence effects. Expected outcome To reduce HRGX violations
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	__X_ Human Factors ___ Transit-oriented Communities __X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Measurable changes in #s of collisions, measurable and non-measurable changes in numbers of close calls; short-term.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Volpe, American Assn. of Motor Vehicle Administrators, AAA
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium X__ Difficult Issues: Depends upon whether it is federally-mandated or voluntary; State compliance may vary.
12. Other Comments	

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/Number	RE-8
3. Title	Judicial Education
4. Project Statement	How do the citations issued in the field translate into convictions? What types of actions do the courts take? How do prosecutors' recommendations and judges' understanding of the safety consequences influence judicial decisions. Purpose: To provide information that informs judges, to give them a clearer understanding of the highway-safety consequences of their decisions and their impact on state and national HRGX and trespass-prevention safety programs.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Clearer, more consistent, more uniform judicial decisions; more uniform treatment of violation of national-level safety concerns.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	FMCSA, National Judicial College; National Association of Proscecuting Attorneys; OLI;
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues: Would expand upon FMCSA's efforts, just add more subject area; consider looking at other agencies' best practices.
12. Other Comments	

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/Number	RE-9
3. Title	Motorist Expectations: Train and Crossing Operations
4. Project Statement	Motorist expectations and operational conditions affect motorist behaviors at HRGX. Basically, why do people try to beat the train? What are motorist expectations and their resulting behaviors that lead to appropriate (and inappropriate) actions at HRGX? And, is there a difference between commercial and non-commercial drivers? Address such issues as train speed; roughness of crossing; type and complexity of gates, lamps, and other traffic control devices; reliability of TCDs; train length, blocked crossings.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors _X__ Transit-oriented Communities ___ Data Requirements _X__ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (list organization & title of current research) Ongoing work on warning signal reliability.
7. Potential Benefit(s) of Identified Research Need Area	Systematic assessment of crash causation and more effective prevention strategies (HRGX safety equivalent to the FMCSA/NHTSA Large Truck Crash Causation Study??); get railroads more involved in effective maintenance of crossing systems; assist law enforcement in writing citations based on quality information.
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA/FHWA/FMCSA/NHTSA/Volpe
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium __ Difficult Issues: The challenge of implementation may be closely tied to the availability of funds to support specific programs.
12. Other Comments	Any new regulations would probably fall within FRA's area of responsibility.

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/Number	RE–10
3. Title	Impact of Locomotive Horn Rule Implementation
4. Project Statement	Review effectiveness of locomotive horn rule in terms of implementation ease for communities and FRA. What are the community impacts and challenges? Does the rule need to be changed? Why is the implementation limited?
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors _X__ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Potential to streamline and standardize quiet zone process.
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Regulations and Enforcement (RE)
2. Research Topic Area/Number	RE–11
3. Title	Quiet Zone Regulations and Signage
4. Project Statement	Review effectiveness of grade crossing advance warning sign (W10-1). Determine if placement and message should be modified for quiet zone implementation.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors _X__ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Enhanced motorist awareness of no-train-horn crossing – an "expected" audible warning may not be available
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

3.1.5 Education and Public Awareness

This area targets the communication aspect of highway-rail grade crossing safety and trespass prevention. The research in this area will be to decrease the number of grade crossing and trespass incidents, fatalities and injuries.

Table 31 lists the nine supplemental research needs identified by the EPA working group. A one-page research need statement for each of these EPA items follows.

Table 31. Education and Public Awareness Supplemental Research Needs

Topic No.	Research Need Title
EPA-6	Evaluation of New Media
EPA-7	Effectiveness of Drivers Educations
EPA-8	Analysis of trespass patterns using GPS technology
EPA-9	Drivers Educations – Computer Based Training
EPA-10	Development of Near Miss Data System (Pilot)
EPA-11	Addressing Complacency of Frequent Crossing Users
EPA-12	Confidential Close Call Reporting System
EPA-13	Trespassing Behavior Analysis
EPA-14	Evaluating existing and potential driver signage and treatment effectiveness

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-6
3. Title	Evaluation of New Media
4. Project Statement	Assess impact and effectiveness of new media (i.e., internet tools, social networking sites, text messages, email, and podcast) outreach programs in public rail safety awareness including grade crossings and trespass safety.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Better targeting of intended audience Provide additional tools for messaging Further reductions in grade crossing and trespass incidents.
8. Research Need Urgency	X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA, Academia, Consultants, Research firms
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-7
3. Title	Effectiveness of Drivers Educations
4. Project Statement	Research if the type and amount of drivers education correlates with the number and types of collisions
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Determine if educational program effective.
8. Research Need Urgency	__ High __ Medium _X_ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium __ Difficult Issues: Hard to collect needed information.
12. Other Comments	Transferred from another topical area group.

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-8
3. Title	Analysis of trespass patterns using GPS technology
4. Project Statement	1. Develop technology that would allow crewmember to use GPS plotting to target trespass hot spots and determine its effectiveness over time 2. Collect and report real time data 3. More accurately target of hot zooms for enforcement 4. Rapid response and prevention for law enforcement
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors ___ Transit-oriented Communities _X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Same as 4 under project statement
8. Research Need Urgency	__ High X __ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K X__ Low < $150K
10. Potential Organization(s) to Conduct Research	Railroad and labor groups
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy X__ Medium __ Difficult Issues: Potential cost of technology.
12. Other Comments	

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-9
3. Title	Drivers Educations – Computer Based Training
4. Project Statement	Collect and analyze existing data provided by OL Canada from Web-based training. Determine effectiveness of online training V/S in class learning potential for pilot USA application.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	___ New _X__ Supplemental (list organization & title of current research) OL Canada
7. Potential Benefit(s) of Identified Research Need Area	Cost effective method to reach entire novice driver population.
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-10
3. Title	Development of Near Miss Data System (Pilot)
4. Project Statement	1. Assess the use of near miss data to identify hot zones using FRA proposed mandatory reporting to target education efforts. 2. Determine collection methods of near miss incidents and ensure consistency of data collection to be shared among cross-section OLI/FRA/Railroad/DOT/Law enforcement 3. Lower incidents that results in injuries and fatalities and promote non-filtered dissemination of data between interested parties.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors _X_ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Decreased loss of life to members of the community. Improve productivity for all agencies. Reallocate money spent in litigation and post accident evaluation and reporting. Short- and long-term advantages
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	FRA coordination with host railroad and labor organization.
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues: The ability to cross communicate the data upfeed. Dependent on FRA requiring near miss data collection.
12. Other Comments	2003 highway rail grade crossing research needs workshop needs HF, HF 06 pg 42 with emphasis on communication control

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area / Number	EPA-11
3. Title	Addressing Complacency of Frequent Crossing Users
4. Project Statement	Assess the means to address the complacency of those who use the crossing regularly (commuters and local residents).
5. Cross-Cutting Areas Please mark a mark an X next to the applicable area(s).	_X__ Human Factors ___ Transit-oriented Communities ___ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	__X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Reduction in collision New educational targeting
8. Research Need Urgency	__ High _X_ Medium __ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	
11. Ease of Implementation If medium or difficult, list key implementation issues	__ Easy __ Medium _X_ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-12
3. Title	Confidential Close Call Reporting System
4. Project Statement	1. A channel for communication to data input while maintaining autonomy 2. Increased target of hot zone without any negative ramifications 3. More accurate reporting
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	___ Human Factors _X__ Transit-oriented Communities __X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X__ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Increase honest fact based reporting Short and long term benefits
8. Research Need Urgency	_X_ High __ Medium __ Low
9. Cost of Research	__ High >$500K __ Medium = $150K - $500K _X_ Low < $150K
10. Potential Organization(s) to Conduct Research	RR and labor groups
11. Ease of Implementation If medium or difficult, list key implementation issues.	_X_ Easy __ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-13
3. Title	Trespassing Behavior Analysis
4. Project Statement	Analyze why people are willing to take trespass risks on RR tracks in order to target specific education and outreach components for target audience
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities _X_ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	Better indentify target audience Allow for development of improved education programs
8. Research Need Urgency	__ High __ Medium _X_ Low
9. Cost of Research	__ High >$500K _X_ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	Academia, research firms
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy _X_ Medium __ Difficult Issues:
12. Other Comments	

1. Research Needs Area	Education and Public Awareness (EPA)
2. Research Topic Area/Number	EPA-14
3. Title	Evaluating existing and potential driver signage and treatment effectiveness
4. Project Statement	Assess the effectiveness of existing and potential new signage/treatments including review of international signage, testing of new signage. Identify best designs for consideration by the MUTCD.
5. Cross-cutting Areas Please mark a mark an X next to the applicable area(s).	_X_ Human Factors ___ Transit-oriented Communities X__ Data Requirements ___ High Speed Rail
6. Relationship to Current Research	_X_ New ___ Supplemental (list organization & title of current research)
7. Potential Benefit(s) of Identified Research Need Area	For the reduction in grade crossing and trespass incidents Increase driver awareness
8. Research Need Urgency	X_ High __ Medium __ Low
9. Cost of Research	_X_ High >$500K __ Medium = $150K - $500K __ Low < $150K
10. Potential Organization(s) to Conduct Research	FHWA
11. Ease of Implementation If medium or difficult, list key implementation issues.	__ Easy __ Medium X__ Difficult Issues: Design of new signage. Changes in signage.
12. Other Comments	

3.1.6 Institutional Issues

This area focuses on the successes and challenges related to planning and implementing programs at the industry, local, State and National levels. The research will provide agencies/organizations with decision making concepts and methodologies to embrace and implement as a means to update and/or advance safety programs comprehensively and cost-effectively.

There were no supplemental research needs identified by the II working group.

3.2 Analysis of Research Needs Statements

The eighty research needs develop at the workshop were uniformly formatted for ease of analysis. The criteria supplied on the formal research needs statement as discussed in Chapter 2 are analyzed against all 80 statements developed herein. The distribution over the topical areas is shown in Figure 8 below. Most research needs developed were evenly distributed amongst five of the six groups. However, as can be seen by the figure below, the Institutional Issues topic area generated only eight percent of all of the needs developed. This did not mean, however, that there we few institutional issues to discuss. In fact, the II working group generated well over 40 ideas during the initial brainstorming session during the morning of the second day. After this initial exercise, the team's facilitator helped organize those ideas into eight general categories. The team shuffled the 40+ ideas around within and across the eight categories and came to the realization that most of the ideas generally fell into one of six topics. Those topics ended up being written as the six II research needs statements.

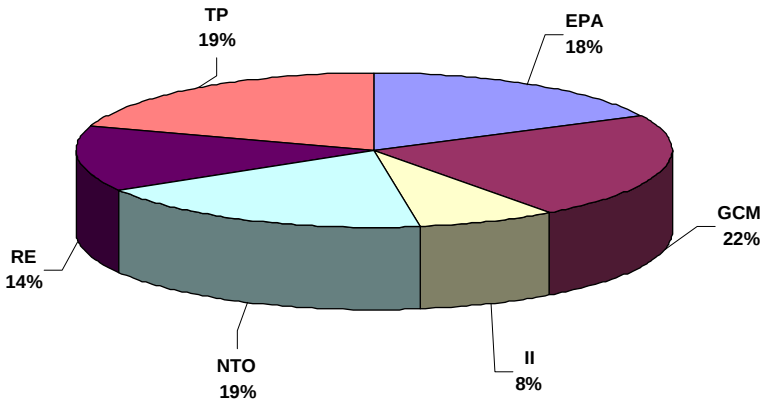

Figure 8. Distribution of All Research Needs by Topic Area

The Steering Committee for the workshop additionally selected four cross-cutting issue categories for use in this analysis to include Human Factors, Transit-oriented communities, Data Requirements and Applicability to the development of HSR corridors. These category descriptors are provided below:

- Human factors - a multidisciplinary field devoted to optimizing human performance and reducing human error. It incorporates the methods and principles of the behavioral and social sciences, engineering, and physiology.
- Transit-oriented communities - development of commercial space, housing, services, and job opportunities close to public transportation, thereby reducing dependence on automobiles. TODs are typically designed to include a mix of land uses within a quarter-mile walking distance of a transit stop or core commercial area.
- Data requirements – a procedure, method or identification of information that would allow a better understanding of the precursors, actual events and/or aggravating factors that effect the causes and severity of incidents at highway railroad grade crossings or trespass events.
- Efforts related to High Speed Rail - a type of passenger rail transport that operates significantly faster than the normal speed of rail traffic, typically above 79 mph train speed.

Subsection 3.2.1 provides information on the distribution of research needs by the cross-cutting areas. This analysis is followed by the other criteria related to the one-page form, as previously shown in Table 24 and discussed in Chapter 2. The following subsections are provided to illustrate the trends in the delegation's development of research needs as formally submitted.

3.2.1 Review of Cross-cutting Areas

The eighty research needs were reviewed for applicability to each of the cross-cutting areas as well as reviewing multiple categories of cross-cutting relationships. Figure 9 reviews the number of research needs by individual cross-cutting areas. The delegates selected multiple categories of cross-cutting relationships and therefore each need maybe counted under multiple categories. As can be expected from a review of current literature the area of Human Factors applies to approximately 60 percent of all the research needs developed, similar to the distribution of the top research needs. Half of the research needs were also associated with the Data Requirements cross-cutting area.

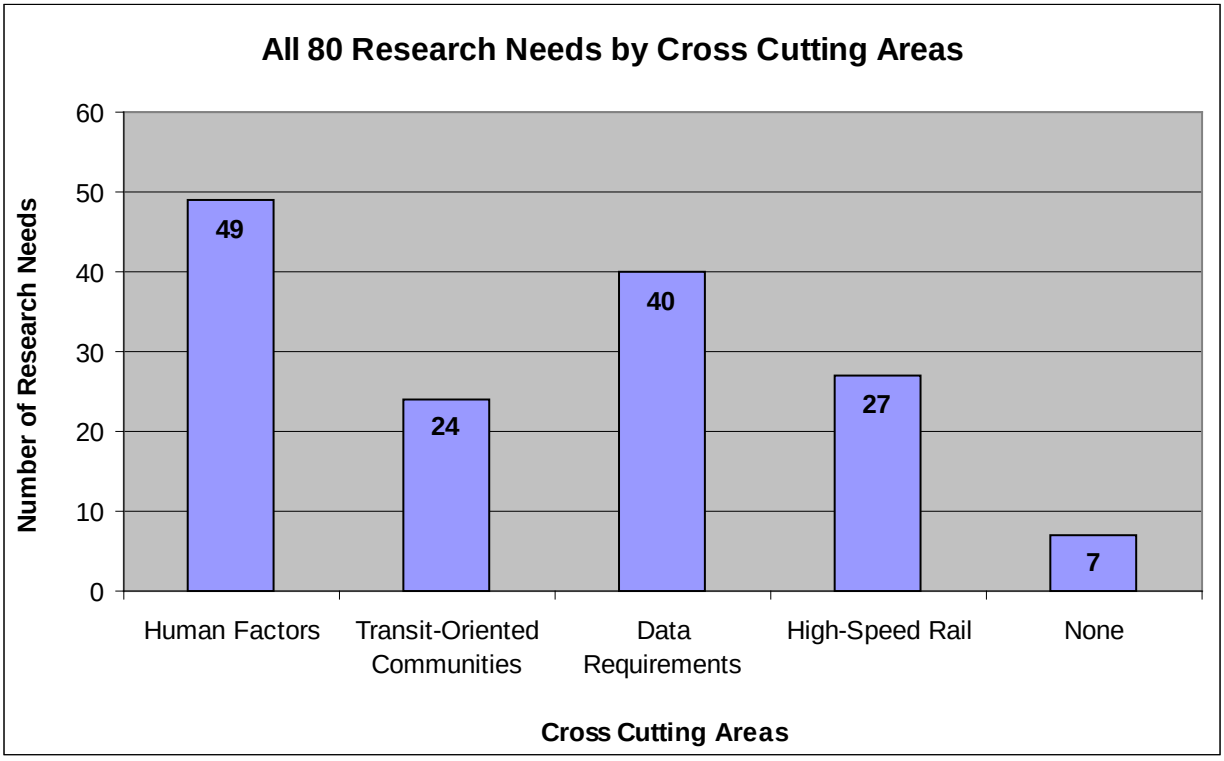

Figure 9. Distribution of All Research Needs by Cross Cutting Area Applicability

As stated above multiple categories could have been addressed by the delegates with regard to cross-cutting affiliations. Figure 10 below distributes each of the 80 research needs by multiple categorization of these areas. As shown in the Figure, seven needs have no cross-cutting designation, 25 have one area designated, 29 have two areas designated, and 19 have three designated. No Research Need had all four cross-cutting areas designated.

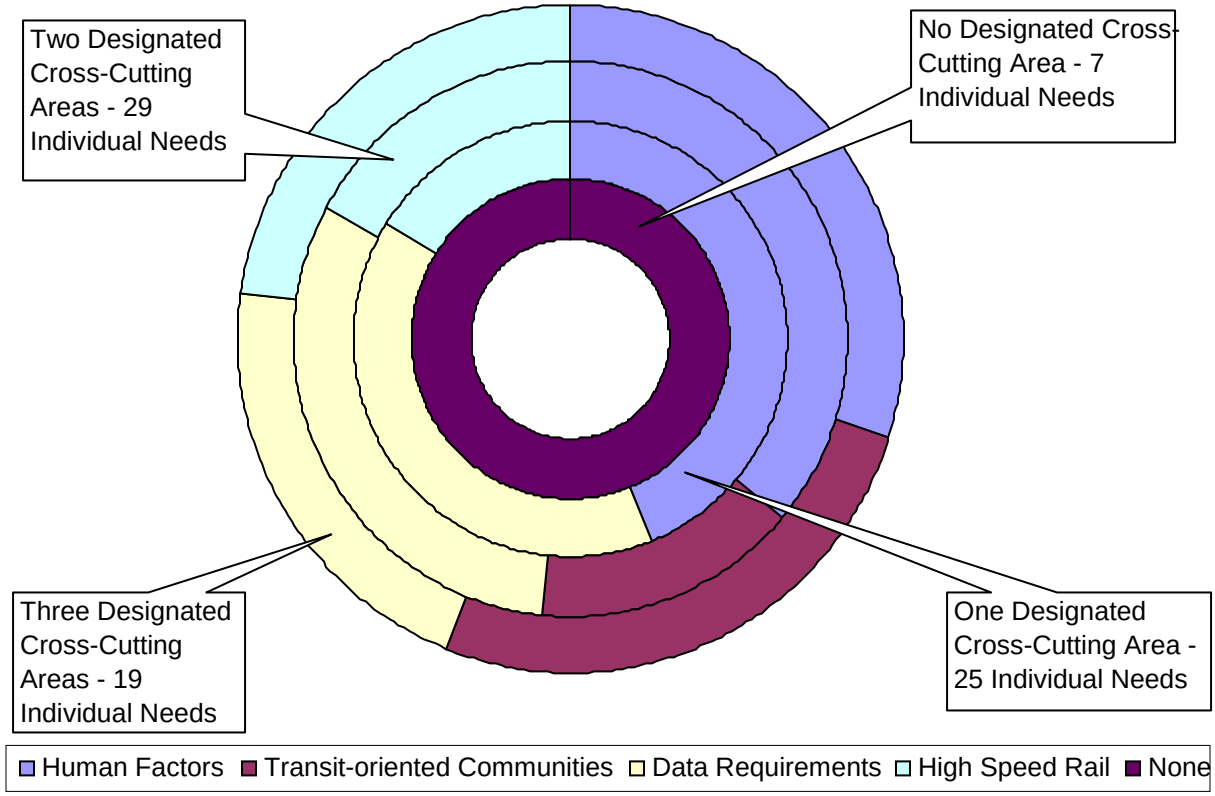

Figure 10. Concentric Graph of All Research Needs with Multiple Cross-cutting Issues

The following seven Research Needs had no cross-cutting designation provided on the standard form:

- GCM-13 Best Practices / Model Specifications for Ideal Crossing
- GCM-16 Investigate Alternative Warning Devices at Ped/Pathway Crossings
- GCM-18 Low Cost Pedestrian 4-Quad Gates
- II-5 Improved Effectiveness of Stakeholder Interaction
- NTO-14 Evaluate alternative power options for remote sensing
- RE-8 Judicial Education
- TP-12 Identify Barriers to Crossing Consolidation Implementation

The GCM-13, II-5, RE-8, and TP-12 research needs appear to be sociotechnical systems issues, which may be why they had no associated cross-cutting designation. The remaining three research needs may have had a time constraint limiting the review of all data fields.

3.2.2 Research Status

Figure 11 displays the distribution of all research needs by topic area and research status. Overall, 63 were designated as new research initiatives and 17 were designated as supplemental to existing research activities. Over half of the supplemental research needs were associated

with the Grade Crossing Modernization topical area. The research status will be reviewed in Chapter 4 for proper designation based on current research information.

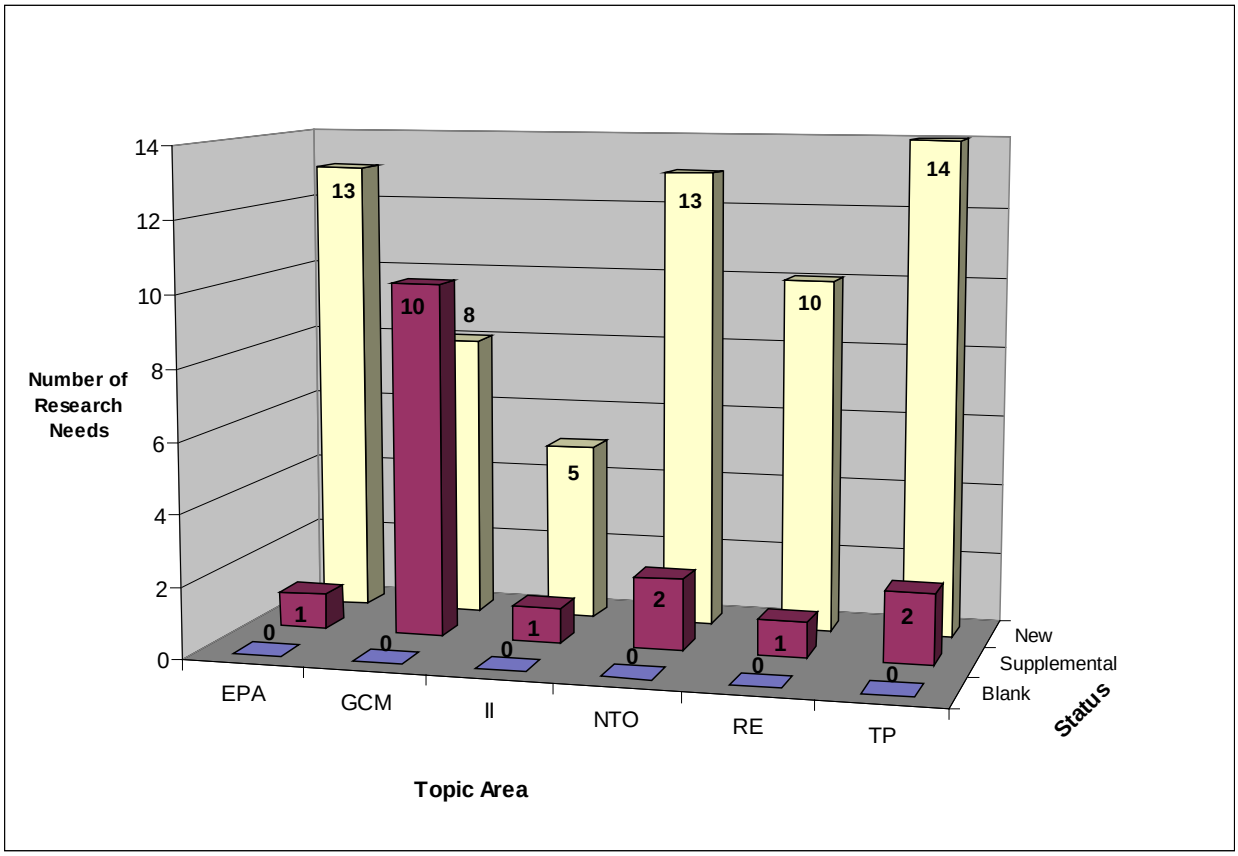

Figure 11. All Research Needs Distributed by Group and Research Status

3.2.3 Review of Urgency Distributions

As shown in Figure 12 most of the research needs developed are considered by the delegates as high urgency activities. As seen in the Figure, two-thirds of all research needs were designated as urgent. All of the research needs developed by the Institutional Issues working group were designated as urgent. The two research needs entitled GCM-18 Low Cost Pedestrian 4-Quad Gates and TP-7 Driver Reaction to Active Advance Warning Signs and Variable Message Signs did not designate the urgency. Time constraints may have limited the groups' ability to complete all data fields.

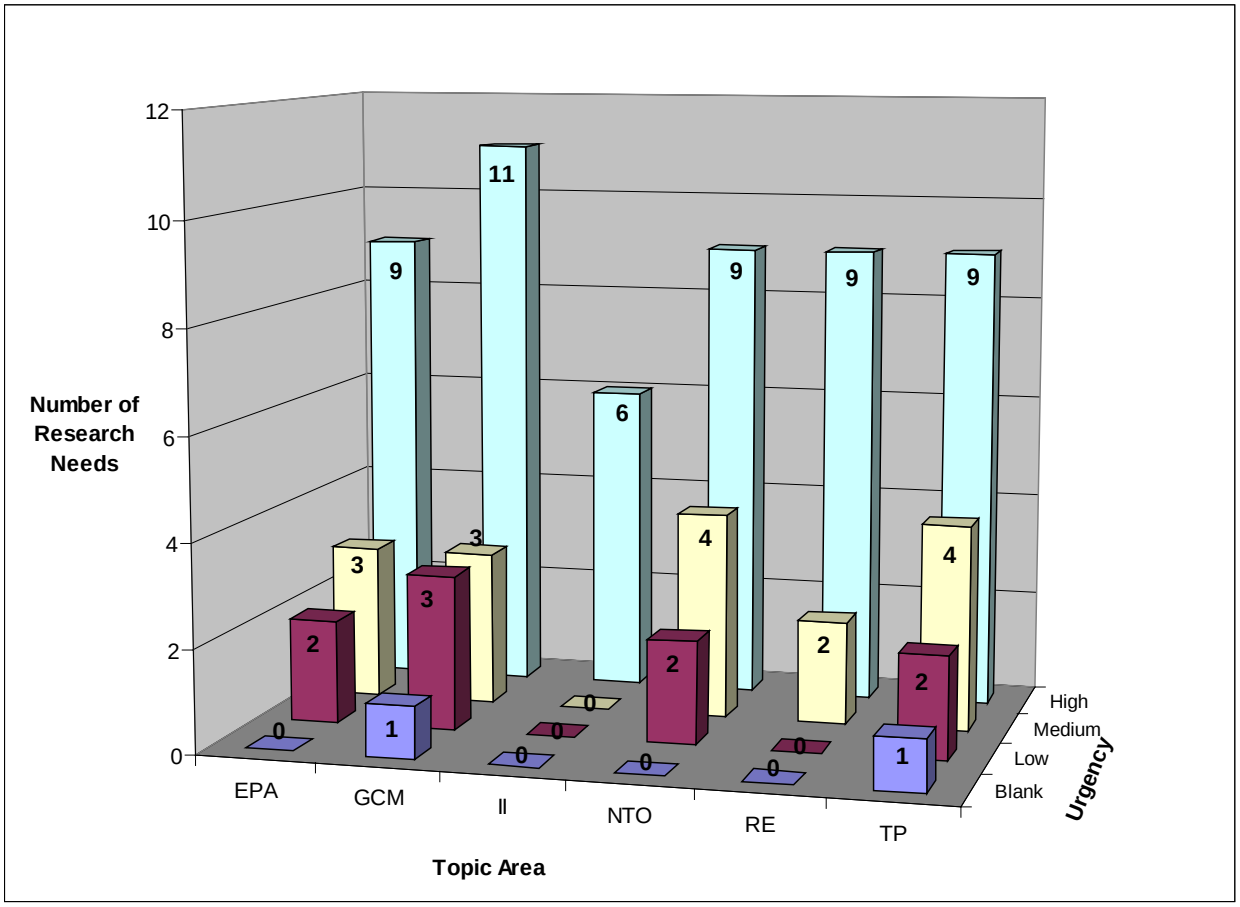

Figure 12. All Research Needs Distributed by Group and Urgency of Research Need

3.2.4 Review of Cost Distributions

Figure 13 displays the distribution of all research needs by topical area and cost. Overall more than half were designated as medium-cost. High cost research needs were mostly found in the Traffic Patterns topical area. Only one research need, TP-7 Driver Reaction to Active Advance Warning Signs and Variable Message Signs, did not designate the cost of research. Time constraints may have limited the group's ability to complete all data fields.

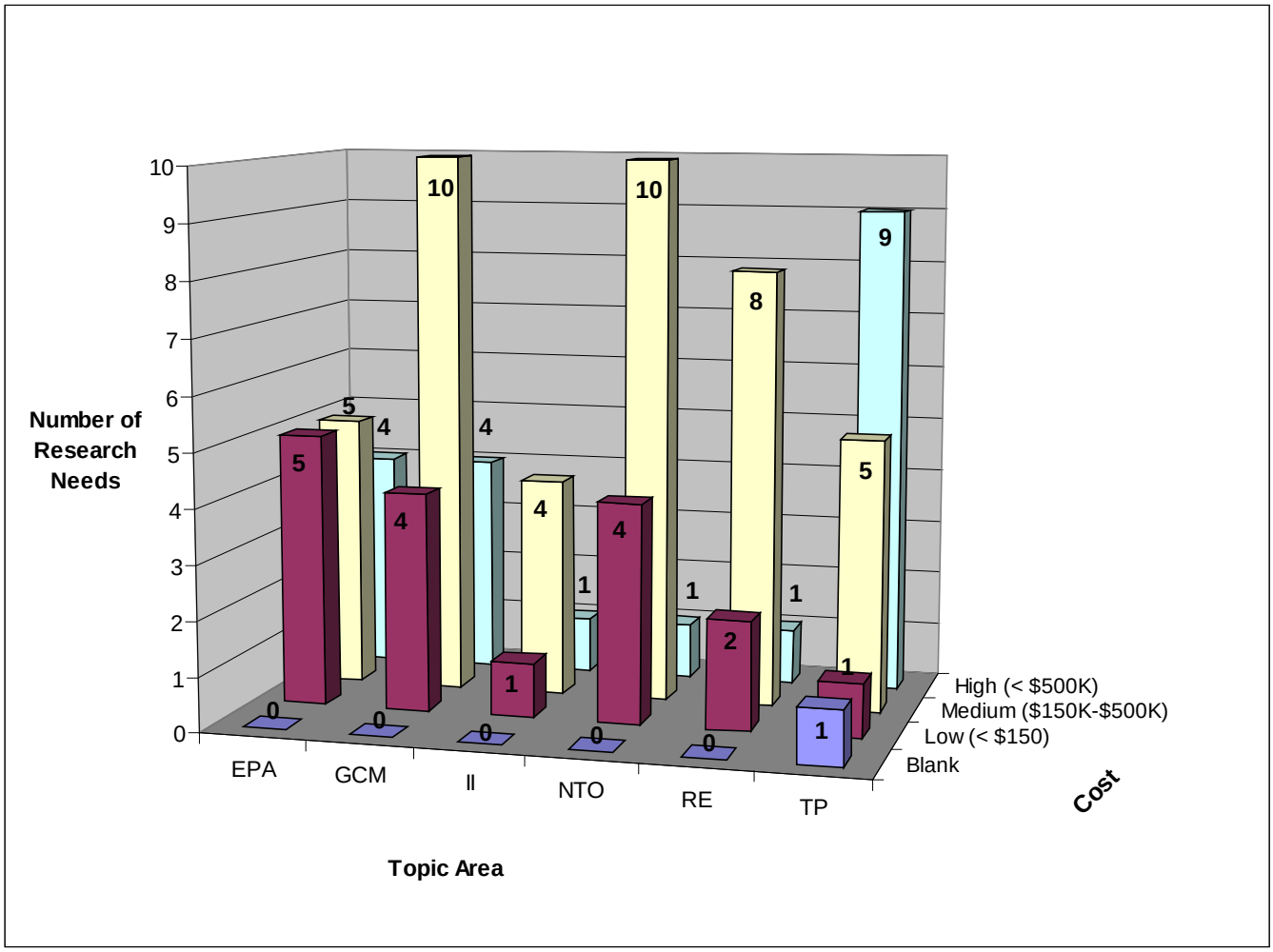

Figure 13. All Research Needs Distributed by Group and Cost

3.2.5 Review of Implementation Probability Distribution

Figure 14 shows the distribution of all research needs by topical area and implementation probability. As reflected in the Figure, almost half (45 percent) were designated as easy to implement. Categories encompassed by new technologies, GCM and NTO, appear to have the easiest perception of implementation. Approximately one-fifth of the needs were identified as difficult to implement. The following three Research Needs had no implementation probability designation provided on the standard form:

- TP-7 Driver Reaction to Active Advance Warning Signs and Variable Message Signs
- EPA-7 Effectiveness of Drivers Educations
- RE-9 Motorist Expectations: Train and Crossing Operations

As previously mentioned, TP-7 experience time constraints that may have limited the group's ability to complete all data fields. On EPA-7, the group noted on the research need form that they "needed information would be hard to collect". On RE-9, the group noted on the research need form that the "challenge of implementation may be closely tied to the availability of funds

to support specific programs". We therefore would consider implementation probability of these last two research needs to be difficult.

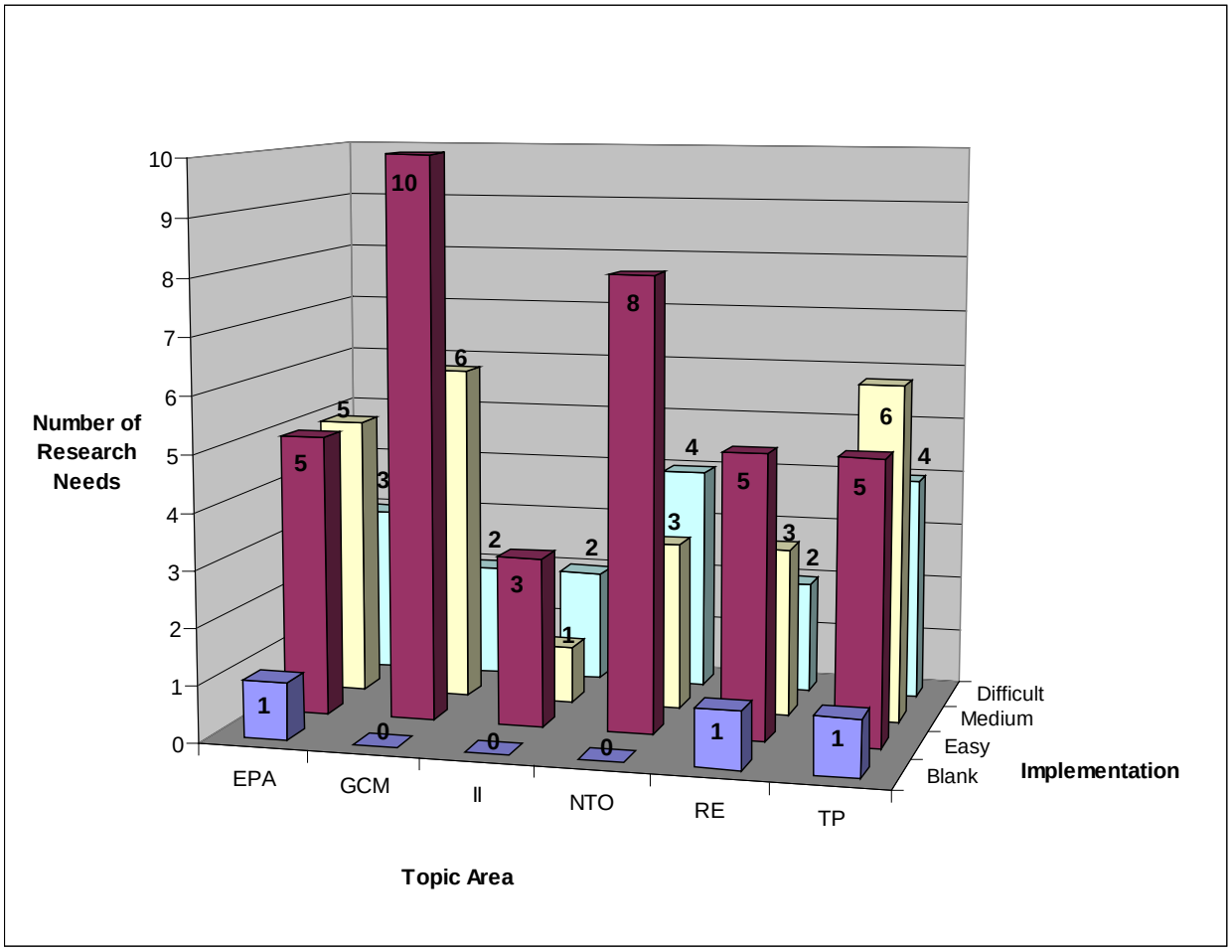

Figure 14. All 80 Research Needs Distributed by Group and Ease of Implementation

3.3 Discussion of Identified Potential Research Organization Types

The final data field requested on the research need statement form from the delegates related to potential organization to conduct the research.

Table 32 reflects the results organized by working group and potential research organization type(s). The analysis of this data field is only presented below for all of the 80 research needs developed. As shown by Table 32, approximately two-thirds of all of the research needs were designated to be a federal responsibility. Most groups designated roughly one-half of their needs to this organizational type.

Table 32. All Research Needs Categorized by Potential Research Organization

All Research Needs by Topic Area and Potential Researcher							
	None	Federal	Highway/Regional Agency	Railroad	Consultants	Academia/ Other Org.	Total
EPA	4	5	0	4	3	4	20
GCM	0	15	3	3	2	9	32
II	2	4	2	1	0	1	10
NTO	1	13	1	0	4	5	24
RE	0	11	0	0	0	6	17
TP	2	11	1	0	1	6	21
Total	9	59	7	8	10	31	124

Multiple research organization types were assigned by the delegates to many of the research needs they developed. Figure 15 below distributes each of the 80 research needs by multiple categorization of these areas. As shown in the Figure, nine needs have no research organization designation, 37 have one area designated, 24 have two areas designated, and ten have three designated. No Research Need had more than three organization types listed.

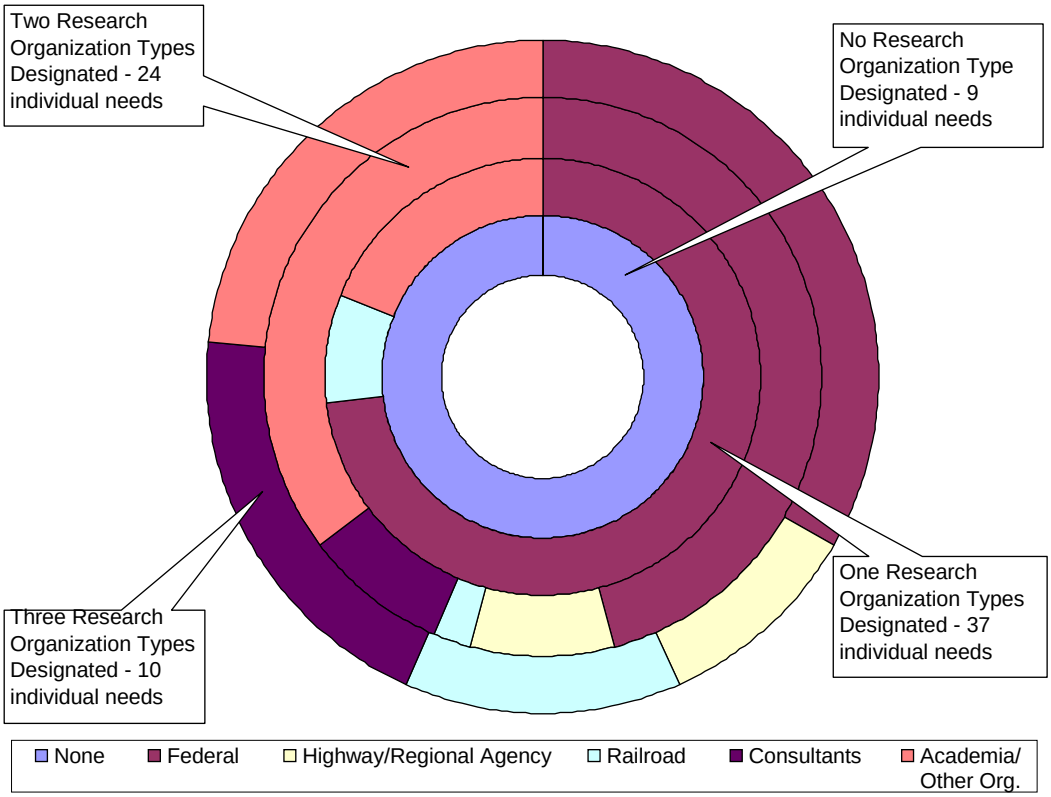

Figure 15. Concentric Graph of All Research Needs with Potential Research Organizations

Forty two percent of the research needs suggested partnership activities involving multiple organizations. As previously mentioned, time constraints may have limited the groups' ability to complete all data fields including potential research organizations.

3.4 Discussion, Analysis and Summary Trends of All Needs

This subsection reviews the ability to aggregate like-research needs statements into summary themes. Discussions during the final day of the workshop indicated the probability that some of the research needs could easily be merged. Some delegates even suggested merging certain research needs statements on their ballots. Furthermore, the Volpe Center analyzed all of the research needs and created research themes that capture common threads as summarized in Subsection 2.5 and expanded upon below for all 80 research needs.

3.4.1 Aggregate Research Themes of All Needs

All 80 research needs were reviewed and first categorized into the original five themes stated in Subsection 2.5. Each individual research need may have multiple connections to the five themes created. However, the Volpe Center staff objectively assigned each research need to its most relevant research theme. This was accomplished by review of each research need's specific language associated with the "Project Statement" data field. Upon review of all 80 needs, one additional theme entitled "Development of Infrastructure and Procedures" was created. Additionally new sub-themes were created for two existing themes.

The six themes are described with annotated research needs statements below:

- High Speed Rail Applications
  Determine adequate warning devices for High Speed Rail
  TP1 and GCM1 are ranked 1st and 2nd in the delegates' prioritization and are both supported by NTO-5, which was ranked 6th, and TP6, which was ranked 19th.
    - TP-1 Application of Warning Devices/Treatments at High Speed Rail Crossings
    - GCM-1 Warning Devices Minimum Requirements for 80-110 MPH Trains
    - NTO-5 Minimum Traffic Control Devices for High Speed Train HRGC
    - TP-6 Review and Improvement of Hazard Indices and Accident Prediction Formulae

  Three additional research needs statements were added to this theme; GCM-10, NTO-9, and NTO-13.

- Pedestrian-oriented research needs:
  Research to assess effectiveness of existing and potential new pedestrian signage and treatments
    - EPA-4 Evaluate Effectiveness and Potential Motorist & Pedestrian Signage and Treatments
    - GCM-4 Second Train Warning Devices for Pedestrian Crossings
    - NTO-2 Pedestrian, Non-Motorized and Limited Mobility Treatments
    - TP-3 Effectiveness of Gates for Pedestrians
    - GCM-2 Flangeway Gap Solutions
    - RE-2 Collecting and Analyzing Trespass Data (for the pedestrian component of trespass data)
    - TP-1 (caveat – High Speed Rail Applications was primary theme)

  Five additional research needs statements were added to this theme; EPA-8, EPA-13, GCM-6, GCM-7, and GCM-16.

- Signal and Sign effectiveness:
  Additional or enhanced signals and signs to provide more effective warning to the users
    - Signal:
        - TP-2 Highway Traffic Signal Pre-emption at Highway-Rail Grade Crossings
        - GCM-4 Second Train Warning Devices for Pedestrian Crossings
        - NTO-4 Effectiveness of LED Enhanced Grade Crossing Traffic Signs
        - EPA-5 Evaluate the Effectiveness of Mobile Warning Devices When Approaching Grade Crossings

      Five additional research needs statements were added to this theme; NTO-7, NTO-12, NTO-15, TP-11, and TP-7.
    - Sign:
        - RE-4 No-Train-Horn Crossings
        - TP-4 Signage at Roundabouts
        - EPA-4 (caveat – Pedestrian-oriented Research was primary theme)

      Four additional research needs statements were added to this theme; EPA-14, GCM-8, RE-11, and TP-10.

Upon review of all 80 needs, the following theme was divided into two sub-themes. Under the sub-theme of "Organization" an additional research need from the top 33 (II-6) was affiliated.

- Sociotechnical Systems Research:
  Identification of risk factors involving trains, motorists, and pedestrians
  - Data
    - TP-5 Driver Decision Making At Complex Crossings
    - RE-1 Data Needs for Proactive Enforcement
    - II-3 Synthesis to Evaluate How, When, and Where Human Perception Negatively Impacts Rail Safety

    Five additional research needs statements were added to this sub-theme; EPA-7,EPA-10, EPA-12, RE-6, and TP-9.
  - Organization
    - II-1 Establishment of a Railroad/Transit Data Clearinghouse
    - EPA-3 Crossing Consolidation Education
    - II-5 Improved Effectiveness of Stakeholder Interaction
    - RE-5 National Campaign for Targeted Seasonal Enforcement Programs
    - *II-6 Identify Opportunities to Make Legislation and Regulation Across Jurisdictions Compatible, Meaningful, and Up-to-Date*

    Five additional research needs statements were added to this sub-theme;EPA-9, GCM-13, TP-12, TP-16, and RE-8.

- Evaluation of Procedures and Technology
  Provide effective best practices for model law development to achieve consistent nationwide applications
  - Technology:
    - GCM-3 GPS/PTC Constant Warning Time
    - NTO1 Alternative Sensors and Warning Systems for Vital Applications
    - NTO6 Enhanced Commercial Systems to Improve HRGC Safety

    Four additional research needs statements were added to this sub-theme; GCM-9, GCM-11, GCM-12, and TP-8.
  - Procedures:
    - II-2 Cost/Benefit analysis of Grade Crossing Improvements
    - RE-3 Photo Enforcement at HRGXs
    - EPA-2 Evaluation of Existing Education and Outreach Strategies
    - EPA-1 Evaluation of Social Media Outreach
    - II-6 Identify Opportunities to Make Legislation and Regulations Across Jurisdictions Compatible, Meaningful and Up-to-Date
    - II-4 Institutionalize Evaluation as a Key component of Project/Program (countermeasure) Design and Implementation

    Four additional research needs statements were added to this sub-theme; EPA-6, EPA-11, RE-10, and RE-7.

Upon review of all 80 needs, the following new theme was created with two new subthemes. Furthermore, under the sub-theme of "Infrastructure" two additional research needs from the

top 33 (NTO-3 and GCM-5) were affiliated to this new theme. The "Procedures" subtheme only consists of supplemental research needs.

.

- Development of Infrastructure and Procedures
  Develop physical infrastructure, technology, and/or procedures to enhance safety
  - Infrastructure:
    - *NTO-3 On-Track Vehicle Detection*
    - *GCM-5 Personal Detection Device for Railroad Workers*

  Six additional research needs statements were added to this sub-theme; GCM-14, GCM-15, GCM-17, GCM-18, NTO-8, and NTO-14.
  - Procedures:

  Six additional research needs statements were added to this sub-theme; TP-13 and TP-15.

3.5 Summary of Top Research Ideas

The preceding chapters of this report have provided salient information to the FRA/Volpe Center to formulate a research plan moving forward into the next phase of research. With the aid of a very dedicated Steering Committee the workshop ensured positive participation and feedback by limiting attendance to nominated delegates. The Steering Committee developed a list of 277 invitees to the workshop. Of those, a total of 77 accepted the invitation and participated as delegates at the workshop, representing the Federal, State, and local governments, as well as railroads, transit agencies, labor unions, academia, non-profit organizations, and consultants, additionally there were international participants from Canada, the United Kingdom (Great Britain and Ireland), and Taiwan (Republic of China).

During the second day of the workshop, the 77 workshop delegates met in designated working groups and joined in an analytical process to define research needs for highway-rail crossing safety and trespass prevention issues. Each working group was then responsible for determining the characteristics of the identified research needs for each concentration area and setting their priorities. The working groups developed a total of 80 research problem statements. Each group was then tasked to identify the top five projects for their respective research needs area. This vetting process resulted in the identification of the top 33 research needs. An aggregate list of these needs was created and distributed to the attendees to provide their thoughts on a priority of all the projects generated at the workshop. A balloting process was then instituted to capture the delegates' thoughts on research need priorities.

A ballot containing the 33 top research needs identified by the working groups was developed and sent electronically to all 77 delegates for prioritization. The individual research needs statements were attached for reference. Each delegate was requested to rank the research needs on the ballot form from "1" for greatest priority down to "33" for least priority. A total of 51 delegates returned their ballots, which equates to return rate of over 66 percent. The delegates' prioritization information for each research need was then aggregated and averaged to provide a score for each of the top thirty-three research needs. Based on the high rate of return on the prioritization ballot and the multitude of organizations present at the workshop, the FRA/Volpe Center is confident that a majority of stakeholders have been represented and that the results are

relevant and can sustain the development of future research plans for the USDOT and all its stakeholders regarding highway rail grade crossing safety and trespass prevention initiatives.

To this end, all 80 research needs were reviewed and categorized into six themes. Each individual research need may have multiple associations to the six themes created. However, the Volpe Center staff objectively assigned each research need to its most relevant research theme. This was accomplished by review of each research need's specific language associated with the "Project Statement" data field. Upon review of all 80 needs, the top two research themes containing seventeen individual research statements were combined to create the top research ideas for a near-term research plan.

The two themes are described with annotated research needs statements below:

- High Speed Rail Applications
  Determine adequate warning devices for High Speed Rail
  TP1 and GCM1 are ranked 1st and 2nd in the delegates' prioritization and are both supported by NTO-5, which was ranked 6th, and TP6, which was ranked 19th.
    - TP-1 Application of Warning Devices/Treatments at High Speed Rail Corridors
    - GCM-1 Warning Devices Minimum Requirements for 80-110 MPH Trains
    - NTO-5 Minimum Traffic Control Devices for High Speed Train HRGC
    - TP-6 Review and Improvement of Hazard Indices and Accident Prediction Formulae

  Three additional research needs statements were added to this theme; GCM-10, NTO-9, and NTO-13.

- Pedestrian-oriented research needs:
  Research to assess effectiveness of existing and potential new pedestrian signage and treatments
    - EPA-4 Evaluate Effectiveness and Potential Motorist & Pedestrian Signage and Treatments
    - GCM-4 Second Train Warning Devices for Pedestrian Crossings
    - NTO-2 Pedestrian, Non-Motorized and Limited Mobility Treatments
    - TP-3 Effectiveness of Gates for Pedestrians
    - GCM-2 Flangeway Gap Solutions
    - RE-2 Collecting and Analyzing Trespass Data (for the pedestrian component of trespass data)
    - TP-1 (caveat – High Speed Rail Applications was primary theme)

  Five additional research needs statements were added to this theme; EPA-8, EPA-13, GCM-6, GCM-7, and GCM-16.

Identified research needs support the continued development of a meaningful grade crossing research agenda and will allow FRA and all US DOT modes and stakeholders to make informed research and development decisions that are consistent with industry needs. Identified needs will also support the selection of research projects that will have the greatest utility for the grade crossing community.

4 Summary of Findings

4.1 Historical Trends of Research Needs Projects

This section presents a review of historical research needs workshop trends dating back to the original workshop in 1995. The first subsection reiterates the relevant research needs from the 1995 and 2003 Research Needs Workshops. Comparing the resulting needs of the two workshops illustrates the evolution of the grade crossing field and major trends or themes within the field. The analysis reflects changes in research need priorities over 10 years. The following list illustrates the 2003 historical priorities:

- Median barriers
- Low-cost crossing device methods
- Pedestrian treatments
- Accident causation, accident effects, and driver risk perception
- ADA concerns
- Highway-rail grade crossing inventory data
- Updating Crossing Inventory and Include sight distance data collection
- Trespasser data
- Program assessment and educational programs and outreach assessment
- Grade crossing data requirements
- Obstacle/intrusion detection

A comparison of the historical date to the 2009 workshop results identifies specific areas of concern that still need to be addressed. From the results of the 2009 workshop, the following list of research themes has been identified:

- High speed rail applications
- Pedestrian-oriented research needs:
- Signal and sign effectiveness:
- Sociotechnical systems research:
- Evaluation of procedures and technology
- Development of infrastructure and procedures

After reviewing the historical results as compared to the 2009 findings, it can be surmised that the body of stakeholders have identified two major concerns that have remained a priority over the last fifteen years. Those two areas, “Pedestrian-Oriented” and “Sociotechnical Systems” research, remain a priority for the development of the next research agenda.

4.2 R&D Trends and New Directions

In the past 20 years, significant progress has been made in improving the safety of public highway-rail grade crossings. Even though both motor vehicle and train traffic have increased, collisions at grade crossings have declined by approximately 63 percent, fatalities by approximately 64 percent, and injuries by approximately 67 percent. Trespass-related incidents have decreased by almost 9 percent, fatalities increased by approximately 4 percent, and injuries

decreased by approximately 19 percent. As these trends are mostly positive, the challenge is to continue to improve the safety of grade crossings as they represent a significant portion of the overall risk from highway and railroad operations. US DOT FRA also recognizes that these trends are due, in part, to the collaboration of numerous agencies and organizations with the common goal to reduce grade crossing incidents, fatalities and injuries. The goal is to continue this downward trend, especially when funds can be limited. Additionally, the FRA has increased its efforts to reduce the number of trespass incidents, because the number of trespass fatalities now surpasses the number of fatalities at highway-rail grade crossings.

To facilitate this effort, FRA sponsored the workshop as a forum to exchange ideas, concepts and strategic planning, thereby fostering communication and collaboration on research, development and implementation among its stakeholders and other modes within the U.S. Department of Transportation. This 2½ day event was coordinated and hosted by the US DOT RITA the Volpe Center in Cambridge, Massachusetts from Tuesday, July 14, 2009, to midday on Thursday, July 16, 2009.
The Volpe Center provides technical support to FRA on all aspects of grade crossing safety and trespass research.

During the course of the workshop, group leaders worked with their respective topic group members to carefully focus their collective attention on pressing research needs. The purpose of such research statements is to bring critical existing and emerging grade crossing and trespass issues of interest before policymakers, administrators, practitioners, researchers, and representatives of government, industry, and academic institutions. Another goal of these work groups was to serve as a seedbed for further discussion and analysis from a wider cross section of practitioners.

The consensus among workshop delegates was that the workshop was a worthwhile step in developing an intermodal approach to improving highway-rail grade crossing safety and trespass prevention and that the process should continue.

Transportation agencies at all levels of government are concerned about the safety and security of the Nation's rail network. Identified research needs support the continued development of a meaningful grade crossing and trespass research agenda and will allow FRA, USDOT, and other stakeholders to make informed R&D decisions that will anticipate, and are consistent with, industry needs. Identified needs will also support the selection of research projects that will have the greatest utility for the safety of highway rail grade crossing and prevention of rail trespass events.

The 2009 workshop delegates developed 80 research needs statements. These research needs statements were reviewed for applicability to the following cross-cutting areas: Human factors, transit-oriented communities, data requirements, and high speed rail. As can be expected from a review of current literature, the area of human factors applies to approximately 60 percent of all the research needs developed. Half of the research needs were also associated with the Data Requirements cross-cutting area.

Analysis was conducted that contains a review of the ability to aggregate similar research needs statements into summary themes. Discussions during the final day of the workshop indicated the

probability that some of the research needs could easily be merged. Therefore, the Volpe Center analyzed all of the research needs and created six research themes that capture common threads as summarized below. All research needs were reviewed and categorized into the six themes below. Each individual research need may have multiple connections to the six themes created. However, the Volpe Center staff objectively assigned each research need to its most relevant research theme. The following ordered list is based on average ranking of all of the research needs statements within each research theme. Data fields were reviewed for the top 33 research needs to determine possible trend information. Most research needs within the six themes exhibited mostly high urgency designations. Most research needs within the six themes were designated as new research under the field of "research status." Further observations are listed under each theme as follows.

- High speed rail applications
  Determine adequate warning devices for High Speed Rail
    - Cost of research–medium to high
    - Ease of Implementation–easy to medium
- Pedestrian-oriented research needs:
  Research to assess effectiveness of existing and potential new pedestrian signage and treatments
    - Cross-cutting areas–mostly human factors
    - Potential organization(s) to conduct research – Federal
- Signal and sign effectiveness:
  Additional or enhanced signals and signs to provide more effective warning to the users
    - Cost of research–mostly medium
    - Ease of implementation– mostly easy
- Sociotechnical systems research:
  Identification of risk factors involving trains, motorists, and pedestrians
    - Potential organization(s) to conduct research–Federal
    - Most data fields exhibited a wide range of responses
- Evaluation of procedures and technology
  Provide effective best practices for model law development to achieve consistent nationwide applications
    - Cross-cutting areas–mostly data requirements
    - Cost of research–mostly medium
    - Potential organization(s) to conduct research–mostly Federal
- Development of infrastructure and procedures
  Develop physical infrastructure, technology, and/or procedures to enhance safety
    - No top research need was included, therefore no analysis was conducted

As evidenced by the priority needs established in this workshop, delegates continue to place high priority on the safety of highway-rail grade crossings, trespass prevention, and the railroad system in general. Many participants identified research needs that share the goal of reducing incidents and casualties.

<u>Near-Term Research Agenda (3–5 years)</u>

The highest priority research theme reflects the Obama Administration's current focus on the implementation of high speed rail nationwide. Main research activities under this theme include developing an updated risk model to effectively apply warning device treatments for high speed rail, and the development of federal guidance that supports the new method. The second-highest priority research theme identified pedestrian oriented issues. The main research activities under this theme include determining the effectiveness of current treatments, developing new treatments, and determining causality of trespass events. The activities would encompass physical conditions that exist at grade crossings, stations, and the rail network. Attention to non-motorized forms of transportation is included in this research theme. These top two research themes can be considered as part of the near-term research agenda for FRA, US DOT, and all their stakeholders.

Midterm Research Agenda (5–10 years)

The ordered ranking of research themes included midterm implementation strategies of the research agenda. The main activities within the *Signal and Sign Effectiveness* theme included a determination of effectiveness of the current signals and signs, developing strategies for integration with enhanced communication platforms, and identifying education and enforcement opportunities to enhance safety. The next priority theme, *Sociotechnical Systems Research*, addresses system wide organizational activities and the need for enhanced information regarding incidents and human behavior. This theme includes activities addressing effectiveness of current regulations, effectiveness of enforcement of violations with the current judicial system, enhanced data sharing platforms and opportunities, and general research in driver and pedestrian behavior. Based on the categories of organizational effectiveness and enhanced information strategies, a 5-10 year research time frame is necessary to initiate and implement these research themes. Therefore, a midterm research agenda would be most appropriate.

Long-Term Research Agenda (10+ years)

In planning of a research agenda, it is often quite necessary to anticipate future requirements. The last two themes of research objectives, *Evaluation of Procedures and Technology* and *Development of Infrastructure and Procedures*, anticipate data-driven results from the from the previously identified near- and midterm research activities. These research themes include development of effective best practices for model laws to achieve consistent nationwide applications and development of physical infrastructure, technology, and/or procedures to enhance safety. Based on the need for data-driven results, a long research time frame is necessary to develop nationwide strategies. Therefore, a long-term research agenda would be most appropriate.

Past research efforts have brought about a better understanding of the design and operation of grade crossings and the relationship between highway rail and other transportation components. Work in the areas of high speed rail and pedestrian-oriented applications will be highly visible research issues over the next several years. The pedestrian-oriented theme, to include trespass research, is a relatively new initiative that can positively impact safety on the nationwide rail network. Workshop results, along with FRA strategic and action plans, will guide the identification of specific research projects. The FRA and the Volpe Center anticipate that this document will be used by other US DOT modal administrations and their stakeholders to enhance safety and improve the effectiveness and capacity of our rail transportation network.