



Pedestrian Safety Strategic Plan: Recommendations for Research and Product Development

Submitted to:

United States Department of Transportation (U.S. DOT)
Federal Highway Administration (FHWA)

Submitted by:

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FOREWORD

The Federal Highway Administration (FHWA) Pedestrian and Bicycle Safety Program and Safety Research Program's overall goal is to increase pedestrian and bicycle safety and mobility by developing pedestrian safety-related products, research documents, and technologies for a wide range of users to aid in improving conditions for pedestrians, reducing pedestrian fatalities and injuries, and providing national leadership on the issue of pedestrian safety. From better and safer crosswalks, sidewalks, and pedestrian technologies to growing educational and safety programs, the program strives to make it safer and easier for pedestrians, bicyclists, and drivers to share roadways in the future.

The Pedestrian Safety Strategic Plan: Recommendations for Research and Product Development (hereafter referred to as the Strategic Plan) is a 15-year plan for pedestrian safety research and technology transfer. It was developed to address pedestrian safety concerns and equip professionals and other stakeholders with knowledge, resources, and information needed to identify problems and implement solutions related to the roadway environment. The Strategic Plan also recommends updates to 17 current FHWA technology transfer tools and more than 20 technology transfer resources and the development of innovative dissemination methods.

Recommendations for research and product development are intended to be addressed through a collaborative approach between various agencies and offices. A cooperative effort is suggested to address the variety of crash problems discussed in the Strategic Plan.

This report will be useful to engineers, planners, researchers, and practitioners who are responsible for implementing pedestrian treatments, as well as city, State, and local agency officials who have a responsibility for public safety.

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16. Abstract Pedestrian fatalities continue to be a major highway safety problem in the U.S., with pedestrians accounting for approximately 12 percent of all traffic-related deaths. This Pedestrian Safety Strategic Plan: Recommendations for Research and Product Development is based on a comprehensive analysis of pedestrian crash data trends and factors, a detailed review of more than 200 reports and publications on pedestrian safety, and input from more than 25 expert stakeholder members. The Federal Highway Administration (FHWA) led the development of the Strategic Plan to address these safety concerns and equip professionals with knowledge, resources, and information needed to identify problems and implement solutions related to the roadway environment. The Strategic Plan identified 28 new research topics to address four primary categories of research needs: problem identification and data collection, analysis and decision making, innovative research and evaluation, and technology transfer. Detailed research problem statements were developed for each of the 28 proposed research topics, including the research goals, background, and schedule. The Strategic Plan also recommends updates to existing FHWA technology transfer tools and resources based on an evaluation by potential end-users. Dissemination activities identified by the Strategic Plan include event marketing, successful practices guides, in-person and web-based training, and software development. Recommended innovative strategies for distributing information include convening interactive webinars, developing a video-share website, and utilizing 3D visualization tools. Recommendations are made for Strategic Plan implementation, while keeping in mind the importance of interagency collaboration. Potential barriers to successful plan implementation are identified along with possible solutions. A recommended timeline for activities is also included, which covers a 15-year period. Strategies for plan review, evaluation, and updates are also included which ensures that the Strategic Plan will be a flexible, living document. Recommendations for research and product development are intended to be addressed through a collaborative approach between various agencies and offices. A cooperative effort is suggested to address the variety of crash problems discussed in the Strategic Plan.					
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Executive Summary

Pedestrian safety is a primary concern in communities across the United States, with pedestrians accounting for nearly 12 percent of traffic fatalities nationally. To address these safety concerns and equip professionals with the knowledge, tools, and resources needed for identifying and implementing solutions, the Federal Highway Administration (FHWA) Office of Safety and Office of Safety Research and Development (R&D) led the development of the Pedestrian Safety Strategic Plan: Recommendations for Research and Product Development (termed the Strategic Plan throughout this report).



The development of the Strategic Plan began with an analysis of pedestrian crash data and demographic trends to identify the existing pedestrian safety issues and interpolate how these issues may evolve in light of recent demographic trends. A literature review of recently published pedestrian safety research and resources was conducted to identify the gaps in knowledge in the field. Finally, an evaluation of existing FHWA pedestrian safety products and product dissemination strategies was conducted to further identify the knowledge gaps in pedestrian safety, the safety information needs of transportation agencies and professionals, and the preferred approaches to delivering information on pedestrian safety. This information constitutes the [Pedestrian Safety Background Report](#) (henceforth referenced as the Background Report). The findings in the Background Report were presented and discussed with a panel of pedestrian safety experts (stakeholders) to develop research topics targeting the knowledge gaps and develop guidance for product updates and new marketing strategies.



The ultimate goals of this Strategic Plan match those of the Office of Safety and the Office of Safety R & D: to increase pedestrian and bicycle safety and mobility by developing pedestrian safety-related products, research documents, and technologies for a wide range of users to aid in improving conditions for pedestrians, reducing pedestrian fatalities and injuries, and providing

national leadership on the issue of pedestrian safety. The Strategic Plan provides recommendations for research, product development, and delivery activities for the next 15 years.

The Strategic Plan identifies 28 new research topics in four primary categories including:

- **Category A, Problem Identification and Data Collection**

- A1. Evaluate and Refine Existing Models for Predicting Pedestrian Use
- A2. Effects of Hand-Held Communication Device Use and Related Driver and Pedestrian Distraction on Pedestrian Safety
- A3. Methods to Improve Physical Conditions for Pedestrians along Existing Roads
- A4. Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities
- A5. Race, Ethnicity, and Immigrant Status for Pedestrian Morbidity and Mortality
- A6. Understanding Diverse Vision Needs of Pedestrians
- A7. Automated Pedestrian/Vehicle Conflict Video Data Collection
- A8. Evaluation of Automated Pedestrian Detection Technologies



- **Category B, Analysis and Decision Making**

- B1. Identification and Prioritization of High Pedestrian Crash Locations/Areas
- B2. Using Automated Counters to Identify Pedestrian Volume Patterns and Extrapolation Factors
- B3. Identification of Institutional Barriers to Pedestrian Funding and Recommended Practices for Using Pedestrian Facility/Safety Funds
- B4. Relationships between Land Use, Built Environment, and Pedestrian Safety

- **Category C, Innovative Research and Evaluation**

- C1. COST-EFFECTIVE RETROFITS FOR HIGH-SPEED MULTILANE ARTERIAL ROADS FOR PEDESTRIANS
- C2. Effects of Traffic Signals on Pedestrian Behavior and Safety
- C3. The Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors
- C4. Develop Guidelines for Pedestrian Midblock Crossings
- C5. Pedestrian Crash Modification Factors
- C6. Accessible Pedestrian Signals
- C7. Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas
- C8. Effectiveness of White Lighting in Reducing Pedestrian Crashes at Crosswalks
- C9. Effects of New Pedestrian Facilities on Pedestrian Exposure
- C10. Increasing the Safety of Interactions between Pedestrians and Large Commercial Vehicles (Trucks and Buses) in Urban Areas
- C11. Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks

- o C12. Evaluation of the Applicability of Lower-Speed Street Designs in Residential and Commercial Zones
- **Category D, Technology Transfer**
 - o D1. Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network
 - o D2. Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference
 - o D3. Successful Practices for Pedestrian Facility Maintenance
 - o D4. Survey of Procedures for Implementing and Evaluating Experimental Treatments

These 28 recommended research topics focus on activities which target pedestrian crash problems with the highest frequency and address various pedestrian crash factors using a strategic, comprehensive approach. Research is geared toward providing quantitative assessments of pedestrian safety strategies to assist engineers and planners in selecting effective measures that will enhance pedestrian safety.

The Strategic Plan identifies product and program delivery activities that focus on summarizing and simplifying information, increasing understanding of issues and products, and updating products to ensure that they provide the most current information. Existing FHWA technology transfer tools and resources were evaluated by potential end-users. Based on the results of the evaluations, the following tools and resources should be updated, supplemented with a companion successful practices guide, or summarized through other media (e.g., slide presentations, brochures, etc.):

- How to Develop a Pedestrian Safety Action Plan (PSAP)
- Pedestrian and Bicycle Crash Analysis Tool (PBCAT)
- FHWA University Course on Bicycle and Pedestrian Transportation
- Pedestrian Forum Newsletter
- Pedestrian Road Safety Audit Guidelines and Prompt Lists
- Pedestrian Safety Guide for Transit Agencies
- Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE)
- Walkability Checklist
- Pedestrian and Bicyclist Safety Materials for Hispanic Audiences
- Pedestrian and Bicycle Intersection Safety Indices Report and Guide
- Pedestrian Safety Campaign
- A Resident's Guide for Creating Safe and Walkable Communities
- Bicycle Countermeasure Selection System (BIKESAFE)
- Bicycle Safer Journey

The Strategic Plan also identifies dissemination needs. Dissemination activities identified by the Strategic Plan include event/conference marketing, direct mailing/emailing, successful practices

guides, in-person training courses, web training, and software. In many cases, FHWA has already utilized some form of these strategies. Innovative strategies to gather, deliver, and communicate information have been presented in the Strategic Plan. Examples include convening interactive webinars and conferences, developing a video-sharing informational website, and utilizing 3D visualization tools.

Finally, recommendations are made for Strategic Plan implementation, while keeping in mind the importance of interagency collaboration. Other agency divisions, including the FHWA Resource Center and FHWA partners, may play an important role in the implementation of the Strategic Plan. A recommended timeline for activities is included and covers a 15-year period. Strategies for review, evaluation, and updates are also included to ensure the Strategic Plan will be a living document.



Chapter 1 – Background and Introduction

1.1 Understanding of the Problem

Pedestrians represent a considerable portion of traffic-related (e.g., cars, trucks, and transit) injuries and deaths on our nation's highways. In 2008, 4,378 pedestrians were killed and 69,000 pedestrians were injured in traffic crashes in the United States. This represents a 12 percent and 3 percent, respectively, of all traffic fatalities and injuries. These statistics mean, on average, a pedestrian was killed in a traffic crash every 120 minutes and injured every 8 minutes.¹

Significant population and other trends have been observed in growth, development, and transportation patterns in the United States and are expected to continue. Most apparent among these changes is the growth of the population as a whole and, more specifically, the growth of immigrant and older adult populations. For example, in 2000, there were approximately 35 million people age 65 and over in the United States. By 2025, the number of people age 65 and older in the U.S. is projected to top 63 million.² Older adults made up 13 percent of the population in 2008, but accounted for 18 percent of pedestrian fatalities.³ In addition, the increasing urbanization of the country, recent decrease in vehicle miles traveled, economic crisis, climate change, gas price fluctuations, and changes in transportation and housing policy may result in shifts in travel behavior that should be considered in the implementation of a long-term Strategic Plan.



A more detailed analysis of pedestrian crash trends and population projections is included in the [Pedestrian Safety Background Report](#). This data was critical for understanding existing pedestrian safety issues and developing a Plan that focused on reducing pedestrian fatalities and injuries.

¹ National Highway Traffic Safety Administration. *Traffic Safety Fact Sheet, 2008 Data, Pedestrians*. DOT-HS 811 163, <http://www-nrd.nhtsa.dot.gov/Pubs/811163.pdf>.

² Shrestha, L.B. (2006). *The Changing Demographic Profile of the United States* (RL32701). Washington, DC: Congressional Research Service. Retrieved from <http://fas.org/sgp/crs/misc/RL32701.pdf>

³ National Highway Traffic Safety Administration. (2009a). *Traffic Safety Facts, 2008 Data: Older Population*. Washington, DC: Author. Retrieved from <http://www-nrd.nhtsa.dot.gov/Pubs/811161.pdf>

1.2 Mission and Vision of FHWA and the Office of Safety

The mission of the Federal Highway Administration (FHWA) is to “improve mobility on our nation’s highways through national leadership, innovation, and program delivery.” Safety is a top priority of FHWA and the United States Department of Transportation (DOT). To achieve FHWA’s core mission of improving mobility on our nation’s highways, improving highway system performance is critical – particularly its safety, reliability, effectiveness, and sustainability. The Office of Safety has identified five priorities for fiscal year (FY) 2010 to guide the FHWA safety program and improve highway system performance:

- Setting the Strategic Direction for Safety
- Moving from Safety Planning to Safety Implementation
- Maximizing the Use of Existing Safety Resources
- Advancing Rural Safety
- Applying Innovation to Address Safety Challenges

Pedestrian safety is one of the key areas to be addressed as part of “Applying Innovation to Address Safety Challenges.”



The Office of Safety focuses on reducing crashes where most fatalities occur. One of these types is pedestrian crashes.⁴

In addition to safety, both the DOT and FHWA have made livability a top priority. Livability focuses on linking transportation facilities – specifically the quality and location of transportation facilities – to other fundamental efforts, including affordable housing, job

⁴ Federal Highway Administration. Office of Safety. <http://safety.fhwa.dot.gov/>. Accessed May 18, 2010.

access, and school quality. Pedestrian safety is a crucial element of this policy and will factor prominently in this collaborative effort to improve livability across the United States. FHWA, in accordance with this initiative, will enhance current and develop new economical and reliable transportation choices to lower transportation costs for families, reduce air pollution, and create healthy transportation alternatives.

1.3 Office of Safety and Office of Safety R&D Goals

Reducing pedestrian injuries and fatalities, while improving pedestrian access to our roadways, continues to be a major focus of U.S. safety agencies. The FHWA Office of Safety and the Office of Safety Research and Development are charged with developing pedestrian safety-related products, research documents, and technologies for a wide range of users to aid in improving conditions for pedestrians, reducing pedestrian fatalities and injuries, and providing national leadership on the issue of pedestrian safety. More specifically, the FHWA Office of Safety had established a goal of reducing pedestrian fatalities and injuries by 10 percent by the year 2011, from a baseline number of 4,774 in 2003 to a target of 4,297 in 2011. As of 2009, that goal has been exceeded, but we wish to continue making progress. The Pedestrian Safety Strategic Plan is intended to guide the agency's development and dissemination of relevant products that will help FHWA reach its goals. These tools are intended to reduce pedestrian fatalities and injuries and increase pedestrian accessibility. Other agency divisions and the Resources Center of FHWA will also be involved in the Strategic Plan process, especially with regard to technology transfer.



1.4 Purpose of the Strategic Plan

The Strategic Plan identifies gaps in existing research, resources, and deployment activities and suggests priorities for short-, intermediate-, and long-term activities that FHWA can undertake to improve pedestrian safety. The Strategic Plan offers a 15-year framework for FHWA activities, including conducting original safety research, developing safety programs and products, ensuring technology deployment, and updating, enhancing, or supplementing existing products or programs. Though some bicycle-related topics are addressed, the primary focus of the Strategic Plan is to recommend projects related to pedestrian safety. The Strategic Plan is evidence-based, informed, and supported by original research and analysis of pedestrian crash/injury and other data, literature reviews, an evaluation of existing products and distribution methods, and input from a diverse group of informed stakeholders, including representatives of State and local agencies. The Strategic Plan fits within the framework of FHWA's mission, strategic objectives, and scope.

Key components of development of this Strategic Plan include:

- Developing a fact base by reviewing existing pedestrian safety literature and analyzing selected pedestrian crash databases and demographic data to identify high-risk populations and crash types, and issues where more in-depth research is needed.
- Reviewing and synthesizing available pedestrian research problem statements, agendas, and safety plans developed by states, agencies, and research professionals.
- Obtaining input from identified stakeholders on research needs and dissemination methods.
- Conducting an evaluation of existing FHWA products to determine how they have been used, whether they have helped improve safety, and what could be improved or marketed better in the future.



The ultimate goal of this effort is to reduce pedestrian fatalities and injuries while improving pedestrian mobility. Within this broad goal are two specific objectives:

1. Develop a comprehensive Strategic Plan that identifies short-, intermediate-, and long-term pedestrian safety and mobility improvements.
2. Evaluate existing pedestrian safety products and deployments developed by FHWA.



The Strategic Plan is intended to be evaluated, tracked, and updated on a regular basis. It provides recommendations for research likely to have the greatest impact on addressing crash trends and improving pedestrian safety. These recommendations are based on an evaluation of existing products and technology deployment methods. The Strategic Plan recommends effective methods to market and disseminate research results, new technologies, and related guides and tools.

1.5 Cooperation and Collaboration

The research and product development recommendations listed in the Strategic Plan present a comprehensive strategy to address growing pedestrian safety concerns and fill gaps in current knowledge and research. Given the scope of the recommendations and the costs associated with implementing each Strategic Plan component, collaboration between agencies, offices, and partners will be needed in order to support and fund the recommended projects. Each of the recommended projects can be supported by an organization or office is committed to reducing pedestrian fatalities and serious injuries.

Many of the projects recommended in this Strategic Plan will fall under the umbrella of the FHWA Office of Safety and Office of Safety R & D, while others might be picked up by other offices and agencies. The Strategic Plan is designed to be coordinated with other stakeholder agencies within the Department of Transportation, as well as private organizations. Other agencies which have an interest in supporting pedestrian research activities might also participate in coordinating future research, products, and programs. Collaboration between these offices and agencies will be vital for successful implementation of the recommendations of the Strategic Plan.

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Chapter 2 – Strategic Plan Development Inputs

2.1 Overview and Framework for Strategic Plan Development

A systematic approach was undertaken to develop the Strategic Plan (see Figure 1). The approach began with an analysis of pedestrian crash data and demographic trends to identify the existing pedestrian safety issues and predict how these issues may evolve in light of recent demographic trends. A literature review of recently published pedestrian safety research and resources and an evaluation of existing FHWA pedestrian safety products and dissemination strategies were conducted to identify the gaps in knowledge and resources available to address pedestrian safety. This information constitutes the Background Report.

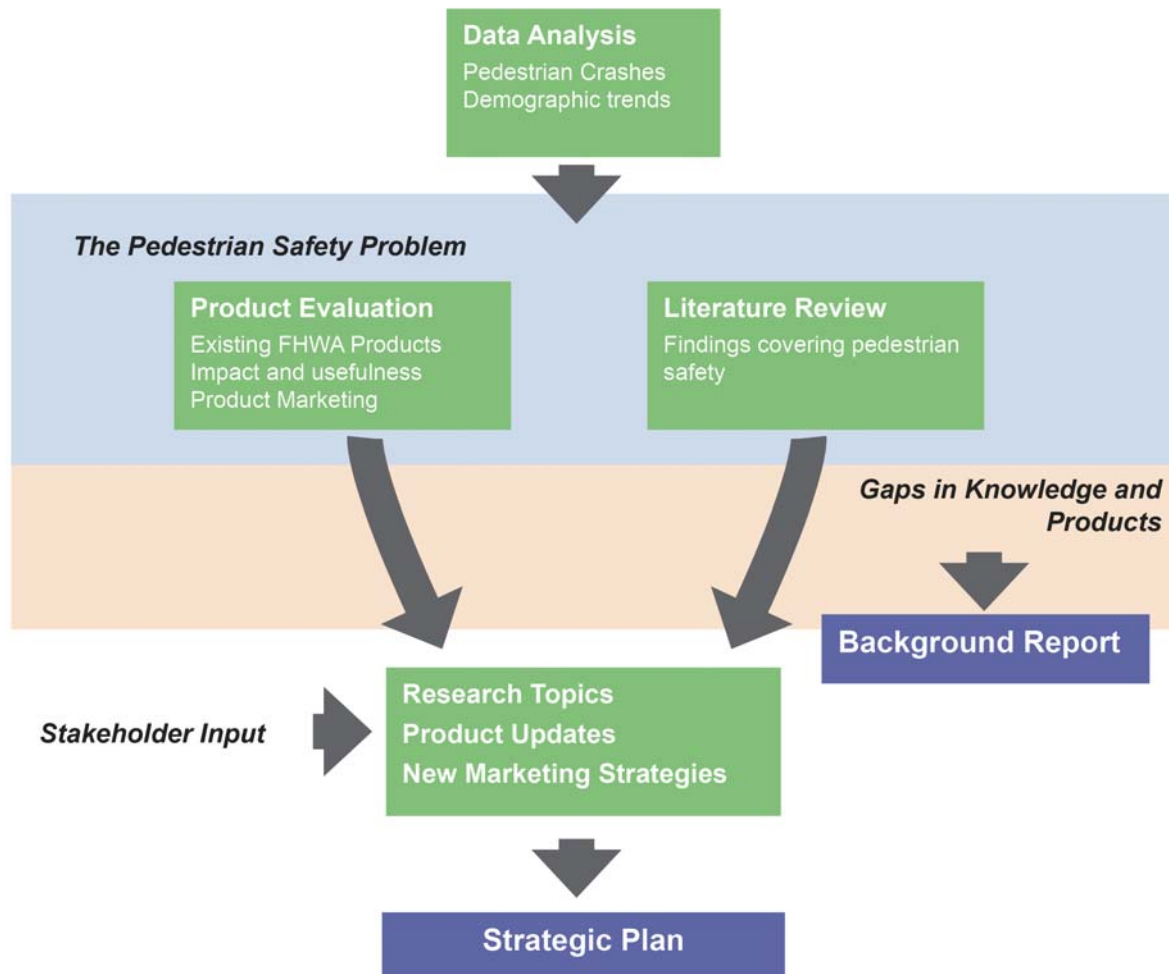


Figure 1. Model for Strategic Plan Development.

Information in the [Background Report](#) was presented and discussed with a panel of expert stakeholders to develop research topics targeting the knowledge gaps, and to develop guidance for product updates and new marketing strategies. These approaches to address pedestrian safety are the key components of the Pedestrian Safety Strategic Plan.

2.2 Data Analysis

The data analysis sought to understand pedestrian crash, injury, and fatality trends, and utilized several information sources, including NHTSA data, published reports that examined Fatality Analysis Reporting System (FARS) and the National Household Travel Survey (NHTS) data, Census data, and others. The analysis synthesized pedestrian safety and demographic trends such as: pedestrian crash and fatality trends; crash types and crash locations; and future demographic, social, and policy changes.

Three key roadway and environmental factors contribute significantly to pedestrian safety issues. These factors are nighttime pedestrian crashes, non-intersection pedestrian crashes, and pedestrian crashes in urban areas. Based on 2008 data from FARS, there were 4,379 crashes involving pedestrians. Of these 4,379 crashes, 69 percent (3,031) occurred at night, 75 percent (3,293) occurred at a non-intersection location, and 72 percent (3,172) occurred in an urban area as shown in Figure 2. Approximately 55 percent of crashes occurred at night at a non-intersection, 49 percent occurred at night in an urban area, 51 percent occurred in an urban area at a non-intersection, and 37 percent occurred at night in an urban area at a non-intersection. This Plan focuses on these issues and other described in more detail in the [Background Report](#) to ensure the Plan's relevance toward FHWA's mission.

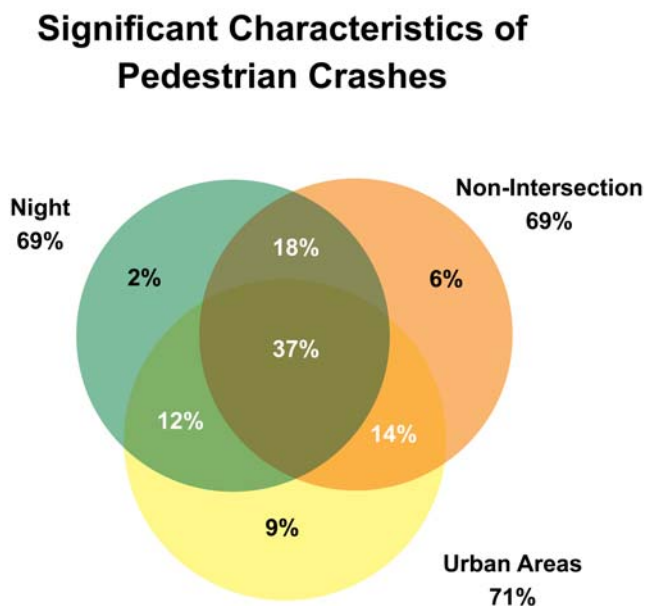


Figure 2. Significant Characteristics of Pedestrian Crashes

Further analysis revealed the following four key areas of need for pedestrian safety research and technology transfer, as well as opportunities with the highest potential to reduce pedestrian crashes:

- **Understanding older pedestrian crash issues and solutions:** As individuals over the age of 65 are overrepresented in pedestrian fatalities (18 percent of all pedestrian fatalities in 2008) and are expected to be a quickly growing demographic group in the coming years (projected to top 63 million by 2025), funding research on understanding the needs of older pedestrians and developing planning and design best practices for accommodating older pedestrians will be critical.
- **Understanding the causes of immigrant pedestrian crashes and potential solutions:** Immigration accounted for 42 percent of population growth between 2000 and 2005. Many immigrant groups and ethnic sub-populations, such as Hispanics, are overrepresented in pedestrian fatalities and injuries. This population often resides in lower-income areas with poor pedestrian facilities, but no other means of travel. Thus, there is a growing need for technology transfer products that can effectively communicate safety messages to these populations.
- **Understanding urban crash issues and best practices in planning and design, and focusing technology transfer in the rapidly-growing South and Southwest:** America's rapid urbanization will likely lead to more pedestrian crashes occurring in urban areas in the next 15 years. In 2008, 72 percent of fatalities occurred in urban areas. Additionally, many of the states with the most rapid metropolitan growth are also the states with historically high pedestrian crash frequencies and rates (primarily states in the South and Southwest such as Florida, New Mexico, Arizona, Texas, and North Carolina).
- **Understanding pedestrian needs on higher speed multilane arterial roads and best practices to accommodate pedestrians crossing these roads:** Within urban areas, the majority of pedestrian fatalities occur on arterial roads (just over 50 percent). High-speed, high-volume multilane arterial roads have long been known to be a problem for pedestrians, especially for those trying to cross the road. The most common crash type found was related to the improper crossing of a roadway or intersection (almost 20 percent of all crash types).



More specific findings from the data analysis can be found in the [Background Report](#).

2.3 Literature Review

An extensive literature review was conducted to identify key findings and gaps in pedestrian safety research. The review included an examination of nearly 200 journal articles, comprehensive studies, broad-based syntheses, pedestrian design technical references, and meta-analyses of the pedestrian safety research literature for the years 2000 through 2008. A list of the literature reviewed as part of this effort can be found in “Appendix A. Literature Review References.”

Based on the data analysis and literature review, there are a wide variety of factors which contribute to the likelihood of a pedestrian crash. These include factors related to such categories as pedestrians (e.g., pedestrian age, behavior), drivers (e.g., driver distraction), vehicles (e.g., large trucks), roadway environment (e.g., vehicle speeds and volumes, roadway and intersection design), as well as demographic, social, and policy factors (e.g., land use and zoning practices). Some of the primary factors within each of these five categories are given in Figure 3. The roadway/environmental circle is highlighted in this figure because it is the focus of FHWA. Similarly, the other circles are covered by partner agencies. For example, the focuses of NHTSA include driver and vehicle factors. There are 28 research problem statements recommended to address one or more of these pedestrian crash factors, as discussed later.



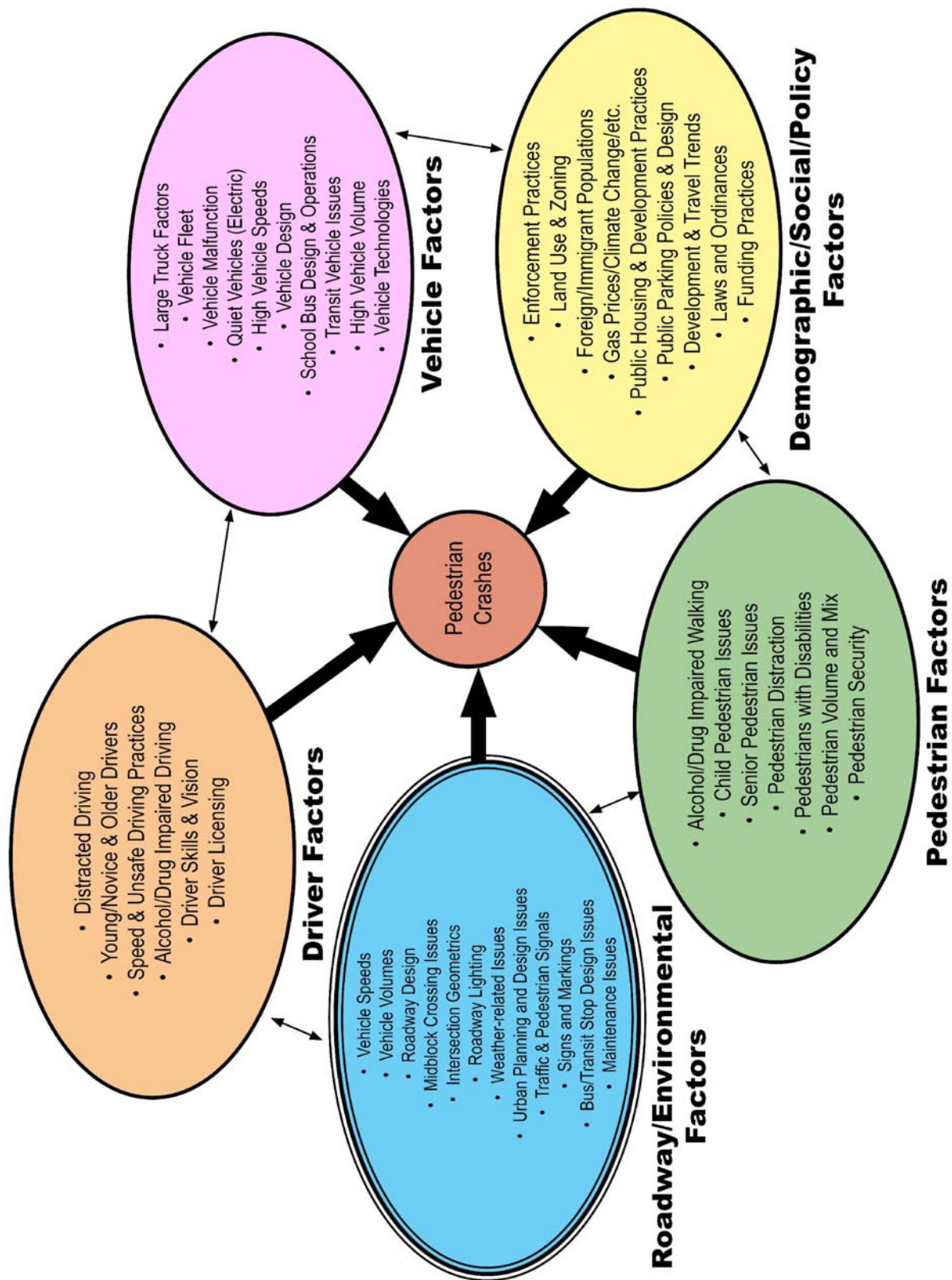


Figure 3. Factors Related to Pedestrian Safety and Morbidity.

Gaps in the available literature on pedestrian safety included the following:

- **Problem Identification and Data Collection:** It was found that few studies have taken into account socioeconomic issues related to pedestrian safety. While more research is needed on these issues, other research is also needed to assess safety concerns of older pedestrians, evaluate the “safety in numbers” concept, examine the role of hand-held communication devices and distraction, and collect pedestrian exposure data.
- **Managing Safety through Analysis and Decision Making:** The literature shows gaps in methodologies for identifying pedestrian crash risk zones and prioritizing them for improvements. There are also gaps in research devoted to analyzing pedestrian safety patterns that stem from land use and the built environment.
- **Innovative Research and Evaluation:** Extensive gaps in pedestrian safety literature were identified. These included guidelines for midblock crossings, lighting technologies, effective countermeasures for improving safety along high speed roads, and crash effects of various pedestrian treatments.
- **Technology Transfer:** The literature review identified a lack of guidance in several key areas for pedestrian safety including the design of parking lots and recommended practices for pedestrian facility maintenance.

The review included a synthesis of existing national research agendas from relevant organizations as well as a review and critique of existing national data sources that support research on pedestrian safety issues. A full description of the literature examined through this effort, as well as a more detailed discussion of the gaps identified, can be found in the [Background Report](#).

2.4 Evaluation of Existing Products

An independent evaluation of 17 existing FHWA products was conducted as part of this effort (Table 1). As part of the evaluation, each product was considered in the context of the three characteristics (night, non-intersection, and urban areas) as presented in Figure 2. The topic areas from Figure 2 are used to describe each topic area for the 17 products in Table 1. Note that the products collectively provide extensive coverage of these three areas. Electronic references to the resources evaluated are provided in Table 2.

Table 1. FHWA Products and Topic Areas.

FHWA Products	Night	Non-Intersection	Urban
1. Bicycle Safer Journey			✓
2. Bicycle Compatibility Index	✓		✓
3. Bikesafe	✓	✓	✓
4. How to Develop a PSAP	✓	✓	✓
5. PBCAT	✓	✓	✓
6. Hispanic Audiences		✓	✓
7. Pedestrian Bicyclist ISI			✓
8. Pedestrian and Course	✓	✓	✓
9. Pedestrian Forum Newsletter	✓	✓	✓
10. Pedestrian RSA Guidelines	✓	✓	✓
11. Pedestrian Safety Campaign		✓	✓
12. Pedestrian Safety Journey		✓	✓
13. Transit Agencies	✓	✓	✓
14. Pedsafe	✓	✓	✓
15. Resident's Guide	✓	✓	✓
16. Marked vs. Unmarked Crosswalks			✓
17. Walkability Checklist	✓	✓	✓

A targeted web-based questionnaire was distributed to 478 people, followed by more focused telephone interviews with 85 respondents. The questions covered issues such as:

- General demographic and business information (e.g., age, location, profession, organization characteristics).
- Product usage, ease-of-use, and impact questions to determine which FHWA products were ordered/used and how recently they were utilized.
- Product specific follow-up questions based on the materials ordered/used.
- Interest/desire for FHWA products not currently available or overall limitations of materials.

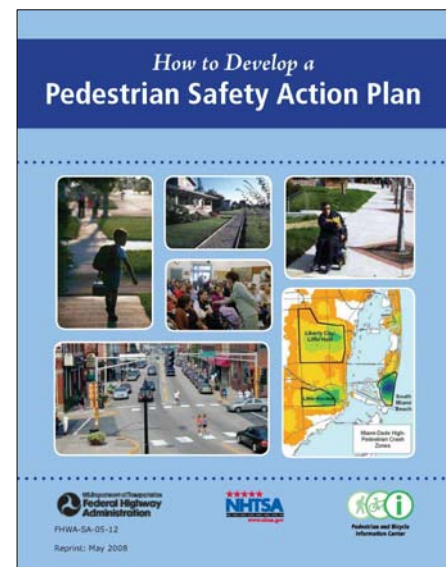
Table 2. FHWA Products Evaluated

Title	Link
Bicycle Safer Journey	http://safety.fhwa.dot.gov/ped_bike/ped_bike_order.htm
Bicycle Compatibility Index	http://www.bicyclinginfo.org/library/details.cfm?id=28
BIKESAFE: Bicycle Safety Guide and Countermeasure Selection System	http://www.bicyclinginfo.org/bikesafe/
How to Develop a Pedestrian Safety Action Plan	http://www.walkinginfo.org/library/details.cfm?id=229
Ped/Bike Crash Analysis Tool (PBCAT)	http://www.walkinginfo.org/facts/pbcats/index.cfm
Pedestrian and Bicycle Safety Materials for Hispanic Audiences	http://safety.fhwa.dot.gov/ped_bike/hispanic/materials/index.cfm
Pedestrian and Bicyclist Intersection Safety Indices	http://www.tfhr.gov/safety/pedbike/pubs/06125/index.htm
Pedestrian and Bicyclist University Course	http://www.tfhr.gov/safety/pedbike/pubs/05085/index.htm
Pedestrian Forum Newsletter	http://safety.fhwa.dot.gov/ped_bike/pedforum/index.cfm
Pedestrian Road Safety Audit Guidelines and Prompt Lists	http://drusilla.hsrrc.unc.edu/cms/downloads/PedRSA.reduced.pdf
Pedestrian Safety Campaign	http://safety.fhwa.dot.gov/local_rural/pedcampaign/
Pedestrian Safer Journey	http://safety.fhwa.dot.gov/saferjourney/
Pedestrian Safety Guide for Transit Agencies	http://safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/index.cfm#toc
PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System	http://www.walkinginfo.org/pedsafe/index.cfm
Resident's Guide for Creating Safe and Walkable Communities	http://safety.fhwa.dot.gov/ped_bike/ped_community/ped_walkguide/index.cfm
Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations	http://www.walkinginfo.org/library/details.cfm?id=54
Walkability Checklist	http://www.nhtsa.dot.gov/PEOPLE/injury/pedbimot/ped/walk1.html

Overall, about half of respondents who claimed familiarity with a product actually used it in the last three years. Even among transportation professionals who had previously ordered FHWA materials, there appeared to be a widespread lack of familiarity with the many FHWA products available for use. The least familiar product (Pedestrian and Bicycle University Course) was familiar to 18 percent of respondents, and the most recognized product (*Walkability Checklist*) was recognized by 60 percent of respondents.

In terms of ease of use, the products/deployments that recent users rated as the easiest to use were those geared for widespread use by a more general audience, while the most difficult to use products tended to be more technical in nature and require significant data inputs (e.g. *Pedestrian and Bicycle Intersection Safety Indices*).

In general, all products/deployments were rated fairly high in terms of usefulness (between 5.8 and 7.3 on a 10-point scale); however, some of the products that were ranked as the most useful (such as the University Course) were also ranked as the least often used (not necessarily by the same respondents).



With respect to product delivery, the analysis found that respondents preferred to receive their information through web-based formats, including email (77 percent), website (68 percent), and web conference/webinar (31 percent). Only 19 percent of respondents preferred receiving information through conferences, as travel budgets to attend such events are becoming limited.



At the end of each follow-up phone interview, respondents were asked if there were any other types of pedestrian safety products that would be helpful to them. There were a number of responses that included suggested improvements to existing materials, such as making the information more generalized for the general public and developing more resources targeted towards children. There were also requests for design guidelines that engineers can use to help implement safety measures and materials that can be used at public meetings.

The following categories describe the majority of the feedback on needed products:

Materials for all audiences:

- More resources directed at children.
- More guidance to the general public.
- Guidance from a community activist perspective instead of an engineering perspective.

Variety of product formats:

- Condensed materials for public meetings, instead of lengthy guidebooks.
- More flyers and posters displaying pedestrian and bicycle safety rules.
- Design materials appropriate for display in a variety of settings, such as college campuses, mixed use land areas, and large scale living communities and resorts.
- Grade school curriculum materials, such as videos and interactive computer games.



Accessibility of materials:

- A single location that lists, or provides access to, both existing material and research that is underway.
- Educational products that children can hold and carry such as refrigerator magnets, bookmarks, or placemats.

New topics to address:

- Materials directed toward the issues that face pedestrians and bicyclists in rural areas, such as a lack of sidewalks and crosswalks, and problems with gravel roads.
- Assistance with crash analyses, such as providing guidance and methodologies for using different kinds of tools like GIS or crash-based models.
- Bicycle and pedestrian demand forecasting using a range of products and more standardized and sophisticated modeling.
- Guidance in trail and pedestrian walkway planning and design.

More detailed findings from the product evaluation can be found in the [Background Report](#).

2.5 Stakeholder Feedback and Expert Opinion

A one-day stakeholder workshop was conducted in December 2008 to solicit input on needed research and research priorities from a diverse group of stakeholders and pedestrian safety experts (see the [Background Report](#) for a list of participants). A series of break-out sessions were held to discuss the vision and goals for the Strategic Plan; identify and prioritize research needs; and brainstorm Strategic Plan implementation challenges and solutions. After the breakout sessions, a list of research topics discussed was compiled, ranked by each stakeholder, and used to identify critical research needs to be included in the Strategic Plan. The following ten research topics were identified as the most significant topics by the group:



1. Roadway design and other factors affecting vehicle speeds and motorists' decisions to yield to pedestrians, and speed reduction countermeasures.
2. Comprehensive and interdisciplinary pedestrian coursework for engineering and planning students in universities.
3. Research evaluating how speed limits are set, especially in urban areas, and best practices for setting speed limits.
4. Impact of land use and development patterns on walking and factors affecting mode choice and pedestrian safety.
5. Research on the safety effects of multimodal design, as well as best practices and training materials related to complete streets.
6. Research on how communities allocate funds for pedestrians and best practices for prioritizing and increasing funding available for pedestrian projects.
7. A further review of crash reduction factors related to pedestrians, and the development of additional CRFs.
8. Guidance on providing resources and expertise to small communities who do not have trained/experienced traffic engineers with a pedestrian safety background.
9. Guidance for improving transit and transportation agency coordination to increase the safety of midblock pedestrian crossings near transit.
10. Research demonstrating the effects of narrowing vehicle lanes to accommodate bike lanes and/or other measures on pedestrian safety.

This list of research topics was further refined and expanded at a second stakeholder workshop in March 2010, just prior to the drafting of the final Strategic Plan. After reviewing research problem statement write-ups for each of the topics included in the [Background Report](#), the stakeholder group further refined the list of recommended research topics.

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Chapter 3. Recommended Strategic Plan Components

3.1 Overview of Strategic Plan

Based on the outcomes of the background research, data analysis, product evaluation, and stakeholder involvement, a total of 28 new research topics, updates to 17 existing FHWA pedestrian safety products, and new marketing and product delivery strategies are recommended. Each of these areas should work together to achieve the goals of the Strategic Plan as illustrated in Figure 4. Each effort is essential to ensure that the Strategic Plan reflects current issues, effectively communicates the latest information, and uses delivery mechanisms to connect information and people in the pedestrian safety field. This is a dynamic process that will require that the Strategic Plan be evaluated and updated periodically.



Figure 4. Overview of Strategic Plan Recommendation Categories.

3.2 Research Topics

Each research topic falls into one of the three key categories of the Strategic Plan framework:

1. Problem identification and data collection.
2. Managing safety through analysis and decision making.
3. Innovative research and evaluation.

While each research problem statement addresses an individual topic, there is some potential overlap between research projects. For example, research conducted for “Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians” could potentially overlap with “The Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors.” Research efforts should be coordinated and refined to ensure that each project is achieving separate objectives that directly relate to the goals of the Strategic Plan.



Each of the following projects is presented in no particular order. Specific decisions related to relative priority will be left to the agencies that choose to pursue and fund a selected project. Full details for each of these 28 topics can be found in the individual research problem statements, listed in “Appendix B. Research Problem Statements.” Within each project description is the page number where the full research problem statement write-up can be found in Appendix B.

In each of the four Strategic Plan components, there are opportunities for technical support and outreach to State and local agencies. The Strategic Plan is dynamic; as activities in support of this Strategic Plan are conducted, these opportunities will be identified.

Problem Identification and Data Collection Components

- **A1. Evaluate and Refine Existing Models for Predicting Pedestrian Use**

The objective of this study is to evaluate the existing pedestrian volume predictive models using a set of criteria in order to identify which models are appropriate in different types of locations and communities.

- **A2. Effects of Hand-Held Communication Device Use and Related Driver and Pedestrian Distraction on Pedestrian Safety**

This research will evaluate the potential effects of driver and pedestrian use of hand-held devices on the safety of pedestrians.

- **A3. Methods to Improve Physical Conditions for Pedestrians along Existing Roads**

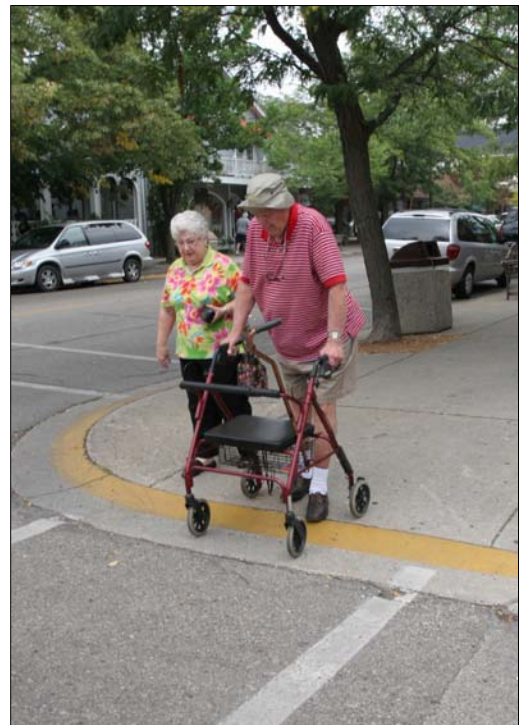
The objective of this research is to identify and analyze institutional barriers to improving the physical conditions for pedestrians along roadways. In the first phase, the most critical institutional measures relating to improving pedestrian accommodations along existing streets will be identified and described. The second phase of the research will evaluate the effectiveness of current practices in making the right-of-way more walkable and accessible for pedestrians.

- **A4. Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities**

The primary objective for this research is to investigate the effectiveness (safety, mobility, and comfort) of visual, audible, and tactile signals or traffic signs and markings for special needs populations consisting of older pedestrians and those with disabilities. This study will evaluate new and innovative devices for which further research is needed.

- **A5. Race, Ethnicity, and Immigrant Status for Pedestrian Morbidity and Mortality**

This project will identify and quantify the subsets of the population by race/ethnicity and immigrant status that are overrepresented as victims in serious injury and fatal pedestrian crashes as compared to the general population. The second phase of the research will identify the common contributing factors related to these crashes in each ethnic/racial/immigrant subset.





- **A6. Understanding Diverse Vision Needs of Pedestrians**

The objective of this research is to provide a description of how vision affects pedestrian mobility and safety, evaluate features that may improve travel by pedestrians with low vision, and develop design guidelines to enhance visual aspects of pedestrian facilities.

- **A7. Automated Pedestrian/Vehicle Conflict Video Data Collection**

The primary research objective is to conduct research on the use of automated video data collection to detect, measure, and evaluate pedestrian/vehicle conflicts and compare the accuracy to human observations. This research will include conducting a literature review to define types of pedestrian vehicle/conflicts and define the measurement parameters. Additional research will also be conducted on the most current video data collection systems.

- **A8. Evaluation of Automated Pedestrian Detection Technologies**

This research will test the accuracy and effectiveness of automated pedestrian detection technologies to detect pedestrians and activate pedestrian signals (and minimize false calls and missed calls), and to collect pedestrian volumes on a segment or at an intersection.

Analysis and Decision Making Components

- **B1. Identification and Prioritization of High Pedestrian Crash Locations/Areas**

This research will start with a synthesis of studies that have developed methods for identifying/prioritizing high pedestrian crash zones. A best practices guide will be developed to assist State and local agencies in identifying high pedestrian crash locations, corridors, and zones.

- **B2. Using Automated Counters to Identify Pedestrian Volume Patterns and Extrapolation Factors**

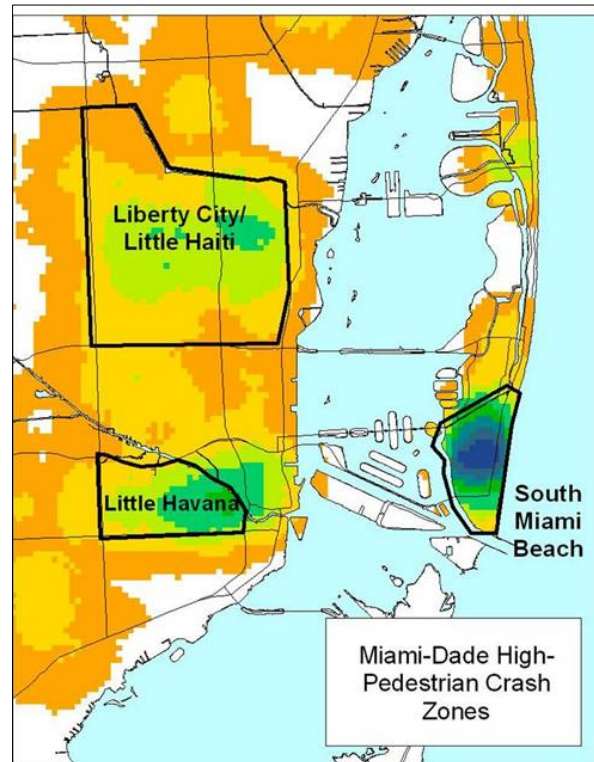
The purpose of this research is to provide guidance for how to extrapolate short pedestrian counts from automated counters to estimate daily, weekly, and yearly time periods.

- **B3. Identification of Institutional Barriers to Pedestrian Funding and Recommended Practices for Using Pedestrian Facility/Safety Funds**

The research objective is to develop a best practices guide to identify how communities can obtain and allocate funds in an effective manner to provide improved pedestrian facilities and implement pedestrian safety treatments. The guide will also identify those institutional barriers that do not provide or create incentives for pedestrian programs, improvements, and funding, and offer solutions for overcoming them.

- **B4. Relationships between Land Use, the Built Environment, and Pedestrian Safety**

There are two research objectives. The first objective will be to determine current knowledge regarding the relationship between the built environment and pedestrian traffic through a comprehensive literature review. The second objective is to understand how one or more built environment attributes affect safety.



Research and Evaluation Components

- **C1. Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians**

The objective of this research will be to develop implementation guidance for cost-effective treatments to improve pedestrian safety on arterial roadways. The study will develop planning guidelines such as distance between pedestrian crossings and what type of crossing treatments should be considered.

- **C2. Effects of Traffic Signals on Pedestrian Behavior and Safety**

This research will develop new guidelines and strategies for accommodating pedestrians at signalized intersections. This research should include pedestrians of all ages, including older pedestrians. The guidelines and strategies will focus on finding the relationship between safety, pedestrian mobility, and signal operational efficiency.

- **C3. The Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors**

The research objective is to investigate how roadway, roadside, and environmental features affect crashes between pedestrians and motor vehicles. The research should involve analyzing crash information at corridors having a variety of land use patterns and for different congestion levels and road user volumes.

- **C4. Develop Guidelines for Pedestrian Midblock Crossings**

The purpose of this study is to quantify the safety of various types of midblock crossings, evaluate countermeasures based on behavioral and conflict measures, and develop a guidebook on where midblock crossings should be provided and the types of treatments that are appropriate.

- **C5. Pedestrian Crash Modification Factors (CMFs)**

There are two research objectives. The first objective will be to perform a comprehensive literature review to determine which CMFs are available and statistically sufficient, as well as what new research is needed. The second project objective is to perform the needed research to develop CMFs for one or more of the selected treatments. Additional treatments could be selected for crash-based evaluations in future funding for this topic.



- **C6. Accessible Pedestrian Signals**

The objectives of the research are to determine whether and how Accessible Pedestrian Signals (APS) offer benefits to sighted pedestrians and improvements in pedestrian safety, evaluate APS installation in fixed timed systems, and develop guidance on maintenance audits and protocol.

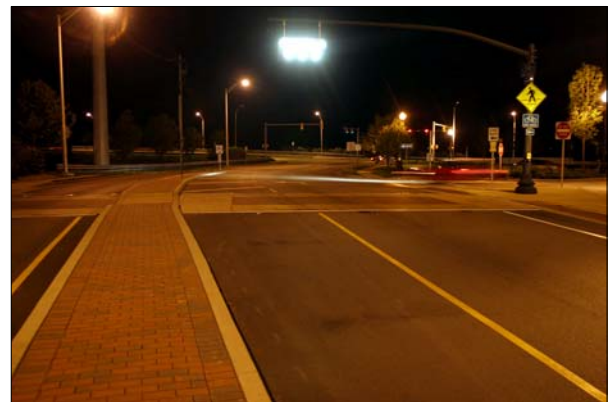
- **C7. Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas**

There are two objectives of this project. The first objective is to create a successful practices synthesis report to document excellent examples of transit agency and roadway agency coordination on pedestrian access issues to transit. This effort is also described in PR13: Pedestrian Safety Guide for Transit Agencies. The second objective of the study will involve evaluating the effectiveness of the most promising treatments discussed in the successful practices synthesis.



- **C8. Effectiveness of Improved Lighting in Reducing Pedestrian Crashes at Crosswalks**

The purpose of this research is to evaluate the effectiveness of lighting improvements on night pedestrian crashes. Studies would analyze such issues as the effects of the addition of various types of lighting: white lighting, LED lighting, "smart lighting", and others.



- **C9. Effects of New Pedestrian Facilities on Pedestrian Exposure**

This research will determine the effects of various types of newly retrofitted pedestrian facilities on the number of increased pedestrian trips. The estimated increase in pedestrian trips should be quantified in terms of the type of pedestrian facility to be added (e.g., sidewalk, walkway, traffic and pedestrian signal, traffic calming treatment), specific area type (e.g., urban, suburban, or rural), and roadway type (e.g., two-lane vs. multilane).

- **C10. Increasing the Safety of Interactions between Pedestrians and Large Commercial Vehicles (Trucks and Buses) in Urban Areas**

Pedestrian crashes involving large trucks usually lead to severe pedestrian injury or death. This project will create a best practices guide for the interaction of commercial vehicles and pedestrian accommodation in urban settings. The main objective of this research is to conduct a detailed analysis of State and/or national databases to quantify the magnitude and characteristics of interactions and collisions between pedestrians and buses and trucks, including identifying some of the related roadway and behavioral factors.

- **C11. Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks**

The objective of this research is to evaluate whether an automated camera system that records violations of pedestrian's right-of-way at signalized crosswalks can reduce motorist violations of pedestrian right-of-way.

- **C12. Evaluation of the Applicability of Lower-Speed Street Designs in Residential and Commercial Zones**

The purpose of this research is to determine the effects of various types of low-speed street designs on safety and operations for various road users and to develop guidelines for their use. The results of this research and documentation could lead to recommended guidelines on the types of lower-speed design concepts and road situations for which various design options are practical, safe, and efficient for all road users.



Each of these recommended research problems was selected to address one or more of the pedestrian safety factors and/or data and analysis needs. Table 3 presents a list of crash factors with corresponding studies (e.g., A1, B2) designed to address those problems or needs. For example, problems or issues related to roadway design would be addressed by studies A3, C1, C3, and C8.

Table 3. Factors Related to Pedestrian Crashes and Corresponding Project Recommendations.

Pedestrian Factors	
• Alcohol/Drug-impaired walking (A5) • Child pedestrian factors (A5, C2) • Senior pedestrian factors (A4, A6, C2, C6, C8) • Pedestrian distraction (A2)	• Pedestrians with disabilities (A4, A6, C2, C6) • Pedestrian volume and mix (A1, C2, C9) • Pedestrian behaviors (A4, A5, C2) • Pedestrian security (A3, B4, C8, D3)
Vehicle Factors	
• Large truck factors (C10) • Vehicle fleet • Vehicle malfunction • Quiet vehicles	• Vehicle design • Transit vehicle issues • School bus Design & operations • Vehicle technologies
Roadway/Environmental Factors	
• Vehicle speeds (C1, C3, C11) • Vehicle volumes (C1, C3) • Roadway design (A3, C1, C3, C8) • Midblock crossings (A3, A4, C1, C3, C4, C5, C6, C7, C8, C11) • Intersection geometrics (A3, C1, C5) • Roadway lighting (A3, C8) • Roadway maintenance problems (A3, D3)	• Weather-related issues (A3, D4) • Urban planning and design issues (A3, B4, C1, C12) • Traffic and pedestrian signals (A3, A4, A8, C1, C2, C4, C5, C6, C7) • Signs and markings (A3, A4, C1, C3, C4, C5) • Bus/transit stop design issues (A3, C1, C3, C4, C5, C7)
Driver Factors	
• Distracted drivers (A2) • Young/novice & older drivers • Speed and unsafe driving practices	• Alcohol/drug-impaired driving • Driver skills & vision • Driver training practices
Demographic, Social, and Policy Factors	
• Enforcement practices (C11) • Land use & zoning (B4, D1) • Foreign/immigrant population (A5) • Gas prices, climate change, etc. • Public housing & development practices (B4)	• Public parking policies & design (D1, D2) • Development & travel trends (B4) • Laws and ordinances (D1, D2) • Funding practices (B3)
Data and Analysis Needs	
• Crash data • Pedestrian volume/exposure data (A7, A8, B2, C9) • Roadway features data (A3)	• Analysis tools to identify problem sites (B1) • Analysis tools to select safety improvements (C5, D4)

The relationships between pedestrian safety factors and the corresponding research problem statements are also shown in Tables 4 through 7. For example, Table 4 shows that five proposed research projects address the issue of senior pedestrian safety. These include:

- A4. Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities
- A6. Understanding Diverse Vision Needs of Pedestrians
- C2. Effects of Traffic Signals on Pedestrian Behavior and Safety
- C6. Accessible Pedestrian Signals
- C8. Effectiveness of White Lighting in Reducing Pedestrian Crashes at Crosswalks

Table 4. Relationship between Pedestrian Crash Factors and Recommended Research Topics.

Research Topic	Pedestrian Factors							
	Alcohol/Drug Impaired Walking	Child Pedestrian Issues	Senior Pedestrian Issues	Pedestrian Distraction	Pedestrians with Disabilities	Pedestrian Volume & Mix	Pedestrian Behaviors	Pedestrian Security
Evaluate and Refine Existing Models for Predicting Pedestrian Use (A1)						X		
Effect of Hand-Held Communication Device Use and Related Driver and Pedestrian Distraction on Pedestrian Safety (A2)				X				
Methods to Improve Physical Conditions for Pedestrians along Existing Roads (A3)								X
Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities (A4)			X		X		X	
Race, Ethnicity, and Immigrant Status for Pedestrian Morbidity and Mortality (A5)	X	X					X	
Understanding Diverse Vision Needs of Pedestrians (A6)			X		X			
Relationships between Land Use, the Built Environment, and Pedestrian Safety (B4)								X
Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians (C1)			X		X	X	X	
Effects of Traffic Signals on Pedestrian Behavior and Safety (C2)		X	X		X	X	X	
Accessible Pedestrian Signals (C6)			X		X			
Effectiveness of White Lighting in Reducing Pedestrian Crashes at Crosswalks (C8)			X					X
Effects of New Pedestrian Facilities on Pedestrian Exposure (C9)						X		
Best Practices for Pedestrian Facility Maintenance (D3)								X

Table 5 shows the relationship between demographic factors and research problem statements. There are six specific studies (A5, B3, B4, C11, D1, and D2) that relate to these factors.

Table 5. Relationship between Demographic Factors and Recommended Research Topics.

Research Topic	Demographic/Social/Policy Factors							
	Enforcement Practices	Land Use & Zoning	Foreign/ Immigrant Populations	Gas Prices/Climate Change/etc.	Public Housing & Development Practices	Public Parking Policies & Design	Development & Travel Trends	Laws and Ordinances
Race, Ethnicity, and Immigrant Status for Pedestrian Morbidity and Mortality (A5)			X					
Identification of Institutional Barriers to Pedestrian Funding, and Recommended Practices for Using Pedestrian Facility/Safety Funds (B3)								X
Relationships between Land Use, the Built Environment, and Pedestrian Safety (B4)		X			X		X	
Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks (C11)	X							
Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network (D1)		X				X		X
Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference (D2)						X		X

For the roadway/environmental factors shown in Table 6, there are 16 different research studies that were recommended to address one or more of these factors. For example, the proposed study “C5. Pedestrian Crash Modification Factors” could address one or more of several roadway factors, including midblock crossing issues, intersection geometries, traffic and pedestrian signals, signs and markings, and transit stop issues.

Table 6. Relationship between Roadway/Environmental Factors and Recommended Research Topics.

Research Topics	Roadway/Environmental Factors											
	Vehicle Speeds	Vehicle Volumes	Roadway Design	Midblock Crossing Issues	Intersection Geometrics	Roadway Lighting	Weather-related Issues	Urban Planning & Design Issues	Traffic & Pedestrian Signals	Signs and Markings	Bus/Transit Stop Design Issues	Maintenance Issues
Methods to Improve Physical Conditions for Pedestrians along Existing Roads (A3)			X	X	X	X	X	X	X	X	X	X
Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities (A4)				X					X	X		
Evaluation of Automated Pedestrian Detection Technologies (A8)									X			
Relationships between Land Use, the Built Environment, and Pedestrian Safety (B4)								X				
Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians (C1)	X	X	X	X	X			X	X	X	X	
Effects of Traffic Signals on Pedestrian Behavior and Safety (C2)									X			
The Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors (C3)	X	X	X	X						X	X	
Develop Guidelines for Pedestrian Midblock Crossings (C4)				X					X	X	X	
Pedestrian Crash Modification Factors (C5)				X	X				X	X	X	
Accessible Pedestrian Signals (C6)				X					X			
Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas (C7)				X					X		X	
Effectiveness of White Lighting in Reducing Pedestrian Crashes at Crosswalks (C8)			X	X		X						
Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks (C11)	X			X								
Evaluation of the Applicability of Lower-Speed Street Designs in Residential and Commercial Zones (C12)								X				
Best Practices for Pedestrian Facility Maintenance (D3)												X
Survey of Procedures for Implementing and Evaluating Experimental Treatments (D4)							X					

Table 7 shows the research problem statements that are recommended to address the pedestrian data and analysis needs. For example, there are four studies (A7, A8, B2, and C9) which are proposed related to obtaining pedestrian exposure data.

Table 7. Relationship between Data and Analysis Needs and Recommended Research Topics.

Research Topics	Data and Analysis Needs					
	Crash Data	Exposure Data	Roadway Features Data	Demographic Data	Analysis Tools to Identify Problem Sites	Analysis Tools to Select Safety Improvements
Methods to Improve Physical Conditions for Pedestrians along Existing Roads (A3)			X			
Automated Pedestrian/Vehicle Conflict Video Data Collection (A7)		X				
Evaluation of Automated Pedestrian Detection Technologies (A8)		X				
Identification and Prioritization of High Pedestrian Crash Locations/Areas (B1)				X	X	
Using Automated Counters to Identify Pedestrian Volume Patterns and Extrapolation Factors (B2)		X				
Pedestrian Crash Modification Factors (C5)						X
Effects of New Pedestrian Facilities on Pedestrian Exposure (C9)		X				
Survey of Procedures for Implementing and Evaluating Experimental Treatments (D4)						X

No separate tables are provided for vehicle factors, since the only vehicle factor selected for future research by FHWA is a study on the interaction between pedestrians and large commercial vehicles. Also, the only driver factor selected for future research involves a study on the effects of hand-held devices (e.g., cell phones) by pedestrians and drivers on pedestrian crashes. NHTSA has primary responsibility for conducting safety research on vehicle factors, as well as pedestrian and driver behavioral factors.

Technology Transfer Components (Identified with Research Topics)

It should be noted that the projects listed in the technology transfer category are not considered to be research projects. Rather, they should provide a synthesis of existing or recommended programs and practices. These topics are critical elements of the Strategic Plan.

- **D1. Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network**

The objective of this project is to provide examples, highlight best practices, and discuss advantages, effectiveness, and any shortcomings of provisions supporting vibrant walking environments in zoning ordinances, subdivision regulations, and design guidelines.

- **D2. Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference**

The proposed project will look for connections between the widespread provision of free and subsidized parking and the limited provision of high quality pedestrian environments, including the pedestrian safety implications of on-street and off-street parking facilities. This project will summarize the safety of present parking provisions and policies and provide recommendations for improvement.

- **D3. Successful Practices for Pedestrian Facility Maintenance**

The purpose of this project is to develop a synthesis identifying successful practices and barriers for sidewalk and other pedestrian facility maintenance – what works and what does not work based on experience from State and local agencies.

- **D4. Survey of Procedures for Implementing and Evaluating Experimental Treatments**

The objective is to provide guidance for State and local agencies on implementing and evaluating experimental treatments. A critical component of this project will include the development of a brochure or guide to explain these procedures.





In addition to four new projects recommended in the area of technology transfer, most (if not all) of the 28 recommended research projects described earlier should include technology transfer components to ensure the delivery of products and research to professionals and practitioners in a variety of fields. Existing guide updates will also have a technology transfer component, and will synthesize the results of the research.

In order to effectively communicate research findings and distribute new information, a critical component of the Strategic Plan will be to develop new tools, resources, and products to communicate specific findings and to update existing tools, resources, and products with new research. Recommendations for existing products are presented in detail in “Appendix C. Existing FHWA Product Recommendations.” Recommendations for new delivery strategies can be found in “Appendix D. New Product Delivery/Strategy Recommendations.”

Each of the aforementioned projects has been broken down by project phase or task. These are shown in detail in Tables 8 through 11.

Table 8. Recommended Problem Identification Projects by Phase/Task.

		Project Phase
Problem Identification and Data Collection	Evaluate and Refine Existing Models for Predicting Pedestrian Use (A1, Time period: 0-5 Years)	1. Review each model 2. Apply/evaluate models 3. Final report and recommendations 4. Develop comprehensive model
	Effect of Hand-Held Communication Device Use and Related Driver and Pedestrian Distraction on Pedestrian Safety (A2, Time period: 0-5 Years)	1. Determine magnitude of problem 2. Controlled attention assessment 3. Identify and evaluate solutions 4. Final report and recommendations
	Methods to Improve Physical Conditions for Pedestrians along Existing Roads (A3, Time period: 0-5 Years)	1. Identify methods/literature review 2. Evaluate current practices 3. Final report and recommendations
	Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities (A4, Time period: 5-10 Years)	1. Literature review 2. Select devices to evaluate 3. Evaluate devices 4. Final report and recommendations
	Race, Ethnicity, and Immigrant Status for Pedestrian Morbidity and Mortality (A5, Time period: 5-10 Years)	1. Identify target population 2. Identify contributing crash factors 3. Develop countermeasures 4. Deploy/evaluate countermeasures 5. Final report and recommendations
	Understanding Diverse Vision Needs of Pedestrians (A6, Time period: 10-15 Years)	1. Literature review 2. Human factors testing 3. Field testing of lab results 4. Develop guidelines
	Automated Pedestrian/Vehicle Conflict Video Data Collection (A7, Time period: 10-15 Years)	1. Literature review 2. Field data collection 3. Evaluate results 4. Final report and recommendations
	Evaluation of Automated Pedestrian Detection Technologies (A8, Time period: 10-15 Years)	1. Literature review 2. Test/evaluate technologies 3. Develop case studies 4. Identify issues/recommendations

Table 9. Analysis and Decision Making Projects by Phase/Task.

		Project Phase
Analysis and Decision Making	Identification and Prioritization of High Pedestrian Crash Locations/Areas (B1, Time period: 0-5 Years)	1. Synthesis of related work/literature 2. Evaluate prioritization methods 3. Apply methods to sample database 4. Final report and recommendations
	Using Automated Counters to Identify Pedestrian Volume Patterns and Extrapolation Factors (B2, Time period: 10-15 Years)	1. Review related research 2. Collect continuous count data 3. Develop extrapolation factors 4. Develop guide
	Identification of Institutional Barriers to Pedestrian Funding, and Recommended Practices for Using Pedestrian Facility/Safety Funds (B3, Time period: 5-10 Years)	1. Literature review 2. Survey of public agencies 3. Develop guide/case studies 4. Final report and recommendations
	Relationships between Land Use, the Built Environment, and Pedestrian Safety (B4, Time period: 10-15 Years)	1. Literature review 2. Expert panel 3. Develop summary and recommendations 4. Final report

Table 10. Technology Transfer Projects by Phase/Task.

		Project Phase
Technology Transfer	Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network (D1, Time period: 0-5 Years)	1. Literature review 2. Panel evaluation 3. Document findings
	Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference (D2, Time period: 5-10 Years)	1. Literature review 2. Data analysis 3. Recommendations 4. Final report
	Best Practices for Pedestrian Facility Maintenance (D3, Time period: 0-5 Years)	1. Literature review 2. Panel evaluation 3. Survey agencies 4. Develop guide
	Survey of Procedures for Implementing and Evaluating Experimental Treatments (D4, Time period: 5-10 Years)	1. Create flyer/guide

Table 11. Innovative Research and Evaluation Projects by Phase/Task.

Innovative Research and Evaluation	Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians (C1, Time period: 0-5 Years)	1 Literature review and expert panel 2 Examine crash data 3. Evaluate treatment effectiveness 4. Final report and recommendations
	Effects of Traffic Signals on Pedestrian Behavior and Safety (C2, Time period: 5-10 Years)	1 Literature review and expert panel 2 Examine crash data 3. Evaluate treatment effectiveness 4. Final report and recommendations
	The Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors (C3, Time period: 5-10 Years)	1. Literature review 2. Select cities and develop database 3. Analyze data, develop crash relationships 4. Final report and recommendations
	Develop Guidelines for Pedestrian Midblock Crossings (C4, Time period: 0-5 Years)	1. Literature review 2. Evaluation of countermeasures 3. Develop guidelines
	Pedestrian Crash Modification Factors (C5, Time period: 0-5 Years)	1. Literature review 2. Select countermeasures and test cities 3. Evaluate treatments 4. Final report and recommendations
	Accessible Pedestrian Signals (C6, Time period: 5-10 Years)	1. Literature review 2. Evaluate APS systems 3. Develop maintenance audits and protocol
	Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas (C7, Time period: 5-10 Years)	1. Examine best practices 2. Select treatments/literature review 3. Evaluate treatments
	Effectiveness of White Lighting in Reducing Pedestrian Crashes at Crosswalks (C8, Time period: 5-10 Years)	1. Literature review 2. Evaluate effects of white lighting 3. Evaluate effects of increased lighting 4. Evaluate dynamic lighting 5. Final report and recommendations
	Effects of New Pedestrian Facilities on Pedestrian Exposure (C9, Time period: 5-10 Years)	1. Literature review 2. Identify test locations 3. Collect before and after data 4. Analyze data 5. Final report and recommendations
	Increasing the Safety of Interactions between Pedestrians and Large Commercial Vehicles (Trucks and Buses) in Urban Areas (C10, Time period: 10-15 Years)	1. Literature review 2. Crash analysis 3. Develop guidelines/case studies 4. Final report and recommendations
	Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks (C11, Time period: 5-10 Years)	1. Literature review/identify locations 2. Analyze locations 3. Final report and recommendations
	Evaluation of the Applicability of Lower-Speed Street Designs in Residential and Commercial Zones (C12, Time period: 0-5 Years)	1. Literature review 2. Identify locations 3. Collect data 4. Final report/recommendations

3.3 Recommendations for Existing Product Updates

Each of the following FHWA tools and resources was evaluated by end-users and follow-up interviews were conducted to assess product usability and the effectiveness of distribution methods. Based on those recommendations and feedback, updates to content and changes to delivery/marketing strategies are recommended for several of these tools. Those recommendations are briefly summarized below and described in full detail in “Appendix C. Existing FHWA Product Recommendations.”



While the development of new products from research findings should occur after the recommended research projects have been completed, the updating of guides, tools, and resources can be tackled in the short-term. Many of the following tools and products were developed several years ago, and would benefit from updates that include current research and best practices. Consideration was given to the value of each existing and new proposed product in terms of its value to various pedestrian users and stakeholders. The FHWA Resource Center and other agency divisions will play a significant role in this process.

Finally, some of the recommended research projects will yield results relevant to one or more of these products. The findings should be used to further update these tools and resources with the latest information. Specific recommendations for updating these guides can be found in Table 12 and “Appendix C. Existing FHWA Product Recommendations.” The intended audiences and outcomes of each of the existing and new products are given in Table 13.

Table 12. Existing Product Update Recommendations for FHWA Office of Safety and Office of Safety Research and Development.

		PSAP Guide	PBCAT	Ped/Bike ISI	University Course	Pedestrian Forum	Ped RSA Guidelines	Transit Guide f	PEDSAFE
Problem Identification and Data Collection	Evaluate and Refine Existing Models for Predicting Pedestrian Use (A1)	X			X	X			
	Effect of Hand-Held Communication Device Use and Related Driver and Pedestrian Distraction on Pedestrian Safety (A2)	X	X		X	X	X		
	Methods to Improve Physical Conditions for Pedestrians along Existing Roads (A3)	X	X		X	X	X		X
	Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities (A4)	X		X	X	X	X	X	X
	Race, Ethnicity, and Immigrant Status for Pedestrian Morbidity and Mortality (A5)	X	X		X	X	X	X	X
	Understanding Diverse Vision Needs of Pedestrians (A6)	X			X	X	X	X	X
	Automated Pedestrian/Vehicle Conflict Video Data Collection (A7)	X			X	X			
	Evaluation of Automated Pedestrian Detection Technologies (A8)	X			X	X			
Analysis and Decision making	Identification and Prioritization of High Pedestrian Crash Locations/Areas (B1)	X	X		X	X	X		X
	Using Automated Counters to Identify Pedestrian Volume Patterns and Extrapolation Factors (B2)	X			X	X			
	Identification of Institutional Barriers to Pedestrian Funding, and Recommended Practices for Using Pedestrian Facility/Safety Funds (B3)	X			X	X			
	Relationships between Land Use, the Built Environment, and Pedestrian Safety (B4)	X	X		X	X	X		
Innovative Research and Evaluation	Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians (C1)	X	X		X	X			X
	Effects of Traffic Signals on Pedestrian Behavior and Safety (C2)	X	X	X	X	X	X		X
	The Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors (C3)	X	X		X	X	X	X	X
	Develop Guidelines for Pedestrian Midblock Crossings (C4)	X			X	X		X	X
	Pedestrian Crash Modification Factors (C5)	X	X		X	X			X
	Accessible Pedestrian Signals (C6)	X		X	X	X			X
	Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas (C7)	X			X	X	X	X	X
	Effectiveness of White Lighting in Reducing Pedestrian Crashes at Crosswalks (C8)	X			X	X	X		X
	Effects of New Pedestrian Facilities on Pedestrian Exposure (C9)	X			X	X			X
	Increasing the Safety of Interactions between Pedestrians and Large Commercial Vehicles (Trucks and Buses) in Urban Areas (C10)	X			X	X		X	X
	Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks (C11)	X			X	X			X
	Evaluation of the Applicability of Lower-Speed Street Designs in Residential and Commercial Zones (C12)	X			X	X			X
Technology Transfer	Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network (D1)	X			X	X			X
	Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference (D2)	X			X	X	X		X
	Best Practices for Pedestrian Facility Maintenance (D3)	X			X	X	X		
	Survey of Procedures for Implementing and Evaluating Experimental Treatments (D4)	X			X	X			

Table 13. Intended Audiences and Outcomes for Product Updates.

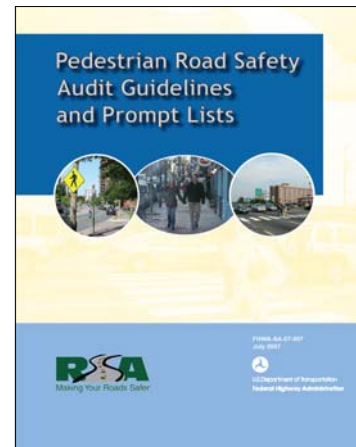
Products		Pedestrian	Bicycle	Audiences							Product Format			
				Planners	Engineers	Health Professionals	Children	Students	Municipal Officials	General Public	User Guides	Brochures	Training	Electronic Resources
Existing Products	Bicycle Safer Journey		X			X	X			X		X		X
	Bicycle Compatibility Index		X	X	X				X	X	X		X	
	BIKESAFE: Bicycle Safety Guide and Countermeasure Selection System		X	X	X				X	X		X	X	X
	How to Develop a Pedestrian Safety Action Plan	X		X	X	X			X	X	X	X	X	X
	Ped/Bike Crash Analysis Tool	X	X	X	X				X			X	X	X
	Pedestrian and Bicycle Safety Materials for Hispanic Audiences	X	X			X			X	X		X		
	Pedestrian and Bicyclist Intersection Safety Indices	X	X	X	X				X		X			
	Pedestrian and Bicyclist University Course	X	X	X				X				X		X
	Pedestrian Forum Newsletter	X		X	X	X			X	X		X		X
	Pedestrian Road Safety Audit Guidelines and Prompt Lists	X		X	X				X		X		X	X
	Pedestrian Safety Campaign	X		X		X			X		X	X		
	Pedestrian Safer Journey	X				X	X	X	X	X		X		X
	Pedestrian Safety Guide for Transit Agencies	X		X	X				X		X			
	PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System	X		X	X				X		X			X
	Resident's Guide for Creating Safe and Walkable Communities	X						X		X	X		X	
	Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations	X		X	X	X			X		X	X		
	Walkability Checklist	X						X		X	X	X		
New Products	Event/Conference Marketing	X		X	X	X		X	X			X		X
	Direct Mailing/Emailing	X		X	X	X		X	X	X				
	Successful Practices Guide	X		X	X	X		X	X	X	X			X
	In-Person Training Course	X		X	X	X			X				X	
	Web Training	X		X	X	X		X	X	X			X	X
	Software	X		X	X	X	X	X	X	X	X			X

- **How to Develop a Pedestrian Safety Action Plan (PSAP)** – The PSAP Guide is intended to assist agencies in further enhancing their existing pedestrian safety programs and activities, including identifying safety problems, analyzing information, and selecting optimal solutions. The guide should be more widely distributed through the appropriate technology transfer channels and the various PSAP courses should be taught more widely in the non-focus states, as well as the focus states.
- **Pedestrian and Bicycle Crash Analysis Tool (PBCAT)** – PBCAT is a software application designed to assist State and local pedestrian and bicycle coordinators, planners, and engineers in addressing pedestrian and bicyclist crash problems. PBCAT could be enhanced by reviewing the current program, updating the countermeasures to reflect current practices, improving the section on engineering countermeasures, increasing marketing efforts, and upgrading the software. With these alterations, the PBCAT will continue to be an important component of safety efforts across the United States.
- **Pedestrian and Bicycle Safety Materials for Hispanic Audiences** – The Pedestrian and Bicyclist Safety Materials for Hispanic Audiences include a collection of flyers, brochures, and posters that contain safety messages targeted specifically at Hispanic audiences. Steps should be taken to redesign the posters so that they can effectively communicate safety messages to this audience. These newly-developed materials could include design templates that allow individual agencies to tailor the messages to specifically address the safety needs of the local population.
- **Pedestrian and Bicyclist Intersection Safety Indices (ISI)**
– The ISI serve as a safety index for use by engineers, planners, and other practitioners to prioritize intersection crossings with respect to pedestrians and bicyclist safety in a proactive manner. It is proposed that a limited effort be made to thoroughly review the ISI User Guide and to try to modify the way that the ISI tool is presented to make it easier to use. We also recommend a series of webinars to the pedestrian/bicycle community to help explain the purpose of the ISI tool in terms of safety and how to use it.
- **FHWA University Course on Bicycle and Pedestrian Transportation** – The FHWA University Course on Pedestrian and Bicycle Transportation contains 24 lessons on topics ranging from facility development and safety to design and advocacy. The course was designed to educate future planners and engineers about the challenges of pedestrian and bicycle planning and about recommended practices. The University Course PowerPoint presentations should be converted to PDF files. The University Course should also be regularly updated as the MUTCD and AASHTO's guidance on pedestrian and bicycle facilities are regularly updated.
- **Pedestrian Forum Newsletter** – The FHWA produces a quarterly newsletter that highlights recent pedestrian safety activities, research, and resources that relate to the 4 E's: Engineering, Enforcement, Education, and Emergency services. The newsletter is a



short document, generally three to four pages, with short articles highlighting the latest activity in pedestrian safety. Improvements to the newsletter could be made by expanding it to include more State DOTs and local news.

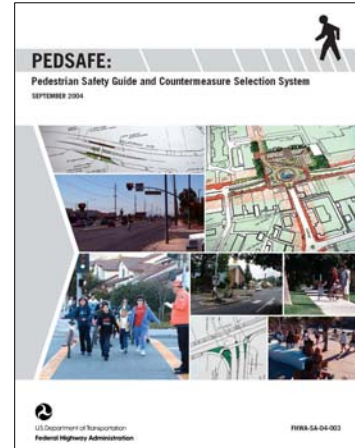
- **Pedestrian Road Safety Audit Guidelines and Prompt Lists** – The Road Safety Audit (RSA) Guide is intended to provide transportation professionals with an understanding of pedestrian safety issues through field assessments of roadway and roadside environments. Efforts should be made to provide information as to where to obtain a printed copy and to distribute the Guide at selected conferences relating to pedestrian safety and road safety audits/assessments at both the State and local level.
- **Pedestrian Safety Campaign** – The Pedestrian Safety Campaign is a toolkit of materials that State and community leaders can use to communicate pedestrian safety messages to a variety of audiences. Since the primary concern related to the Pedestrian Safety Campaign seems to be an individual’s ability to properly distribute the materials, there should be a focus on assisting States and local agencies with dissemination.
- **Pedestrian Safer Journey** – Pedestrian Safer Journey is an interactive CD that takes the user through various pedestrian safety scenarios encountered every day across America. The tool is intended to improve the level of pedestrian knowledge for all road users (including schools, driver education groups, enforcement, etc.) and safety practitioners. To promote use among all audiences, FHWA will consider developing a similar tool that includes content that is more appropriate for older and more technical audiences. To address format concerns, FHWA will also update the CD-ROM so that it is compatible with more current operating systems. Also, supplemental materials should be developed (such as posters) to enhance the messages contained in Pedestrian Safer Journey and promote its use by a wider audience.
- **Pedestrian Safety Guide for Transit Agencies** – The transit guide is intended to provide transit agency staff with an easy-to-use resource for improving pedestrian safety. The guide includes a variety of approaches to address common pedestrian safety issues that are likely to arise near transit stations, bus stops, and other places where transit (bus or rail) is operated.



In summary, there are four desired outcomes for this program:

- Develop a one-, two-, and four-hour training course on providing safe pedestrian access to transit.
- Update the Pedestrian Safety Guide for Transit Agencies with additional recent case studies. This effort must precede research statement “C7. Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas.”
- Create a companion Streetcar/ Light Rail Pedestrian Safety Guide.
- Disseminate the printed guides through conferences involving transit agencies and other media.

- Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE)** – The Pedestrian Safety Guide and Countermeasure Selection System is intended to provide practitioners with the latest information available for improving the safety and mobility of those who walk. It is recommended that the PEDSAFE Guide be updated as soon as possible. This would include revising the countermeasure descriptions based on updated pedestrian safety research from the past six years. There is also a need to update the “expert system” software to add some of the more recent engineering strategies (e.g., HAWK signal, advanced yield lines on multi-lane roads, rectangular rapid-flash beacon) into the countermeasure options.
- Resident’s Guide for Creating Safe and Walkable Communities** – This guide is intended for use by residents looking to improve pedestrian safety and walkability in their community. The Guide includes facts, ideas, and resources to help residents understand traffic safety issues that affect pedestrians and find ways to help address these issues and promote pedestrian safety. A project to update the Guide should be initiated once the findings of the NHTSA project are complete. One of the key features to the update should be additional detailed case studies.
- Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations** – This report contains guidelines for when it is or is not acceptable to install marked crosswalks. The FHWA Crosswalk study was a research report which resulted in specific guidelines and recommendations, which have now been incorporated into the 2009 MUTCD. Certainly, there is much more that needs to be learned about the best and safest manner in which to treat pedestrian crossings at uncontrolled locations. More research is needed to accomplish that, and several of the 28 recommended research studies relate to this topic (e.g., safety at midblock crossings, development of crash modification factors, etc.).
- Walkability Checklist** – The Walkability Checklist is intended to provide citizens and advocates with an easy-to-use guide for identifying local pedestrian safety concerns. The checklist provides users with a series of guided questions that allow citizens to score the walkability of their neighborhood. The scores can then be used to rank the neighborhood’s overall safety and walkability. No substantial changes are recommended for the Walkability Checklist; however, the product should be routinely revised and updated with new links and resources.
- Bicycle Safer Journey** – The purpose of Bicycle Safer Journey is to increase awareness of bicycle safety by educating all road users, including children, the general public, and safety advocates. Recommendations include making the materials available in a web format, creating a more realistic version of the tool, and creating a version more appropriate for older audiences.



- **Bicycle Compatibility Index (BCI)** – The BCI was developed to provide a measure of how comfortable roadways are for bicyclists. Although the BCI is not used as widely as some of the other analytical tools for pedestrians and bicyclists, it is still being used by some planners and engineers to analyze roadway sections for bicyclists. There are also other tools that have been developed to quantify the level of service for bicyclists, including the updated Highway Capacity Manual. Therefore, there is no recommendation for any further updating or revision of the BCI at this time.
- **Bicycle Countermeasure Selection System (BIKESAFE)** – BIKESAFE is a helpful resource for selecting appropriate countermeasures to specific issues relating to bicycle safety. It should be updated to reflect current and soon-to-be released design guidance and should be marketed to planners and engineers.



3.4 Expanded Marketing and Delivery Strategies

The following list of marketing tools, products, and delivery mechanisms should be considered when developing technology transfer components to research projects, guides, and other technology transfer products distributed by FHWA. In many cases, FHWA has already utilized some form of these strategies. In addition, other agency divisions, including the division which houses the Safe Routes to School Program and the FHWA Resource Center, will be helpful partners in this process. As outlined below, however, there are other methods and strategies worth considering that can be used to distribute information, tools, and resources.

Recommendations for developing research findings into new products can be found in Table 14 and “Appendix D. New Product Delivery/Strategy Recommendations.”

Table 14. New Product Deployment Recommendations for FHWA Office of Safety and Office of Safety Research and Development.

		Event/Conference	Mailing/Emailing	Guide	Training Course	Web Training	Software	Web Site
Problem Identification and Data Collection	Evaluate and Refine Existing Models for Predicting Pedestrian Use (A1)	X	X			X		
	Effect of Hand-Held Communication Device Use and Related Driver and Pedestrian Distraction on Pedestrian Safety (A2)	X	X			X		
	Methods to Improve Physical Conditions for Pedestrians along Existing Roads (A3)	X	X			X		
	Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities (A4)	X	X			X		
	Race, Ethnicity, and Immigrant Status for Pedestrian Morbidity and Mortality (A5)	X	X			X		
	Understanding Diverse Vision Needs of Pedestrians (A6)	X	X			X		
	Automated Pedestrian/Vehicle Conflict Video Data Collection (A7)	X	X		X	X		
	Evaluation of Automated Pedestrian Detection Technologies (A8)	X	X			X		
Analysis and Decision Making	Identification and Prioritization of High Pedestrian Crash Locations/Areas (B1)	X	X	X		X	X	
	Using Automated Counters to Identify Pedestrian Volume Patterns and Extrapolation Factors (B2)	X	X			X		
	Identification of Institutional Barriers to Pedestrian Funding, and Recommended Practices for Using Pedestrian Facility/Safety Funds (B3)	X	X		X	X		X
	Relationships between Land Use, the Built Environment, and Pedestrian Safety (B4)	X	X			X		
Innovative Research and Evaluation	Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians (C1)	X	X	X		X		
	Effects of Traffic Signals on Pedestrian Behavior and Safety (C2)	X	X			X		
	Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors (C3)	X	X			X		
	Develop Guidelines for Pedestrian Midblock Crossings (C4)	X	X	X	X	X	X	
	Pedestrian Crash Modification Factors (C5)	X	X	X	X	X	X	
	Accessible Pedestrian Signals (C6)	X	X	X		X		
	Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas (C7) * ^	X	X	X	X	X		
	Effectiveness of White Lighting in Reducing Pedestrian Crashes at Crosswalks (C8)	X	X	X		X		
	Effects of New Pedestrian Facilities on Pedestrian Exposure (C9)	X	X			X		
	Increasing the Safety of Interactions between Pedestrians and Large Commercial Vehicles (C10)	X	X			X		
	Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks (C11)	X	X		X	X		
	Evaluation of the Applicability of Lower-Speed Street Designs in Residential and Commercial Zones (C12)	X	X	X		X		
Technology Transfer	Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network (D1)	X	X	X		X		X
	Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference (D2)	X	X	X	X	X		X
	Best Practices for Pedestrian Facility Maintenance (D3)	X	X	X	X	X	X	X
	Survey of Procedures for Implementing and Evaluating Experimental Treatments (D4)	X	X	X		X		X

- **Event/Conference Marketing** – The results of the study could be developed into a workshop or panel discussion at conferences for professionals in the field, such as the Transportation Research Board (TRB), Pro Walk/Pro Bike, American Planning Association (APA), and Institute for Transportation Engineers (ITE) annual meetings. These conferences, among others, draw a large number of engineers, planners, and other professionals who address pedestrian safety concerns on a daily basis. Within a conference setting, there could be multiple options for presenting the results of a particular study such as presentations, poster sessions, or panel discussions.

In order to effectively reach the conference attendees, these methods should be combined with marketing efforts prior to the conference.

To reach a more broad audience of professionals, FHWA should consider marketing its resources at conferences that address related fields, such as health, transit, and smart growth. Offering materials and sessions at these conferences would allow FHWA to reach a broader audience and ensure that pedestrians are considered in multiple fields.

In addition to hosting sessions at existing conferences, FHWA could explore the possibility of hosting its own conferences at the State, regional, and local levels. Many professionals working for these agencies may not have access to national conferences, so bringing that information to them could be an effective strategy.

- **Direct Mailing/Emailing** – Professionals would be alerted to the research findings via mailing list or listserv. Numerous organizations distribute weekly, monthly, or quarterly newsletters to their members. These organizations often circulate requests for announcements, which would allow FHWA and researchers the opportunity to share news of recently completed research and findings. Guides, training courses, webinar opportunities, and conference announcements (which also serve as potential deployment options for new research) could be included in these newsletters as well. In addition to including announcements in these newsletters, FHWA will use its own mail and email lists (and those operated by FHWA programs like the Pedestrian and Bicycle Information Center (PBIC)) to distribute news releases announcing recently completed projects.

To reach individuals at the State, local, and regional levels who may not readily have access to an email listserv, FHWA will distribute materials directly through division offices and State DOTs. FHWA should also explore emerging technologies and social media services, which have become increasingly popular among professionals looking to network and share information.

- **Successful Practices Guide** – Research findings could be developed into a revised version of FHWA's *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes*. The guide would also document pedestrian projects that incorporate pedestrian-friendly designs and



policies. Any best practices guides would be well-designed and user-friendly. Graphics and images should be incorporated throughout the guides and the language should be relatively simple and written to an appropriate audience.

- **In-Person Training Course Expansion** – A variation on one or more of the pedestrian safety action plan (PSAP) courses could be developed to communicate the findings to groups of professionals across the country, such as top-level State and city DOT officials in conjunction with the existing two-day courses. Experts on that particular topic (which may include those involved in the original PSAP Guide and trainings) would lead the training courses in individual communities that expressed interest or need. The two- and three-day PSAP trainings have been successful in reaching a variety of audiences, and should be used as a model for future training courses. These courses have been offered at no cost to professionals in Focus Cities and Focus States where pedestrian safety concerns and crash trends are especially problematic. It is recommended that expanded training should continue to be offered at no cost to Focus Cities and Focus States, and also non-Focus Cities and Focus States that have demonstrated a need for technical assistance in the area of pedestrian safety.
- **Web Training** – A webinar or web conference could be developed to present the research findings to a large audience simultaneously. Agencies are increasingly looking toward distance education and web training to meet their employees' professional development needs. A brief presentation (or series of presentations) could be developed from the research findings and delivered using web presentation software. Announcements for webinar registration could be included in the aforementioned newsletters and mailings, allowing a large audience access to the training.
- **Software** – More technical findings should be developed into software programs (similar to PBCAT), and be distributed via listservs or websites. A website is currently being used to market PBCAT, which also serves as a portal for receiving orders for hard copy distribution. By collecting information from individuals who order the product, FHWA can easily follow up with updates to products when they are made. Various software types should be explored, including CD-ROM and open-source, web-based software.
- **Innovative Information Gathering** – Webinars and conferences can be used to collect and synthesize participant opinions, needs, and demographics, which can help evaluate the effectiveness and direction of the Strategic Plan. For example, webinar and conference participants can be provided with remote voting capabilities and assigned a unique identification. Participants can respond to questions posed by webinar and conference presenters. These responses can be shown in real time, allowing the presentation to be tailored to the knowledge base of the participants. The information gathered through these responses can be archived and used for future informational purposes.
- **Innovative Delivery Mechanisms** – A panel should be established to review and pursue marketing materials and release information through emerging forms of media such as viral video and hand-held device applications. Consideration could be given to creating a video-sharing website (similar to YouTube) where informational sources can be uploaded and viewed. So much time is often spent searching the web and multiple

websites in an attempt to find a specific link to a video or presentation. Like YouTube, this website could have a search engine designed to locate information by title, author, etc.

- **Innovative Communication Strategies** – Technologies such as 3D visualization can be used as tools to help in the selection of pedestrian-related solutions at problem locations and corridors. Visualization has been used in web applications as visual reference surveys where individuals are asked to select the types of facilities that they would prefer (e.g., wide 5-lane arterials versus 3-lane street with raised median islands, bike lanes, and pedestrian crossings). Visualization techniques and pedestrian simulators may also be considered in future pedestrian safety research, similar to current simulation techniques currently being used by INRETS in France for studying the safety of older pedestrians.

Chapter 4. Considerations for Strategic Plan Implementation

4.1 Roadmap for Implementation

The implementation of the Strategic Plan will require a 15-year period. Table 15 presents the proposed timeline for recommended Strategic Plan elements. Implementation of the Strategic Plan's elements is organized into short-term (under 5 years), intermediate (6 to 10 years), and long-term (11 to 15 years). The research timeline does not reflect the relative priority of each project. The timeframe for each element considers several factors including antecedent needs (e.g., formative research), the expected time period needed for implementation, and the urgency of the element. In Table 15, each project is presented with a research period and proposed timeframe. All projects are assigned to one of the five-year periods, with the time within each bar indicating the proposed length of the research period.

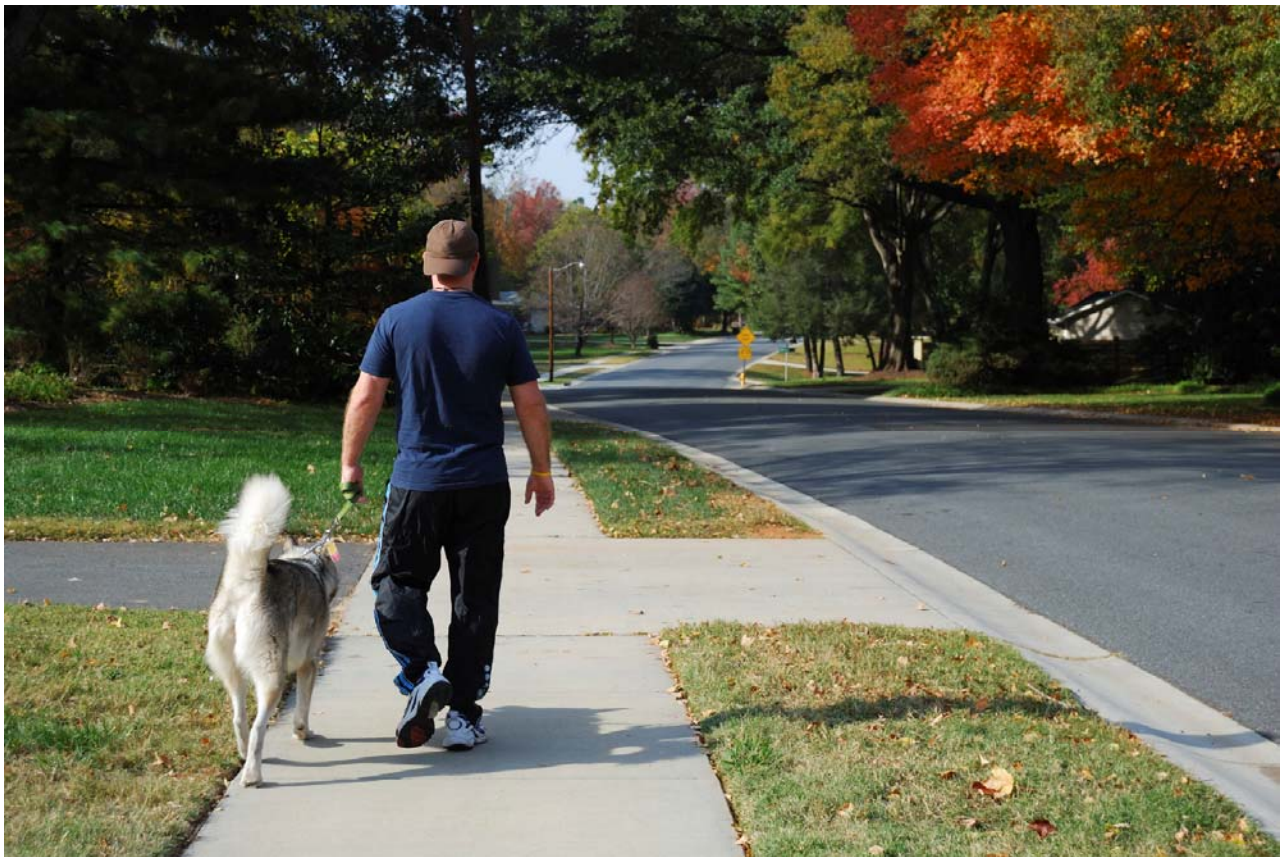


Table 15. Proposed Timeline for Strategic Plan Recommendations.

		Short-term					Intermediate					Long-Term				
		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Research	A1. Evaluate Models	2.5 Yrs														
	A2. Hand-Held Device	2 Yrs														
	A3. Improve Conditions	5 Yrs														
	A4. Traffic Control Devices						5 Yrs									
	A5. Race/Ethnicity						5 Yrs									
	A6. Vision Needs											3 Yrs				
	A7. Automated Video											2-3 Yrs				
	A8. Detection											2-3 Yrs				
	B1. Crash Area ID	2 Yrs														
	B2. Volume Patterns											3.5 Yrs				
	B3. Institutional Barriers						5 Yrs									
	B4. Land Use & Safety											3-5 Yrs				
	C1. Retrofits for Arterials	3-6 Yrs														
	C2. Traffic Signal Effects						3-5 Yrs									
	C3. Roadside Features						2-4 Yrs									
	C4. Midblock	5 Yrs														
	C5. CMFs	3-5 Yrs														
	C6. Accessible Signals						5 Yrs									
	C7. Transit Access						3-5 Yrs									
	C8. Lighting						3-4 Yrs									
	C9. Facilities & Exposure						3-4 Yrs									
	C10. Large Vehicles											2 Yrs				
	C11. Automated Enforcement						3-4 Yrs									
	C12. Low-Speed Streets	2 Yrs														
	D1. Case Studies	2 Yrs														
	D2. Parking						3 Yrs									
	D3. Maintenance	5 Yrs														
	D4. Experimental Treatments						5 Yrs									
Product Updates	PR1. Bike Journey			1 Yr												
	PR2. Bike Compatibility															
	PR3. BIKESAFE		1 Yr													
	PR4. PSAP	Ongoing					Ongoing					Ongoing				
	PR5. PBCAT			1-3 Yrs												
	PR6. Hispanic Audiences	1 Yr														
	PR7. Ped/Bike ISI			1 Year												
	PR8. University Course	1 Yr					1 Yr					1 Yr				
	PR9. Pedestrian Forum	Ongoing					Ongoing					Ongoing				
	PR10. RSA Guidelines	Ongoing					Ongoing					Ongoing				
	PR11. Ped Safety Campaign			1-2 Yrs					1 Yr					1 Yr		
	PR12. Ped Journey	1 Yr														
	PR13. Transit Guide			1-3 Yrs												
	PR14. PEDSAFE	1 Yr					1 Yr					1 Yr				
	PR15. Resident's Guide	1 Yr						1-2 Yrs					1-2 Yrs			
	PR16. Crosswalk Study															
	PR17. Walkability Checklist		1 Yr					1 Yr					1 Yr			
New Delivery	NP1. Mail/Email	Ongoing					Ongoing					Ongoing				
	NP2. Event Marketing	Ongoing					Ongoing					Ongoing				
	NP3. Training Course	Ongoing					Ongoing					Ongoing				
	NP4. Software	Ongoing					Ongoing					Ongoing				
	NP5. Web Training	Ongoing					Ongoing					Ongoing				
	NP6. Successful Practices	Ongoing					Ongoing					Ongoing				
	NP7. Info Gathering	Ongoing					Ongoing					Ongoing				
	NP8. Delivery Mechanisms	Ongoing					Ongoing					Ongoing				
	NP9. Communication	Ongoing					Ongoing					Ongoing				
Identification of New Research Needs		Ongoing					Ongoing					Ongoing				

The actual implementation schedule of these elements will also depend on available funding from various organizations. The implementation schedule may also change as pedestrian activity and crashes change, and with advances in technology in supporting fields such as crash data advances. It is important to note that the project details presented in this Strategic Plan are recommendations and may be altered based on the needs and goals of the supporting agency.

4.2 Evaluation Methods

The Strategic Plan is intended to be reviewed, evaluated, and updated periodically. The program and activities identified in this Strategic Plan were developed based on the current state of knowledge and current research needs. Pedestrian crashes, pedestrian trips, emerging technologies, and funding may all change the way the Strategic Plan is tracked and implemented. Inter- and intra-agency meetings to review the Strategic Plan should occur frequently throughout the period covered by the Strategic Plan. Meetings should be held bi-annually and involve key stakeholder agencies and offices. The Strategic Plan should be evaluated for effectiveness on an annual basis, focusing on measures such as pedestrian fatalities and injuries, and pedestrian travel trends such as trips and/or mode share. More detailed meetings/workshops to assess the overall direction of the Strategic Plan should occur every two to five years. These meetings could be conducted much in the same way the Strategic Plan was developed: reviewing literature, analyzing crash trends, obtaining stakeholder feedback, and analyzing product delivery and technology transfer activities. Individual audiences and user groups (such as planners, engineers, local officials, among others) could be interviewed to solicit feedback in order to guarantee that the tools being developed are reaching their intended audiences and are addressing their needs. Several strategies can be used to get this feedback, including:

- Interviews with professionals,
- Analysis of web statistics, and
- Focus group testing or meeting.

By routinely evaluating the effectiveness of new products, FHWA can alter product development and deployment strategies to more closely match the needs of professionals in a variety of fields. Based on these efforts, the Strategic Plan should be periodically revised to reflect the state of the practice, re-assessed research needs, and emerging technologies.

The Strategic Plan provides a framework for implementing program activities and research likely to have the greatest impact on the improvement of pedestrian safety. It is expected that over time pedestrian fatalities and injuries will be reduced. However, since the focus of this Strategic Plan is largely based on engineering measures to address pedestrian safety, implementation of this Strategic Plan will require coordination with other agencies to ensure the remaining “Es” of safety (education, enforcement, and emergency medical services) are addressed.

Success of this Strategic Plan and the FHWA Office of Safety's overall Pedestrian and Bicycle Safety Program must not only consider the effect on pedestrian crashes, but also the effect on pedestrian activity. That is, a decrease in pedestrian fatalities and injuries should be accompanied by an increase in pedestrian activity.

The FHWA Office of Human Environment is expected to be an important collaborator in promoting walking as a mode of travel and evaluating walking activity.

The Strategic Plan's ultimate goal of reducing pedestrian fatalities and injuries will yield other benefits to the FHWA Office of Safety's overall Pedestrian and Bicycle Safety Program. This includes increased collaboration among interested agencies, improved pedestrian accessibility, and potentially an increased pedestrian mode share.



4.3 Potential Roles and Partnerships

Effective deployment and implementation of this Strategic Plan will require coordination between FHWA offices and other agencies. While specific recommendations regarding program funding, staffing, and management are not made in this Strategic Plan, the FHWA Office of Safety and the Office of Safety R & D should promote interagency collaboration in pursuit of funding and completing the recommended activities.

It is expected that, in general, the Office of Safety will primarily oversee the technology transfer activities and the Office of R & D will oversee the research activities. However, for several of the activities, there could also be a shared responsibility for funding and oversight from other agencies and offices. Potential partner agencies include other agencies within the FHWA, other Federal agencies, research organizations, State DOTs, and private organizations. For a listing of potential partnerships, see Table 16.

As previously described, the recommendations listed in the Strategic Plan will be made available to a variety of agencies, offices, and partners. Due to limited resources within any one agency or office, the implementation of this Strategic Plan will require cooperation between potential funders. Collaborative funding mechanisms will ensure that the separate pieces of the Strategic Plan will be supported by a variety of groups that have a stated commitment to improving pedestrian safety.

4.4 Barriers and Challenges

While the Strategic Plan provides a 15-year framework for FHWA pedestrian research activities, there are several potential barriers to its full implementation. The largest barrier is funding limitations. While federal funding available for pedestrian improvements has been increasing steadily over time, it still remains a small portion of the overall transportation budget. The total amount of pedestrian (and bicycle) funding from federal sources has only accounted for about 1.5 percent of total annual Federal Aid Highway Program funds reserved for transportation projects.⁵ This compares to pedestrians accounting for 4,378 fatalities of the 37,261, or 11.7 percent of total traffic fatalities in 2008.

One strategy to address funding limitations is for the FHWA Office of Safety and the Office of Safety R & D to collaborate with other federal, State, and private agencies. This collaboration would involve pooling of resources in order to fund research and other activities (Table 16).

4.5 Conclusion

This document provides recommendations for a nationwide Strategic Plan which addresses future needs for research and also for technology transfer activities related to the roadway environment over the next 15 years. Although this report was produced for the FHWA Office of Safety and Office of Safety R&D, the recommendations contained herein may pertain not only to FHWA but also to other potential partners who have responsibility and/or interest in creating a safer roadway environment for pedestrian travel. This Strategic Plan is meant to be flexible to allow for adjustments based on changing safety concerns, trends, and needs for pedestrians. Forming strong partnerships with other agencies is important to ensure that progress is made toward managing pedestrian safety and mobility in the years ahead.

⁵ Federal Highway Administration. Highway Statistics: Finance. Retrieved from <http://www.fhwa.dot.gov/policy/ohim/hs06/finance.htm>.

Table 16. Potential Partnership Opportunities for Project Recommendations

Strategic Plan Element		FHWA Office of Operations	FWHA Office of Planning/Envr.	FMCSA	FTA	NHTSA	NCHRP	TCRP	Pooled Fund Program	Private
Problem Identification and Data Collection	Evaluate and Refine Existing Models for Predicting Pedestrian Use (#1, Timeline: 5 Years)		X				X			X
	Effect of Hand-Held Communication Device Use and Related Driver and Pedestrian Distraction on Pedestrian Safety (#2, Timeline: 5 Years)					X	X	X		X
	Methods to Improve Physical Conditions for Pedestrians along Existing Roads (#3, Timeline: 5 Years)						X		X	X
	Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities (#15, Timeline: 10 Years)		X				X			X
	Race, Ethnicity, and Immigrant Status for Pedestrian Morbidity and Mortality (#16, Timeline: 10 Years)						X	X		X
	Understanding Diverse Vision Needs of Pedestrians (#23, Timeline: 10-15 Years)						X			X
	Automated Pedestrian/Vehicle Conflict Video Data Collection (#24, Timeline: 10-15 Years)		X				X			X
	Evaluation of Automated Pedestrian Detection Technologies (#25, Timeline: 10-15 Years)		X				X		X	X
Analysis and Decision Making	Identification and Prioritization of High Pedestrian Crash Locations/Areas (#10, Timeline: 10 Years)						X		X	X
	Using Automated Counters to Identify Pedestrian Volume Patterns and Extrapolation Factors (#27, Timeline: 10-15 Years)		X				X			X
	Identification of Institutional Barriers to Pedestrian Funding, and Recommended Practices for Using Pedestrian Facility/Safety Funds (#17, Timeline: 10 Years)					X	X	X	X	X
	Relationships between Land Use, the Built Environment, and Pedestrian Safety (#26, Timeline: 10-15 Years)	X					X			X
Innovative Research and Evaluation	Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians (#4, Timeline: 5 Years)						X		X	X
	Effects of Traffic Signals on Pedestrian Behavior and Safety (#18, Timeline: 10-Years)		X			X	X	X		X
	The Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors (#11, Timeline: 10 Years)	X					X			X
	Develop Guidelines for Pedestrian Midblock Crossings (#5, Timeline: 5 Years)						X		X	X
	Pedestrian Crash Reduction Factors (#6, Timeline: 5 Years)						X		X	X
	Accessible Pedestrian Signals (#19, Timeline: 10 Years)		X				X		X	X
	Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas (#12, Timeline: 10 Years)				X		X			X
	Effectiveness of White Lighting in Reducing Pedestrian Crashes at Crosswalks (#13, Timeline: 10 Years)		X				X			X
	Effects of New Pedestrian Facilities on Pedestrian Exposure (#14, Timeline: 10 Years)	X					X			X
	Increasing the Safety of Interactions between Pedestrians and Large Commercial Vehicles (Trucks and Buses) in Urban Areas (#28, Timeline: 10-15 Years)			X	X		X		X	X
	Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks (#20, Timeline: 10 Years)					X	X	X		X
	Evaluation of the Applicability of Lower-Speed Street Designs in Residential and Commercial Zones (#9, Timeline: 5 Years)						X			X
Technology Transfer	Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network (#7, Timeline: 5 Years)	X					X		X	X
	Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference (#21, Timeline: 10 Years)						X		X	X
	Best Practices for Pedestrian Facility Maintenance (#8, Timeline: 5 Years)						X		X	X
	Survey of Procedures for Implementing and Evaluating Experimental Treatments (#22, Timeline: 10 Years)						X		X	X

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Appendix B. Research Problem Statements

The following research problem statements have been numbered to reflect their position in this document. The preceding letter indicates the section of recommended research activities with the letter A identifying “Problem Identification and Data Collection,” B identifying “Analysis and Decision Making,” C identifying “Innovative Research and Evaluation,” and D identifying “Technology Transfer.”

A1. Evaluate and Refine Existing Models for Predicting Pedestrian Use

Problem: One of the most significant barriers to conducting pedestrian research is the lack of data on the number of pedestrians that use any given sidewalk, path, crosswalk, or other facility. Pedestrian volume data can be used to account for exposure when analyzing pedestrian-vehicle crashes at specific locations, to document changes in pedestrian volumes before and after pedestrian facilities are improved, or for assessing the need for pedestrian crossing improvements, such as signals and grade separations. However, pedestrian counts are too expensive to perform everywhere in a community, and sketch planning methods only rank locations where pedestrian activity is likely to be higher or lower rather than provide actual volume numbers. Therefore, statistical models have been developed to estimate pedestrian volumes in several communities in the United States. Communities with pedestrian volume models now include Baltimore (Clifton 2004), Oakland (Raford and Ragland 2004), Charlotte (Pulugurtha and Repaka 2008), San Francisco (Liu and Griswold 2008), Alameda County (Schneider, Arnold, and Ragland 2009), San Diego (Jones, et al. 2010), and Santa Monica (Haynes, et al. 2010). All of these models predict pedestrian volumes at intersections (either crossings or approaches). Two of the models predict pedestrian volumes along street/sidewalk segments (Oakland and Baltimore).

New pedestrian volume models represent a significant step forward for pedestrian planning and safety analysis. However, few of these models have been evaluated and compared. While many of the models share some common inputs, such as measures of population density and employment density, all have unique variables and assign different weights to each input. These variations are due to differences in the sample of sites used to collect the empirical pedestrian volume data, counting methods, variables considered for modeling, statistical modeling approaches, and unique aspects of the communities where the models were developed. Therefore, there is a need to understand the margin of error of the pedestrian volume estimates from each model and identify the types of locations where the models work well and where they may not be appropriate. This will lead to a better understanding of which models should be promoted for broader application throughout the United States and identify shortcomings that can be improved through future research.

Objective: Evaluate the existing pedestrian volume models using a set of criteria in order to identify which models are appropriate in different types of locations in different community settings. Criteria for comparison should include:

- Methodology used to develop the model (site selection process, counting process, adjustments to counts for weather/time of counts/seasonality/land use variations, predictive variables considered, statistical modeling process)
- Statistical significance (model parameters should be relatively precise estimates of the true effect of each variable in order to be defensible to technical critique)
- Consistency with theoretical expectations (model parameters should have signs and magnitudes that make sense in order to be defensible for practical application)
- Ease of use (ease of collecting inputs, ease of applying the model formula, ease of understanding the model output)
- Predictive accuracy at locations in a variety of communities (predicted pedestrian volumes are close to actual pedestrian counts)

This study should be done in three phases: 1) Review the technical aspects of each model and write a detailed summary of the methodology used to develop each model. Include any additional pedestrian volume models that are not mentioned in this research statement. 2) Apply each model in several different communities. In order to do this, it would be necessary to collect background GIS data from local jurisdictions and calculate all model inputs. The pedestrian volume estimates from each model would then be compared with pedestrian count data collected at a variety of sites in each community. This would show the predictive accuracy of each model in different situations. Existing modeling techniques such as Space Syntax may be prohibitively expensive to apply due to software requirements, but vendors should be approached to see if they would be willing to donate time or software to participate in the study. 3) Develop a final report describing the strengths, weaknesses, and possible applications for each pedestrian model as well as suggestions for future pedestrian model development. The results of this work should be shared through outlets such as a FHWA Technical Brief, the TRB Annual Meeting, and the ITE Journal.

Key Words: pedestrian volume, pedestrian volume estimation models

Related Work: The National Cooperative Highway Research Program (NCHRP) Project 08-78 is currently evaluating methods to “estimate and forecast bicycling and walking activity in relation to transportation infrastructure characteristics, land use, topography, weather/climate, and socio-demographic characteristics.” However, this project has a broad scope and is likely to produce tools for integrating pedestrian and bicycle modes into regional travel demand models, which tend to be applied at a larger scale than is useful for evaluating pedestrian exposure and safety at specific locations, such as intersections and street segments. In addition, it is unlikely that the NCHRP project will include resources to perform validation testing of existing pedestrian volume models in different communities.

Research Period: 2.5 years (6 months for Phase 1, 18 months for Phase 2, and 6 months for Phase 3)

1. Review each model
2. Apply/evaluate models
3. Final report and recommendations
4. Develop comprehensive model

Urgency, Payoff Potential, and Implementation: Traffic engineers, planners, and safety analysts are the intended users of the research findings. This study will increase awareness about the variety of models that are now available for estimating pedestrian volumes. In addition to increasing technical capacity, the study will also provide better information about the accuracy and applicability of these tools and increase the credibility of pedestrian demand and safety analysis.

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A2. Effect of Hand-Held Communication Device Use and Related Driver and Pedestrian Distraction on Pedestrian Safety

Problem: Due to continuing technological advances over the last two decades, hand-held communication devices (e.g., cell phones) are commonly used by motorists and pedestrians. Studies have shown that such devices are a distraction to motor vehicle operators in that they divert driver attention from the roadway. Driver use of these devices has a direct effect on perception-reaction time, compliance with traffic control devices, and communications with other road users – all of which can affect the vehicle’s path. While research today has focused primarily on vehicular safety issues associated with hand-held communication devices, distracted drivers in general pose a risk to pedestrians crossing the street or walking along the road.

In urban business districts and college campuses, pedestrian use of hand-held communication devices is also widespread and pedestrian attention is affected. Pedestrian use of these devices has a direct effect on their perception-reaction time, compliance with traffic control devices, and monitoring the pedestrian environment. Distracted pedestrians are at increased risk of an incident due to inadequate monitoring of the walking surface and potential tripping hazards, failing to check for approaching and turning motor vehicles before entering the roadway, and following unpredictable paths.

A multimodal transportation system will involve pedestrians and vehicles in close proximity to one another. In any such conflicts, the pedestrian is clearly the vulnerable user. Therefore, it is clear that, in order to enhance pedestrian safety, there is a need to understand the specific hazards that hand-held communication devices (whether used by drivers or pedestrians) pose for pedestrians. As a result, while there are certainly many causes and sources of distraction to drivers and pedestrians, the primary focus of this proposed study will be on the role technology (such as hand-held devices) plays on pedestrian safety.

The research has direct implications for policymakers.

Objective: The main objective of this research is to evaluate the potential effects of driver and pedestrian use of hand-held devices on the safety of pedestrians. Given the broad scope and the complexity of the topic, the proposed research has been divided into four phases. The phases could be conducted serially or, except for the final stage, conducted in parallel, depending on availability of resources.

The first phase would be to determine the magnitude or potential magnitude of the problem. The tasks within this phase include:

- Conduct a review of the published literature to identify risk to pedestrians posed by driver and pedestrian use of hand-held devices.

- Through short-term field observations at selected geographic locations, quantify hand-held device usage by drivers and pedestrians.
- Compile and summarize pedestrian-vehicle crash data to quantify the involvement of hand-held device usage in such crashes.
- Prepare a technical report documenting the methodology and results of Phase 1.

The second phase of the research would assess the effect of hand-held device usage on driver and pedestrian attention. Tasks within this phase include:

- Use a driving simulator to study the effect of driver device usage on inattention.
- Use a controlled environment to study the effect of pedestrian device usage on inattention.
- Prepare a technical report documenting the methodology and results of Phase 2.

The third phase would identify regulatory controls that have been implemented and evaluate their effectiveness. Tasks within this phase include:

- Prepare a compilation of State and local regulations addressing hand-held device usage by drivers and pedestrians.
- Compare pedestrian crash data before and after implementation of regulations.
- Survey drivers and pedestrians in multiple states about their perceptions of driver and pedestrian use of hand-held devices.
- Prepare a technical report documenting the methodology and results of Phase 3.

The fourth phase would synthesize the results of the previous three phases into a report documenting the effects of driver and pedestrian hand-held device use on pedestrian safety and recommending policy action, enforcement strategies and educational programs intended to improve pedestrian safety. Tasks within this phase include:

- Critically review the findings from Phases 1, 2 and 3.
- Develop recommendations for improving pedestrian safety in the areas of policy, enforcement, and education, specifically related to the use of hand-held devices.
- Develop an implementation plan for each of the areas identified above.

Key Words: hand-held electronic devices, cell phones, text messaging, pedestrian distraction, driver distraction, pedestrian safety

Related Work: The National Highway Traffic Safety Administration (NHTSA) estimates that more than 25 percent of reported crashes involve some form of driver inattention and distraction. A study conducted by the Virginia Tech Transportation Institute for NHTSA in 2006 found that almost 80 percent of crashes and 65 percent of near crashes (or conflicts) involved some form of driver inattention and distraction within 3 seconds of the crash. Typical causes of driver distraction include (but are not limited to) use of cell phones or other hand-held devices, fatigue, and other in-vehicle activity (such as eating, applying make-up, or reading).

Research indicates that motorists using hand-held devices are four times as likely to be involved in an injury or property damage only crash while driving than drivers who do not use hand-held devices (Insurance Institute for Highway Safety, 2006; McCartt, Hellinga and Braitman, 2006; McEvoy, Stevenson, McCartt, Woodward, Haworth, Palamara and Cercarelli, 2005; National Safety Council, 2005). Recent studies (Neyens and Boyle, 2007, 2008) have shown that teenage drivers are overrepresented in these crashes when compared to other groups. Huang, Stutts and Hunter (2003) found that, while crashes involving use of cell phones by drivers are less likely to be serious or fatal, they are twice as likely to be rear-end type collisions and somewhat more likely to occur during off-peak hours on streets in urban areas.

In light of the data demonstrating adverse safety effects of hand-held devices, it is not surprising that policymakers are interested in regulating use of hand-held devices by drivers. Since the first law passed in New York in 2001 banning use of hand-held cell phones while driving, several other states (including California, Connecticut, New Jersey, Washington) have enacted laws prohibiting the use of hand-held cell phones while driving (Governors Highway Safety Association, 2008). In addition, several states have special cell phone driving laws for novice (teenage) drivers and others are considering similar policy measures.

While most studies have based their analyses on simulated experiments and the effect on driver perception-reaction times while using hand-held devices, some studies have analyzed crash data and cell phone usage bills to examine the relationship between crashes and driver use of hand-held devices. Very few studies have examined the effect of driver cell phone use on pedestrian safety and on the safety consequences of pedestrian use of hand-held devices. Therefore, there is a need for research that examines the effect of hand-held communication devices on pedestrian safety.

Research Period: 2 years (24 months)

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| <ol style="list-style-type: none">1. Determine magnitude of problem2. Controlled attention assessment3. Identify and evaluate solutions4. Final report and recommendations |
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Urgency, Payoff Potential and Implementation: There has been a considerable emphasis on encouraging the use of human-powered modes of transportation such as walking and biking in recent years. However, encouraging pedestrian activity also requires making conditions safer for pedestrians and bicyclists, especially in terms of reducing vehicle-pedestrian conflicts. The outcomes of this research will support evidence-based decisions and policies regarding driver and pedestrian use of hand-held devices. Given the potential for saving lives and reducing serious injuries, this research should receive high priority. While this research should focus on hand-held communication devices (given they are currently seen as the most critical for improving safety) the research could be expanded to include all hand-held devices including music devices.

Problem Statement Drafted using Research Needs Statements: “Effect of Hand-Held Communication Device Use on Pedestrian Safety” by Ronald Eck and Srinivas Pulugurtha and “Evaluating the Effect of Driver Cell Phone Use on Pedestrian and Bicyclist Safety” by Srinivas Pulugurtha.

A3. Methods to Improve Physical Conditions for Pedestrians along Existing Roads

Problem: Sidewalks are an important part of a “Complete Street” – a national initiative to plan, design, build, and maintain a street for all users, and not just for motor vehicles. Conditions for pedestrians along existing roads have wide-ranging impacts on pedestrian safety as well as whether public transportation services can be used, children walk to school, people walk for local trips (i.e., shopping), and perhaps most importantly whether people walk for general health. In addition, walking is in many instances not a choice, especially if the person is disabled, does not own or have use of a motor vehicle, or is too young or otherwise unable to drive. During the 1960’s - 80’s, almost exclusive emphasis was placed on automobile facilities. As a result, pedestrian facilities were often overlooked or were eliminated due to a desire to control costs or to preserve a “rural look” in the community. Many State agencies did not build sidewalks along State highway projects as a policy, leaving the obligation to the local jurisdictions which often did not have the resources to do so. When built, many sidewalks were too narrow, built right adjacent to a busy road with no buffer, or were cluttered with a host of obstacles such as utility poles, fire hydrants, traffic signal poles, irrigation structures, utility boxes, and other barriers making them undesirable for use for ambulatory pedestrians and often not usable by those pedestrians in wheelchairs. The absence of sidewalks forces pedestrians to walk in the roadway and often causes pedestrians to cross at less than desirable locations, leading to a higher pedestrian crash risk. However, the foremost negative outcome from the lack of good and continuous pedestrian facilities is inhibiting walking, which has an undesirable impact on the health of the community.

Many agencies have limited resources to retrofit their roads to provide missing sidewalk segments or to remove barriers and make existing sidewalks more suitable to walk on. State and local agencies should identify their sidewalk needs along existing roadways and then prioritize those missing or inadequate sidewalk sections for construction or retrofit. Funding sources must be identified, and a formal program is needed to assure sidewalks and pedestrian facilities are routinely provided and are well designed as a part of developer and other improvements along existing roadways.

Objective: Identify and analyze institutional barriers to improve the physical conditions for pedestrians along roadways. In the first phase, the most critical institutional measures relating to improving pedestrian accommodations along existing streets will be identified and described. Key topics include:

- Methods to identify missing or inadequate pedestrian facilities
- Methods to prioritize needs for sidewalk construction or retrofit
- Funding options

The second phase of the research will evaluate the effectiveness of current practices in making the right-of-way more suitable to walk on and accessible for pedestrians. This phase will quantify the magnitude of the problem. In addition, best practices will be identified and

documented as case studies. Finally, recommendations for improving institutional environments to support improved accommodations will be developed.

Key Words: sidewalk, safety, pedestrian accessibility, retrofit, sidewalk continuity

Related Work: A relatively recent survey of practices to address pedestrian needs by Ilona Kastenhofer of the Virginia Transportation Research Council showed that an inventory of missing pedestrian accommodations rarely exists at State and local transportation organizations. Improving any network required having data about the network. Not only were inventories non-existent, but most agencies did not keep a “wish list” of needed pedestrian improvements along existing roadways. Survey respondents reported almost 30 different types of funding for constructing missing sidewalk segments and other pedestrian accommodations, but only two were dedicated to this purpose. Most local jurisdictions, particularly cities, had well-developed prioritization methods, but only five of the 26 responding State DOTs reported such a method for the construction of missing sidewalks. Sidewalk retrofit guidelines and ten prioritization criteria are provided in the PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System (FHWA), along with a case study from Seattle on their program to identify, prioritize, fund, and build missing sidewalk segments.

Research Period: 5 years

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| <ol style="list-style-type: none">1. Identify methods/literature review2. Evaluate current practices3. Final report and recommendations |
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Urgency, Payoff Potential and Implementation: The urgency is high for planners, traffic engineers, and community leaders to have and employ a set of guidelines to identify and prioritize the missing sidewalks segments, as well as funding sources, to make their communities more suitable to walk through. This will lead to improved pedestrian safety as well as having a positive health benefit to the community.

References:

Kastenhofer, I. *Examination of Practices for Retrofitting Existing Roads with Sidewalks in Virginia*, Transportation Research Board 89th Annual Meeting, Washington, D.C., 2010.

Problem Statement Drafted using Research Needs Statement: “Methods to Improve Physical Conditions for Pedestrians along Existing Roads” by Ilona Kastenhofer.

A4. Evaluation of Traffic Control Devices for Older Pedestrians and People with Disabilities

Problem: On December 16, 2009 a final rule adopting the 2009 MUTCD was published in the Federal Register by the FHWA. Each State has up to two years to adopt the 2009 National MUTCD, or one that is in substantial compliance with the new Manual. The new MUTCD provides a host of new provisions and operating parameters for signs, traffic signals, and pavement markings. Much of the FHWA final ruling for the new MUTCD was based on research on how to serve the needs of healthy adult pedestrians with good vision. There has not been significant testing on comprehension of traffic control devices involving more vulnerable pedestrians such as elderly adults and pedestrians with disabilities. There is a continuing need to test the new traffic control devices on pedestrians with visual disabilities who may not be able to detect or understand how to use traffic signs, signals, or pavement markings effectively. Furthermore, agencies occasionally experiment with or investigate innovative or new traffic control devices, some of which have an effect on pedestrian operations or safety. Much of this testing is also typically done on the population of healthy adult pedestrians.

Objective: The objective is to investigate the effectiveness (safety, mobility, and comfort) of visual, audible, and tactile signals or traffic signs and markings for special needs populations consisting of older pedestrians and those with disabilities. This will require field testing of signs, markings, and signals that direct, warn, guide or inform pedestrians on sidewalks or crossing streets. Pedestrians of all ages and with various levels of visual and mobility impairment should be included in the test groups, but the emphasis should be on the older pedestrians. The ability of the pedestrians to understand and follow the signs, markings, and signals correctly should be observed objectively. The participants should also be asked to report the difficulties that they experienced and to provide their input on how to make the devices more functional for them.

Key Words: visual disabilities, physical disabilities, MUTCD, traffic signs, traffic markings, traffic signals, vulnerable pedestrians, elderly pedestrians.

Related Work: The National Cooperative Highway Research Program (NCHRP) Project 3-62 (*Guidelines for Accessible Pedestrian Signals*) was recently completed. This study developed guidance regarding recommended and optional characteristics of accessible pedestrian signals to optimize safe and independent crossing at signalized intersections by pedestrians who are blind. Most research that has evaluated traffic control devices with respect to elderly persons has been focused on elderly drivers. There has not been as much research on the comprehension of traffic control devices by elderly pedestrians.

Research Period: 5 years

1. Literature review
2. Select devices to evaluate
3. Evaluate devices
4. Final report and recommendations

Urgency, Payoff Potential, and Implementation: Because of the new MUTCD and the needs of vulnerable pedestrians, the urgency is high. The results will allow for the development of traffic signs, signals, and pavement markings that are easier to understand and more functional for all pedestrians. The results will also lead to future changes in the next MUTCD and to provide improved guidance on how to evaluate new traffic control devices that are being tested by State and local agencies. A separate study can be conducted to evaluate the effect of various traffic control devices on children as well as their parents' understanding on how well their children are able to comprehend the traffic control devices and safely walk along or cross streets.

Problem Statement Drafted using Research Needs Statement: "Evaluation on MUTCD Signing, Markings, and Traffic Signals for People with Visual Impairments, Children, and the Elderly" from the 2005 TRB Pedestrian Research Circular.

A5. Race, Ethnicity and Immigrant Status Evaluation for Pedestrian Morbidity and Mortality

Problem: Minority populations are often overrepresented as victims of serious injury and fatal pedestrian crashes. Examples of minority groups that are overrepresented include members of the Haitian community in Little Miami, the Native American populations, and Hispanics. New immigrants to the U.S. typically congregate in homogenous communities before dispersing into the general population in later generations. The FHWA Safety website states that Hispanic immigrants and persons of Hispanic descent are involved in a disproportionate number of pedestrian and bicyclist crashes. Hispanics represent the fastest growing population group in the United States. Some of the factors contributing to this overrepresentation include language barriers, cultural differences, lack of good pedestrian facilities, income level, and the lack of understanding of traffic laws by recent immigrants. Also, alcohol involvement is often cited for pedestrian crashes. A high level of alcohol consumption occurs among males in Hispanic culture and among Native Americans, both male and female. Since alcohol is prohibited on many reservations, those individuals wishing to drink alcohol have to travel to nearby towns to consume it, often walking home late at night on poorly lit rural roads. Unfortunately, most police reports do not include racial information or immigrant status, making accurate understanding of the ethnic pedestrian crash problems difficult to identify.

Objective: The objective is to identify and quantify the subsets of the population by race/ethnicity and immigrant status that are overrepresented as victims in serious injury and fatal pedestrian crashes and compare to the general population. The second phase of the research will be to identify the common contributing factors related to these crashes in each ethnic/racial/immigrant subset. The results will be used to develop Engineering (as well as Enforcement and Education) countermeasures and programs to target the pedestrian crashes in these ethnic communities. Barriers to effectively implementing countermeasures or reaching each targeted ethnic group (such as language difficulty or a lack of trust in police/public officials due to cultural differences) need to be identified as well.

Key Words: race, ethnicity, minority, immigrant, pedestrian safety, pedestrian fatality

Related Work: Leaf and Preusser published a study in 1997 that focused on race/ethnic characteristics of pedestrian crash victims. The report investigated the level of alcohol involvement in pedestrian crash victims and correlated these to race/ethnicity, age, and gender. It was found that some racial/ethnic groups had a significantly higher probability of alcohol intoxication when involved in a fatal crash compared to other racial/ethnic groups or the general population.

Research Period: 5 years

1. Identify target population
2. Identify contributing crash factors
3. Develop countermeasures
4. Deploy/evaluate countermeasures
5. Final report and recommendations

Urgency, Payoff Potential, and Implementation: This is an important study due to the high number of immigrants and concentrations of ethnic groups in the U.S. This project should have greater impact in urban core areas where new immigrants and ethnic minorities congregate and in and around Native American reservations. The research should lead to field testing of the identified countermeasure to measure their effectiveness on the various ethnic or immigrant populations and should include the impact on the overall population. A longer period is needed to provide a measure of crash reduction effectiveness on the pedestrian groups.

Problem Statement Drafted using Research Needs Statement: “Race/Ethnicity” by William Leaf, David Preusser, and Heike Karsch of the Preusser Research Group.

A6. Understanding Diverse Vision Needs of Pedestrians

Problem: As the U.S. population is beginning to experience an upward shift in age, there will be a commensurate increase in the number of people with declining vision since vision impairment prevalence rises with age. According to Census and other estimates, 1% to 3% of the American adult population is estimated to have low vision. Low vision is a clinical diagnostic term that refers to vision in the range of 20/70 to 20/160 (American Optometric Association (AOA), 2004a). These individuals are not classified as legally blind, but their vision loss may limit their ability to drive. This is likely to result in larger numbers of individuals who can be expected to use public transit or walking as a primary means of travel. However, if the designers of transportation facilities (including sidewalks) assume that pedestrians either have unrestricted vision or are totally blind, they may establish false expectations of pedestrians' ability and responsibility. We need to understand pedestrians' physical capabilities in order to successfully create physical and traffic environments that are safe for pedestrians. Pedestrians who are not legally blind, but are navigating with limited vision, may constitute our most vulnerable population.

Some common vision problems include Albinism, Cataracts, Corneal opacity, Diabetic retinopathy, Glaucoma, Macular degeneration, Myopia, Retinitis pigmentosa, Stargardt's macular dystrophy, and Uveitis. Information about types of vision loss and their frequency in the general population, and the specific limitations and effects associated with those types of vision loss, is not easily available to transportation planners and designers and other traffic safety professionals.

In addition to the increase in vision loss, the pedestrian environment is increasingly complex. Pedestrians need to recognize and utilize signs, signals, and markings. In particular, safe initiation of pedestrian crossing at signalized intersections depends on both knowledge of the onset of the walk interval (as indicated by the pedestrian signal indication) and on the ability to simultaneously monitor conflicting movements of vehicles that may be turning across the crosswalk or that may be running the red light. Persons having reduced visual fields may particularly have difficulty locating pedestrian signals in a visually cluttered background. Persons having low acuity often have difficulty discriminating the signal information. While it is assumed that color provides a helpful cue to discriminate pedestrian signal information, low vision and age may affect ability to discriminate color under varied lighting conditions. Usability of pedestrian signals by pedestrians with low vision appears to be influenced strongly by differences in lighting and glare.

Older pedestrians typically have decreased contrast sensitivity and visual acuity, reduced peripheral vision, and reduced "useful field of view" (Wilson and Grayson, 1980), all of which may affect their ability to use pedestrian signal information while simultaneously monitoring vehicular movement. Twenty-five percent of older persons surveyed in Orlando, FL reported that they had difficulty seeing pedestrian signals (Bailey, Jones, Stout, Bailey, Kass, and Morgan, 1992).

There is anecdotal information that ladder crosswalk markings are easier for low-vision pedestrians to follow than continental, “piano key”, or transverse lines; however, we are not aware of any research that examines this issue. Also, some have called for visual contrast of sidewalks crossing driveways to make it easier for low-vision pedestrians to stay within the sidewalk area.

Objective: The objective of this research is to provide a description of how vision affects pedestrian mobility and safety, evaluate features that may improve travel by pedestrians with low vision, and develop design guidelines to enhance visual aspects of pedestrian facilities. Practitioners will be able to better anticipate and accommodate pedestrians with low vision. By more accurately understanding the visual restrictions of pedestrians, safety planners, driver educators, enforcement, and engineering professionals will be able to better serve the greatest number of people. Specifically, this research project will:

- (1) Utilize a detailed review of the literature and experts in travel by pedestrians with low vision, catalog and explain how various limitations in vision affect one’s interactions with the transportation environment,
- (2) Conduct human factors testing on crosswalk markings, pedestrian signals, and other features identified as potentially useful to pedestrians with low vision. Some testing may take place in simulated environments or with large format video technology to examine the effects of varying features on decisions by pedestrians with varying levels of vision.
- (3) Field test of recommendations resulting from the laboratory research.
- (4) Develop guidelines for features to enhance the visual aspects of pedestrian facilities.

Keywords: safety, ADA, vision, roadway design, crosswalks, physical abilities

Related Work: There has been some work done to improve accessible design for people who are blind, which may also benefit pedestrians who are navigating with low vision. However, there is very little research that directly addresses needs of individuals with low vision in the transportation environment. Additionally, there is very little written material that explains vision loss or techniques used by individuals who are blind or who have low vision in a manner that addresses issues in the public rights-of-way. Some literature that is relevant in this area includes (a) modeling of pedestrian tasks, (b) data on prevalence of vision loss in the general population, (c) a review of low vision guides and mobility training materials for people with low vision, and (d) evaluations of use of markings, signs, and signals by pedestrians, including pedestrians who are blind.

I. Modeling of Pedestrian Tasks

- Waldau, Nathalie and Peter Gattermann, Hermann Knoflachner, and Michael Schreckenberg, eds. (2005) *Pedestrian and Evacuation Dynamics*. Berlin: Springer.

- Hugo H van der Molen (1984) Identification of Child Pedestrian Training Objectives: the role of task analysis and empirical research. *British Journal of Educational Technology* 15 (2), 125–150.

II. Data on Vision Loss Prevalence

- Prevent Blindness America. "Vision Problems in the U.S.: Prevalence of Adult Vision Impairment and Age-Related Eye Disease in America." 2008. Update to the Fourth Edition. <http://www.preventblindness.org/vpus/>. Accessed March 2, 2010
- Houtenville, Andrew J. 2008. "Disability Statistics in the United States." Ithaca, NY: Cornell University Rehabilitation Research and Training Center, www.disabilitystatistics.org. Posted May 15, 2003. Accessed May 14, 2008.
- http://www.nfb.org/nfb/blindness_statistics.asp

III. Review of Education & Training Materials

- Harkey, D.L., Carter, D.L., Barlow, J.M. & Bentzen, B.L. (2007) Chapter 2 - Travel by Pedestrians Who are Blind or Who Have Low Vision in *Accessible pedestrian signals: A guide to best practice*. National Cooperative Highway Research Program Web-Only Document 117A, Washington, DC: National Cooperative Highway Research Program. www.apsguide.org. Accessed March 2, 2010
- Numerous materials are available that describe eye diseases and treatment, mainly directed toward the patient, rather than a practitioner looking to design more accessible features, for examples, see <http://www.lighthouse.org/about-low-vision-blindness/>, <http://www.lighthouse.org/about-low-vision-blindness/all-about-low-vision/>, or <http://www.lighthouse.org/services-and-assistance/lifestyle-independence/orientation-mobility-training/>

IV. Evaluations of use of signs and signals by pedestrians, including pedestrians who are blind

- Gattis, J. L., Levinson, H.S., Gluck, J.S., Barlow, J.M., Eck, R.W., Hecker, W.F. (2010) Multimodal Driveway Design. *Transportation Research Board 89th annual meeting compendium of papers*. CD-Rom, Washington, DC: Transportation Research Board.
- Several studies as part of NCHRP 3-62 and a National Eye Institute project have evaluated crossings by blind pedestrians with and without accessible pedestrian signals (Barlow, J.M., Scott, A.C., Bentzen, B.L. (2009) Audible Beacons with Accessible Pedestrian Signals. *AER Journal: Research and Practice in Visual Impairment and Blindness*, Vol. 2, Number 4, 149 – 158; Scott, A.C., Barlow, J. M., Bentzen, B.L., Bond, T.L.Y. & Gubbe, D. (2008) Accessible pedestrian signals at complex intersections: Effects on blind pedestrians. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2073, 94–103; Harkey, D.L., Carter, D.L., Barlow, J.M., Bentzen, B.L., Myers, L. & Scott, A.(2007) *Guidelines for accessible pedestrian signals final report*. Contractor's Final Report for NCHRP Project 3-62, National Cooperative Highway Research Program Web-Only Document 117B, Washington, DC: National Cooperative Highway Research Program.; Bentzen, B.L., Scott, A.C., & Barlow, J.M. (2006) Accessible

pedestrian signals: Effect of device features. *Transportation Research Record: Journal of the Transportation Research Board*, No. 1982, 30-37; Scott, A.C., Myers, L., Barlow, J.M., & Bentzen, B.L. (2005) Accessible pedestrian signals: The effect of pushbutton location and audible WALK indications on pedestrian behavior. *Transportation Research Record: Journal of the Transportation Research Board*, No. 1939, 69-76).

- Three studies have examined perception-reaction time of pedestrians at signalized intersections, however the nature of the signal indications, ambient light, and background complexity were not systematically varied, and pedestrians with reduced vision were not intentionally included in the samples (Knoblauch, Nitzburg, Dewar, Templer and Petrucha. Older pedestrian characteristics for use in highway design. Publication No. FHWA-RD-93-177, Federal Highway Administration, 1995; Fugger, Randles, Stein and Gallegher. Analysis of pedestrian gait and perception-reaction time at signal-controlled crosswalk intersections. *Transportation Research Record* 1705, pp. 20-25, 2000; Parsonson. Signal timing improvement practices, NCHRP Synthesis of Highway Practice 172, 1992).
- Related research is currently being conducted through a National Eye Institute project (Boston College, Alan Scott) that looks at the effect of pedestrian signal symbol height, background complexity, and symbol type (symbols only, symbols plus countdown, walking person plus countdown without flashing hand) on reaction time and accuracy of interpretation of signal information by college students with different levels of simulated acuity.
- Van Houten, Blasch and Malenfant. A comparison of the recognition distance of several types of pedestrian signals with low vision pedestrians, 2001, *Journal of Rehabilitation and Development Research* 38(4)

Research Period: 3 years

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| <ol style="list-style-type: none">1. Literature review2. Human factors testing3. Field testing of lab results4. Develop guidelines |
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Urgency, payoff potential, and implementation

Vision impairment prevalence rises with age. The growing elderly population in the U.S is likely to result in larger numbers of individuals who are unable to drive because of impaired vision, many of whom can be expected to use public transit or walking as a primary means of travel. As the U.S. population is beginning to experience an upward shift in age, there will be a commensurate increase in the number of people with declining vision. It is estimated that in 2010 there will be 20 million visually-impaired persons in the U.S. over the age of 45. By increasing sensitivity to pedestrians with low vision among both our design and our enforcement and driver education communities, there should be a resulting increase in overall attentiveness and road safety. Results of this research will increase the guidance available to

practitioners in signing, installing pedestrian signals, and general design features. It may lead to language in the MUTCD that will provide improved safety in crossing decisions by pedestrians having varying levels of vision.

References

Wilson and Grayson, *Age-Related Differences in the Road Crossing Behavior of Adult Pedestrians*, Publication No. TRRL-L-933, Transport and Road Research Laboratory, Crowthorne, England, 1980

Bailey, Jones, Stout, Bailey, Kass, and Morgan, 1992, *Issues of Elderly Pedestrians*. Transportation Research Record 1375.

Problem Statement Drafted using Research Needs Statements: “Understanding Users’ Diverse Vision Needs for Safe, Usable Transit Systems” by David Levinger, “Pedestrian Signals: Visibility to Pedestrians with Varying Levels of Vision” by Beezy Bentzen, and “Pedestrians’ Vision Characteristics: Cataloguing Abilities of the General Population with respect to Common Task Requirements” also by David Levinger.

A7. Automated Pedestrian/Vehicle Conflict Video Data Collection

Problem: Each year in the United States, approximately 5,000 pedestrians are killed in traffic crashes, accounting for approximately 11% of all traffic fatality victims (NHTSA). Vehicle collisions involving non-motorized traffic often produce severe injuries. Traffic safety analyses have traditionally relied on historical collision data. However, collisions involving pedestrians are less frequent than other collision types. The use of non-collision safety measures has been advocated as a complementary approach to address the previous issues and to offer more in-depth analysis than relying on collision statistics alone. One of the most developed methods relies on pedestrian-vehicle conflict analysis. Using manual human observations to collect pedestrian-vehicle conflict data is time consuming, expensive, and is subject to human error. Video data collection offers an alternative method to collect pedestrian-vehicle conflict data. Video data collection technologies are rapidly developing. There is a need to research the emerging automated pedestrian video data collection technologies to determine their validity as an alternative to traditional manual data collection methods.

Objective: The primary objective is to conduct research on the use of automated video data collection to detect, measure, and evaluate pedestrian-vehicle conflicts and compare the accuracy to human observations. This research will include conducting a literature review to define types of pedestrian-vehicle conflicts and define the measurement parameters. Additional research will also be conducted on the most current video data collection systems. A study will be conducted to choose several video data collection systems that have shown some success in detecting, measuring, and evaluating pedestrian-vehicle conflicts. The study locations will be chosen and manual data collection will be conducted at the same locations during the same time frame as the automated video data collection. The accuracy of the results of each method will then be compared.

Key Words: pedestrian safety, video data collection, video pedestrian detection, pedestrian/vehicle conflicts.

Related Work: There have been several studies on automated data collection technologies used to detect pedestrians, but none were identified that used video data collection to detect pedestrian- vehicle conflicts. There is no standardized state of the practice established to determine pedestrian-vehicle conflicts.

Research Period: 2 – 3 years

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| <ol style="list-style-type: none">1. Literature review2. Field data collection3. Evaluate results4. Final report and recommendations |
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Urgency, Payoff Potential, and Implementation: The benefit of this project is to provide researchers and practitioners with a body of knowledge to measure the level of safety of pedestrian facilities in a more efficient and less costly way than relying on collision-based analysis or traditional manual pedestrian/vehicle conflict data collection. This will enable agencies to identify issues and evaluate treatments faster while involving less social cost due to collisions.

References:

National Highway Traffic Safety Administration. *Traffic Safety Facts 2007 Data: Pedestrians*, DOT-HS-810-994, 2008.

Problem Statement Drafted using Research Needs Statement: “Automated Pedestrian Safety Analysis using Video Data” by Sayed and Saunier.

A8. Evaluation of Automated Pedestrian Detection Technologies

Problem: Improving pedestrian safety and increasing walking are important national transportation goals for public health and environmental purposes. This emphasis will favor increased use of pedestrian signals and special devices to warn motorists of the presence of pedestrians (such as flashing beacons or in-pavement crosswalk lights). While these can be actuated with pedestrian pushbuttons, numerous studies have shown that roughly half of the pedestrians will not use pushbuttons (or find them physically difficult to use). Automated detection can be used in place of pushbuttons to trigger pedestrian phases for traffic signals, but also can be used to extend crossing times for slower pedestrians and to curtail pedestrian phases when not needed.

There is limited understanding of the most effective technologies for automated detection, partly because of the great variety of technologies. The range of automated detection technologies is growing, but includes: infrared, microwave, heat sensors, pressure mats, and computer-assisted video. There are significant concerns about the reliability of remote detection devices. Furthermore, there are questions about the maintenance requirements, liability exposure, and accessibility requirements of such devices. This research project should result in more effective and wider use of automated pedestrian detection.

Objective: The objective of this research is to test the accuracy and effectiveness of automated pedestrian detectors 1) to detect pedestrians to activate pedestrian signals (and minimize false calls and missed calls) and 2) to collect pedestrian volumes on a segment or at an intersection. The research effort will attempt to accomplish the following:

- Quantify the potential benefits of automated pedestrian detection.
- Develop a set of technical requirements for automated pedestrian detection.
- Evaluate the performance of leading technologies on the accuracy and reliability of detection.
- Identify the primary issues (including accessibility, cost, liability, and maintenance) that need to be resolved.

The proposed research will include a literature review, which will build upon an effort being conducted by a technical committee of the Institute of Transportation Engineers (ITE), described further under Related Work. Upon completion of the literature review, focused interviews will be carried out with experts in such areas as:

- Pedestrian safety and research.
- Maintenance of automated detection devices.
- Manufacturing and installation of automated detection devices.
- Liability and risk management issues.
- Accessibility issues.

Detailed case studies of at least a dozen installations in the U.S. and possibly abroad will also be conducted. These will describe the range of automated detection installations and experience. These technologies include stereoscopic video/infrared cameras, heat sensors, long wave infrared or millimeter wave detectors. Device effectiveness will be assessed, where available, on such factors as:

- Missed detection rate.
- False activation rate.
- Ability to count pedestrians and/or calculate speed.
- Impact of environmental conditions on device effectiveness (e.g., precipitation, lighting, sun angles).

These criteria will be carefully defined to minimize the impacts of subjective assessment by different personnel. The results of the literature review and survey will be summarized in a comprehensive report.

Key Words: pedestrian safety, automated detection, pedestrian data collection

Related Work:

This project will expand on the work underway by a technical committee of the Institute of Transportation Engineers (ITE). This committee is developing a broad state-of-the-art report on automated pedestrian detection, considering the literature and the views of transportation engineers and planners (including completing a major on-line survey). However, it is not undertaking original field research or case studies. The proposed project would expand on the work of the ITE committee by developing case studies. It will also explore the maintenance, legal, and accessibility issues in greater depth.

There are also several sources of literature on automated pedestrian detection that supports the potential value of these technologies. For example, a 2008 FHWA (Federal Highway Administration) *Pedestrian Safety Report to Congress* emphasized the potential of automated (or passive) pedestrian detection to improve safety. However, it also found that these technologies “require additional research and extensive field testing to demonstrate and evaluate the benefits of deploying the systems.” It pointed to concerns about costs and reliability, as well as the gap between limited U.S. experience and broader European and Australian acceptance of these devices. The Pedestrian and Bicycle Information Center provides a web survey of features of passive pedestrian detection related to Accessible Pedestrian Signals (www.walkinginfo.org/aps/7-17.cfm). A recent evaluation of several sensors at a test bed in College Station, TX found that infrared and microwave sensors had error rates ranging from 9% to 39% (Turner et al., 2007).

Research Period: 2 – 3 years

1. Literature review
2. Test/evaluate technologies
3. Develop case studies
4. Identify issues/recommendations

Urgency, Payoff Potential, and Implementation: This research project would directly address pressing questions in pedestrian safety. Automated detection of pedestrians is central to improving the effectiveness of signalized intersections and also warning devices at uncontrolled crossings. Dissemination of use of the results should contribute significantly toward the improvement of pedestrian safety.

Problem Statement Drafted using Research Needs Statements: “Automated Pedestrian Safety Analysis using Video Data” by Sayed and Saunier and “Evaluation of Automated Pedestrian Detection Technologies” by Frank Markowitz, Jim Misener, and Steve Schladover.

B1. Identification and Prioritization of High Pedestrian Crash Locations/Areas

Problem: Pedestrian crashes often appear to occur randomly because they are relatively infrequent compared to the total number of vehicle crashes. Pedestrian crash locations, corridors, or zones with large numbers of pedestrian incidents must be identified before audit tools can be employed and countermeasures can be identified to treat those areas. In urban areas, pedestrian crashes may only represent 2% of the total reported crashes involving automobiles. However, pedestrians represent a disproportionately higher percent of the injury crashes and 33% to 40% of the total fatal crashes in urban areas. Because of the relatively small number of pedestrian crashes at an individual location, they may be treated as isolated incidents. Yet, studies show that they are typically repeatable at a location or in a corridor or an area of similar characteristics or demographics. These high crash areas can be identified to implement engineering and other countermeasures to effectively treat those areas. Often local agencies do not have the resources to search and map individual pedestrian crashes or expertise to identify high crash areas. These crashes include pedestrians struck while crossing roadways as well as pedestrians walking along the roadway. Procedures are needed to provide guidance to State and local agencies on how to accurately identify and prioritize frequent pedestrian crash locations, corridors, or zones in an efficient manner.

Objective: This research will start with a synthesis of studies that have developed methods for identifying/prioritizing high or frequent pedestrian crash zones, and will follow with a recommended practices guide to assist State and local agencies in identifying high pedestrian crash locations, corridors, and zones. This project will also involve a review of literature and agency websites, and a survey of practicing pedestrian/traffic safety engineers. Efforts will focus on the use of GIS techniques to utilize geo-coded crash data for high crash identification. Furthermore, measures will be identified for prioritizing these high crash areas to determine which locations/areas should be treated first. Methods to accurately geo-code crash data will be identified so that a systematic approach can be used to identify high pedestrian crash zones by State and local agencies. Measures to identify zones or corridors with sub-sets of high pedestrian crashes (such as elderly pedestrian crashes, alcohol/impaired pedestrian crashes, immigrant pedestrian crashes, or child pedestrian crashes) will also be documented.

Key Words: pedestrian safety, GIS, geo-coded crashes, pedestrian crash zones, pedestrian countermeasures

Related Work: An Elderly Pedestrian Zone study conducted in the early 1990's by Blomberg and Zegeer found that nearly 50% of the elderly pedestrian crashes in Phoenix occurred within about 5% of the city. Elderly pedestrian zones depicting a disproportionate number of crashes were also identified in Chicago as a part of this same study. This study identified areas to provide targeted engineering, educational and other countermeasures to treat the types of crashes involving elderly pedestrians. Some guidance on the identification of high pedestrian crash locations, corridors, and zones was provided in the FHWA report *How to Develop a*

Pedestrian Safety Action Plan (2006) by Zegeer et al. A case study example using Seattle experience was provided.

Research Period: 2 years

1. Synthesis of related work/literature
2. Evaluate prioritization methods
3. Apply methods to sample database
4. Final report and recommendations

Urgency, Payoff Potential, and Implementation: This research has a high sense of urgency. Agencies need information on how to identify and prioritize high pedestrian crash zones before they can use audit tools and other mechanisms for identifying appropriate countermeasures and other treatments. This is especially important for urban and suburban areas where most pedestrian crashes occur. The need is greatest for those agencies that do not have the expertise in utilizing traffic safety tools for high pedestrian crash zone identification. The resulting guidance can be disseminated in a training course module that would be incorporated into the FHWA *How to Develop a Pedestrian Safety Action Plan* training course.

B2. Using Automated Counters to Identify Pedestrian Volume Patterns and Extrapolation Factors

Problem: Accurate methods of counting pedestrians are needed to quantify exposure for safety analysis, prioritize infrastructure improvements and safety programs, evaluate the benefits of pedestrian projects, develop models of pedestrian volumes, and track changes in pedestrian activity over time. The number of communities collecting pedestrian counts is increasing, but most agencies only have enough resources available to conduct counts during short time periods (e.g., a few hours on a single day each year). Therefore, it is important to understand how the pedestrian volumes during these short time periods relate to pedestrian volumes at other times. Automated pedestrian counting technologies provide continuous count data that can be used to identify pedestrian activity patterns and extrapolate short counts to daily, weekly, and annual pedestrian volumes. Methods exist for extrapolating annual motor vehicle volumes from short time period counts, as formalized in the Federal Highway Administration's *Traffic Monitoring Guide*. In contrast, methodologies for extrapolating pedestrian volumes are much less established.

A small number of local and regional agencies, researchers, and consultants have started to use automated counters to document pedestrian volume patterns and develop factors to extrapolate short counts to longer time periods. However, these prior efforts have used a variety of count technologies and different location sampling approaches. Most results are specific to a particular community. Therefore, there is a need to compile and review existing automated pedestrian volume data from a variety of communities and analyze it according to a systematic approach. This analysis will make it possible to establish more accurate pedestrian extrapolation factors that can be used in communities throughout the United States. It will also provide guidance for communities that seek to develop their own pedestrian extrapolation factors.

Objective: Provide guidance on how to extrapolate short pedestrian counts to daily, weekly, and yearly time periods. This study should be done in four main phases:

- 1) Review previous research on pedestrian volume extrapolation factors. Summarize the adjustment factors that have been developed in the following categories: time of day, day of week, season of year, annual trends, weather (e.g., snow, rain, clouds, hot temperatures, cool temperatures, humidity, wind), and land use (e.g., central business district, neighborhood commercial area, residential area, near multi-use trail, near school). Include a detailed summary of the methodologies used to derive these extrapolation factors (e.g., What types of automated counters were used? Was the counter used at a sidewalk, trail, or other location? What were some of the challenges of gathering the data?).
- 2) Develop preliminary extrapolation factors using data from a set of 10 to 15 communities of different sizes in different regions of the United States. Each of the study communities should have at least one year of continuous pedestrian count data at three to five sites. Some of the study communities may already have automated counter data

that can be used for this project, as long as the data collection methods have been documented in detail. Other communities may require new automated counters to be purchased through the project. The continuous pedestrian data will be used to calculate the relationship between a one- or two-hour pedestrian volume counted during any specific hour of the day or week and the cumulative pedestrian volume over a full day, full week, or full year. Extrapolation factors should be designed to be as applicable as possible to a wide variety of communities and situations, but they should also recognize major differences in pedestrian volume patterns by land use or type of urban area, climate patterns, recreational activity patterns, and primary community industries (e.g., university town vs. industrial city). Note situations where generalized adjustment factors may not be appropriate (e.g., near museums, stadiums, festival locations or other special pedestrian attractors that do not have regular schedules).

- 3) Collect new continuous pedestrian count data in several additional communities to test the accuracy of the preliminary extrapolation factors, and modify them as necessary. Analyze the variability of pedestrian volumes from day-to-day (or week-to-week) from all of the automated counter data and report the level of accuracy that is expected when applying the extrapolation factors.
- 4) Develop a pedestrian supplement to the FHWA *Traffic Monitoring Guide*. This supplement will include the final extrapolation factors developed from the analysis of pedestrian volume patterns in each study community. It should also provide a discussion of the strengths and weaknesses of the methodologies used to develop the extrapolation factors, and provide examples of how to apply the factors. The pedestrian supplement should also provide clear direction to communities that wish to develop their own pedestrian adjustment factors. This may include a detailed summary of the approach used in the study communities. The results of this work should be shared through outlets such as a FHWA Technical Brief, the TRB Annual Meeting, and the ITE Journal.

Key Words: pedestrian volume, extrapolation, adjustment factors, Traffic Monitoring Guide supplement

Related Work: Zegeer (2005) used 12-hour pedestrian volume patterns to develop extrapolation factors for midblock crossing counts in urban, suburban, and rural locations. Aultman-Hall (2009) studied one year of continuous count data from a sidewalk location in Montpelier, VT to identify weather effects on pedestrian volumes. Schneider et al. (2009) and Schneider et al. (2010) calculated factors to adjust two-hour manual pedestrian counts to weekly and annual pedestrian volumes at specific locations in Alameda County, CA. These factors accounted for differences in counts by time of day, day of week, season of the year, surrounding land use, and weather condition. Alta Planning and Design (2010) has compiled pedestrian volume data from volunteer communities throughout the country as a part of the National Documentation Project. These data have identified differences in hourly and daily pedestrian and bicycle activity patterns. They have also shown unique seasonal volume patterns in different climate regions in the United States.

The most recent edition of the FHWA *Traffic Monitoring Guide* was published in 2001. This reference provides guidance for collecting short motor vehicle counts and extrapolating them to daily, weekly, and annual volumes. A motorcycle supplement was added to the *Traffic Monitoring Guide* in 2008 to provide correction factors for daily and weekly motorcycle volume patterns. In order to support the development of a multimodal transportation system and promote livability, it is essential to have analysis tools that apply to users of all modes, including pedestrians and bicyclists. Therefore, the pedestrian supplement will be an important addition to the FHWA *Traffic Monitoring Guide*.

Research Period: 3.5 years (6 months for Phase 1, 18 months for Phase 2, 12 months for Phase 3, and 6 months for Phase 4)

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| <ol style="list-style-type: none">1. Review related research2. Collect continuous count data3. Develop extrapolation factors4. Develop guide |
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Urgency, Payoff Potential, and Implementation: Traffic engineers, planners, and safety analysts are the intended users of the research findings. This study will provide extrapolation factors that can be used to estimate daily, weekly, and yearly pedestrian volumes from short manual counts. The extrapolation factors will be applicable in a variety of community contexts. It will give analysts the ability to estimate pedestrian volumes and compare them with daily, weekly, and yearly motor vehicle volumes. In addition, the extrapolated pedestrian volumes can be used to account for exposure when evaluating pedestrian risk along street segments, at mid-block crossings, and at intersections. The study will result in extrapolation factors that are much more accurate than existing assumptions that are often used in practice (e.g., “a one-hour pedestrian count taken on a weekday between 5 p.m. and 6 p.m. represents 10% of the daily volume”). This information will increase the credibility of pedestrian volume estimation and safety analysis.

References:

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Zegeer, C.V., J.R. Stewart, H. Huang, and P. Lagerwey. *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations*, U.S. Department of Transportation, Federal Highway Administration, FHWA-RD-04-100, Available online: <http://www.tfhrc.gov/safety/pubs/04100/index.htm>, 2005.

B3. Identification of Institutional Barriers to Pedestrian Funding and Recommended Practices for Using Pedestrian Facility/Safety Funds

Problem: Funding is limited in most public agencies and, unfortunately, funding for pedestrian facilities and safety is often a lower priority. There are never enough funds to ensure that all pedestrian facilities are complete and that the safest and most effective pedestrian treatments are in place. Identifying institutional barriers to effectively utilizing funding for pedestrian facilities is especially important in tough economic times. There are a number of ways funding can be obtained for pedestrian treatments that many agencies do not use or use effectively. Some types of funds have more restrictions attached to them than others (such as Federal Funds), and some involve no cost to taxpayers such as developer improvements or policy changes for new or reconstructed projects. Agencies need a guide to identify the many types of project/program funding sources that are available and the best ways to use them. Identification of resources for maintenance of pedestrian facilities is also crucial. There is also a lack of understanding among engineers and public officials how funding levels for pedestrians relate to the walkability of a community and overall pedestrian safety.

Objective: Develop a best practices guide to identify how communities can obtain and allocate funds in an effective manner to provide improved pedestrian facilities and implement pedestrian safety countermeasures. The guide will also identify those institutional barriers that do not provide or create incentives for pedestrian programs, improvements and funding. The second phase of the project will involve research on appropriate funding levels for pedestrian programs and how the funding levels relate either directly or indirectly to pedestrian safety or improved mobility outcomes. The project will involve a literature search on effective funding practices and availability of funds, as well as the identification of barriers that prohibit the use of funds for pedestrian safety and mobility projects. Another important part of the project will be a survey of public agencies (planners, engineers, and public officials) to address these same issues. Efforts will include identifying the entire spectrum of institutional barriers and diverse funding resources. This may include facilities funded as a part of a developer's off-site improvements, institutionalizing agency policies and design guidelines to provide for new pedestrian facilities, and safety projects as a part of any roadway improvement projects (new construction and retrofit). The guide should include a number of case studies to illustrate successful ways to fund pedestrian projects and programs, as well as identifying ways to eliminate the institutional barriers to funding pedestrian projects.

Key Words: pedestrian facilities, pedestrian safety, funding, developer improvements, policies and programs

Related Work: Some guidance on the identification of funding sources for pedestrian facilities and countermeasures was provided in the FHWA report *How to Develop a Pedestrian Safety Action Plan* (2006) by Zegeer et al. A case study example using Seattle experience is provided. Information on policies to mainstream non-motorized transportation and general funding requirements for transportation projects is contained in the FHWA online guide (last updated

October 2008). It states that Federal surface transportation law provides tremendous flexibility to States and MPOs to fund bicycle and pedestrian improvements from a wide variety of programs. Virtually all the major transportation funding programs can be used for bicycle and pedestrian-related projects.

Research Period: 5 years

1. Literature review
2. Survey of public agencies
3. Develop guide/case studies
4. Final report and recommendations

Urgency, Payoff Potential, and Implementation: This type of guidance is especially important in a time of shrinking budgets. Agencies need to know what resources are available to them and how to effectively use the limited funding that is available. The information could be summarized in a report and disseminated in a series of webinars.

B4. Relationships between Land Use, the Built Environment, and Pedestrian Safety

Problem: The built environment can be characterized by the intensity, location, pattern, and design of human-made development. Land uses, density of population, street pattern, and the aesthetic characteristics of development are often used to describe the built environment. Pedestrian safety can be influenced by the built environment in various ways. First, the built environment is likely to influence pedestrian activity and vehicular activity. Although socio-demographic characteristics of residents (like household size and income) explain trip generation rates, the built environment is expected to contribute to explain variation in pedestrian activity. As a result, characteristics of the built environment influence the potential exposure of pedestrians to vehicular traffic. Second, conditional on being exposed, the built environment is expected to influence safety by affecting how drivers and pedestrians behave. Lines of sight, pedestrian-vehicle conflict points such as curb cuts and driveways, and the presence of specific land uses are likely to affect safety. A better understanding of how the built environment influences pedestrian safety will allow improved and evidence-based decisions regarding the characteristics of future development and how prior development should be retrofitted to enhance pedestrian safety.

Objective: In order to determine the relationship between safety and the built environment, there must first be an understanding of the relationship of the built environment and pedestrian activity/exposure. The objective of this research will be to determine current knowledge regarding the relationship between the built environment and pedestrian activity/exposure and to understand how the built environment affects safety. This review will: a) identify specific attributes of the built environment such as land use mix, population density, and street pattern, and their relationship to pedestrian activity. This review will also examine attributes that are often examined as a “bundle” because they tend to co-occur (for example in what some practitioners and research call “walkable” and “non-walkable” areas); b) classify the built environment attributes in terms of current evidence regarding their ability to influence pedestrian traffic using categories such as “conclusive,” “supportive,” “indicative,” or “unknown”; c) when possible, provide estimates regarding the magnitude of the relationship between the attributes and pedestrian activity; d) recommend additional research necessary to provide evidence regarding pedestrian trip generation rates; e) understand how one or more built environment attributes affects safety. While it will be difficult to draw direct correlations, this research will shed some light on where pedestrian safety efforts can be more effectively targeted.

Key Words: pedestrian safety, built environment, exposure

Related Work: The Institute for Transportation Engineers (ITE) and the National Documentation Project have specific interest in understanding pedestrian traffic generation. The *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes* provides estimates of the crash reduction that might be expected if a specific countermeasure is implemented with

respect to pedestrian crashes. Other research questions focusing on methods collecting data on pedestrians and specific treatments should be reviewed for use in the current project.

Research Period: 3 to 5 years (project can be conducted in stages)

1. Literature review
2. Expert panel
3. Develop summary and recommendations
4. Final report

Urgency, Payoff Potential, and Implementation: Land use planners, traffic engineers, and transportation planners can use the information provided by this research to identify priority areas for targeted pedestrian treatments or modifications to the built environment. Similarly, planners reviewing development proposals can use the evidence identified here to determine changes that should occur in order to improve pedestrian safety. Planners considering retrofits to existing development will find the evidence presented useful. However, that benefit may be low unless there is significant research done to help “localize” the results through a calibration procedure. Finally, researchers will benefit from the review materials and the identification of research gaps.

Problem Statement Drafted using Research Needs Statements: “Design, Safety, and Operational Considerations of Pedestrian Treatments at Intersections” from the AHB65 TRB Committee on Operational Effects of Geometrics and “Operational Guidelines for the Provision of Sidewalks” by David Johnson and Doug Harwood.

C1. Cost-effective Retrofits for High-speed Multilane Arterial Roads for Pedestrians

Problem: Arterial streets are one of the primary roadways used to move vehicular traffic on our nation's roadways. As such, they have been designed and operated to primarily serve vehicular traffic. The 2000 Edition of the *Highway Capacity Manual* (HCM) defines an arterial street as "a signalized street that primarily serves through-traffic and that secondarily provides access to abutting properties." The result is that many arterial roadways expose pedestrians to high-speed vehicular traffic and have few pedestrian crossings. An analysis of recent crash data helps illustrate the magnitude of the problem. In 2007, more than 50 percent of all pedestrian fatalities occurred on arterial roads in urban areas compared to 14 percent on local roads or streets. This trend was similar for pedestrian injuries in urban areas; nearly 50 percent of all pedestrian injuries occurred on arterial roads compared to 17 percent of all injury crashes occurring on local roads. Arterial roads in rural areas accounted for almost 16 percent of all fatal pedestrian crashes compared to 6 percent on local roads or streets. This trend is similar for injury crashes. (FARS, 2008).

Overall, for both fatality and injury crashes involving pedestrians, the majority of crashes occur on arterial roads. Thus, research on how to cost-effectively retrofit high-speed multilane arterial roads for pedestrians and how to balance these safety improvements with other demands is needed.

Objective: The objective of this research will be to develop implementation guidance for cost-effective treatments to improve pedestrian safety on arterial roadways. These treatments could include (but are not limited to):

- lighting enhancements,
- various types of traffic signal devices,
- speed limit reductions, and
- geometric measures.

Implementation guidance will be based on known roadway characteristics such as driveway density, posted speed limit, number of lanes, and traffic volumes.

This project is divided into three phases. Phase I examines crash data to identify roadway features and characteristics of pedestrian crashes on multilane arterials. Hazards can then be compared to various roadway features and a feasibility study conducted to determine which treatments have a high likelihood of success (i.e., those deployed in sufficient number to evaluate the conditions where the treatments are most effective). Phase II consists of identifying treatments from the crash analysis, conducting a literature review, and having a panel of experts then select treatments for evaluation. Phase III is the evaluation of the effectiveness of treatments considering implementation costs and the development of implementation guidance. The study should endeavor to determine planning guidelines such as

distance between pedestrian crossings and what type of crossing treatments should be considered.

Key Words: pedestrian safety, arterial roadways, pedestrian crossings

Related Work: There are several research reports concerning evaluation of treatments that may be applicable on multilane arterial roadways. These reports are:

- *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations (HRT-04-100)* <http://www.tfhrc.gov/safety/pubs/04100/index.htm>
- *Improving Pedestrian Safety at Unsignalized Crossings (NCHRP Report 562)* http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

Furthermore, based on recent on-going research from Strategic Highway Research Program (SHRP2), there will be an investigation of the relationship between crashes and surrogate measures of effectiveness (e.g., pedestrian-vehicle conflicts). This may affect the methodology applied to this study. The results of this study are expected within the next 12-24 months.

Research Period: 3 to 6 years depending upon the study design and outcome of interest (e.g., crashes, conflicts, etc.)

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| <ol style="list-style-type: none">1. Literature review and expert panel2. Examine crash data3. Evaluate treatment effectiveness4. Final report and recommendations |
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Urgency, Payoff Potential, and Implementation: As illustrated in the problem statement, pedestrian safety on arterial roadways is one of the biggest challenges facing traffic engineers and other transportation professionals today. The information provided in this study can be used to help determine how to cost-effectively retrofit high-speed multilane arterial roads to improve pedestrian safety. The outcome of this effort could be a guidelines document and a successful practices guide. Consideration as to how to balance safety improvements with other roadway needs, such as traffic operations, should also be presented in order to provide an understanding of the effects of implementation. The guidelines and successful practices guide could be accompanied by web training and a marketing effort.

C2. Effects of Traffic Signals on Pedestrian Behavior and Safety

Problem: Increasing mobility and safety for pedestrians of all ages is a major issue at signalized intersections, especially in light of recent pedestrian clearance interval requirements detailed in the 2009 edition of the *Manual on Uniform Control Devices for Streets and Highways (MUTCD)*. The revised standards reduce the pedestrian walking speed from 4.0 feet per second to 3.5 feet per second, yielding longer pedestrian clearance intervals. The changes may have trade-offs between safety and operations for both isolated and coordinated signal systems.

Traffic signals help control pedestrian and vehicular traffic at intersections but they do not guarantee that a crossing is safe. A 1995 FHWA study determined that almost one-third of all pedestrian fatal and injury crashes occur within 50 feet of an intersection (Hunter et al, 1995). Traffic signal characteristics such as traffic signal timing, cycle length, and signal phasing affect pedestrian and motorist behaviors and conflicts.

Objective: The objective of this research is to develop new guidelines and strategies for accommodating pedestrians at signalized intersections. This research should include pedestrians of all ages, including older pedestrians. The guidelines and strategies should focus on finding the relationship between safety, pedestrian mobility, and signal operational efficiency.

More specifically, the research may endeavor to answer the following questions:

Pushbuttons

- Under what conditions should pedestrian signals be actuated with pushbuttons?
- What is the operational effect of a variable length pedestrian clearance interval for slower walkers using a “call extender” based on time the button is pushed, or other technologies?

Traffic Signal Timing

- What is the effect of a pedestrian “head start” (leading pedestrian intervals) on traffic operations?
- What is the relationship between cycle length and pedestrian delay, compliance, and safety?
- How will pedestrian signal timing changes impact users at intersections in terms of pedestrian access, delay, and traffic congestion?
- What effects will pedestrian signal timing changes have on safety?
 - Will there be more pedestrian crashes because of frustrated drivers, or will driver awareness increase and pedestrian safety improve?
 - Will longer cycle lengths result in pedestrians more frequently crossing against the signal, or drivers running red lights thus increasing vehicle accidents?

Traffic Signal Phasing

- What are the pedestrian safety and operational effects of split phasing versus concurrent-phase operations?
- What are the pedestrian safety and operational effects of using multiple signal phases to cross one leg of an intersection?
- What are the pedestrian safety and operational effects of leading and lagging left turn signals?
- What are the pedestrian safety and operational effects of no right-on-red?
- How does phasing affect pedestrian and driver behavior?

Technology

- What is the ability of passive detection to cancel unnecessary calls and to provide pedestrian clearance interval extensions?
- What experience is there with the use of vehicle detectors to sense traffic gaps and transfer the additional signal time to the pedestrian phase (for under-capacity locations in the peak hour and everywhere in the off-peak)?

This research statement can be broken into phases by category described above.

Key Words: pedestrian safety, signalized intersections, pedestrian clearance interval, traffic signal cycle length

Related Work: There are two NCHRP research needs statements that cover subject areas similar to this study. These are:

- Pedestrian Accommodation in Traffic Signal Systems
- Integrating Pedestrian Considerations into Traffic Signal Design

The research objectives of this study need to be closely coordinated with the objectives of the related NCHRP research needs statement. These statements have identified much of the existing research related to pedestrian safety at traffic signals. These research needs statements found literature on optimizing signal timing for pedestrians and State and national guidelines for setting pedestrian clearance intervals, both of which focus on start-up delay and walking speed. However, there has been little research on how to balance pedestrian needs with the needs of motor vehicles and other users at signalized intersections. There is a need for research and new guidelines for optimizing traffic signal timing and phasing for all users.

Research Period: 3 to 5 years (project can be conducted in stages). Evaluating the effect of increasing the pedestrian clearance interval based on the latest changes in the MUTCD will require a before-after study, which will increase the cost and duration of the project.

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| <ol style="list-style-type: none">1. Literature review and expert panel2. Examine crash data3. Evaluate treatment effectiveness4. Final report and recommendations |
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Urgency, Payoff Potential, and Implementation: The proposed research is timely and would address a growing need for improved safety for all pedestrians (particularly older pedestrians) at signalized intersections. More specifically, this research will evaluate the effectiveness of the recent changes to the MUTCD for pedestrian clearance intervals. Furthermore, this research will help provide a better understanding of the trade-offs between safety, pedestrian mobility, and operational efficiency which can be used to better guide transportation agencies in the design and operation of their urban transportation facilities. Results from the research should be directly implemented in the form of application guidelines to assist transportation engineers and policy makers in selecting strategies for pedestrian safety and access, as well as system efficiency. The results could also be incorporated into existing and future pedestrian courses.

References:

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Problem Statement Drafted using Research Needs Statements: “Pedestrian Accommodation in Traffic Signal Systems” and “Integrating Pedestrian Considerations into Traffic Signal Design” by the TRB Committee on Pedestrians (ANF 10), Subcommittee on Research.

C3. The Effect of Roadway and Roadside Features on Pedestrian Crashes on Urban and Suburban Corridors

Problem: The design of urban and suburban corridors affect the operating characteristics of motorists and pedestrians, as well as crash experience. Safety problems may result from certain design features within the roadway domain, and it may be possible to modify one or more of these features to enhance safety and mobility. Traffic calming measures such as narrow lanes, raised crossings, speed humps, chicanes, and traffic mini-circles have been used on local and residential streets in many cities, but many of these measures are not appropriate on major collector and arterial streets. There may also be a direct correlation between pedestrian crashes and the conditions of the roadside (e.g., presence of on-street parking; number of fixed objects such as trees, poles and sign posts; curb and gutter vs. shoulders), since such “side-friction” may affect motorist speeds as well as pedestrian and motorist behavior.

NCHRP 17-26 “Pedestrian Safety Prediction Methodology” (March, 2008) was able to identify roadway and other factors that were associated with pedestrian crashes at signalized intersections, but no large-scale study has attempted to quantify crash-related features for pedestrians on roadway sections and corridors. Therefore, there is a need for engineers and planners to gain a better understanding of how to design new roads and retrofit existing roads to enhance the behaviors of motorists and pedestrians and improve the safety of pedestrians and other road users. Modifications to roadway or and/or roadside conditions will not only improve pedestrian and motorist safety, but can also help facilitate pedestrian access and mobility.

Objective: Investigate how roadway and roadside features affect crashes between pedestrians and motor vehicles. Features of interest include roadway design elements and traffic control characteristics, and walking and bicycling elements. Roadside conditions will also be considered in this study as they are related to pedestrian crash risk. By determining the characteristics that have the greatest impacts on vehicle and pedestrian crashes, roadways can be designed to be safer for pedestrians and other road users. The research should involve analyzing crash information at corridors having a variety of land use patterns and for different congestion levels and road user volumes. Safety effects of roadway and roadside characteristics on the safety of older pedestrians will also be included, since older pedestrians are at greater risk of being struck and killed as pedestrians compared to other pedestrian age groups.

Pedestrian crash models should be developed as a function of roadway and roadside characteristics. To accomplish this, data will need to be collected on such features as traffic volume, pedestrian volume, speed limit and actual speeds, number of lanes, lane width, shoulder width, presence of sidewalks and planting strip, presence of on-street parking, bus lanes and bicycle lanes, lateral separation from travel lane to roadside obstacles (e.g., trees, poles), roadway alignment, pavement striping pattern, number and types of intersections and driveways along the corridor, presence of medians or median islands, presence and type of traffic calming devices, spacing of pedestrian crossings, traffic signal characteristics, type and

presence of on-street parking (parallel, angle), type of roadway edge (curb and gutter, shoulder width and type, if any), etc. Total vehicle crashes should also be considered, since the safety of corridors should consider the safety of other road users, in addition to pedestrians.

Key Words: vehicle speeds, traffic calming, roadway design, design speed, pedestrian crashes, pedestrian safety, land use planning, injuries, highway features.

Related Work: Engineering guidelines for roadway design speed.

Research Period: 2 – 4 years

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| <ol style="list-style-type: none">1. Literature review2. Select cities and develop database3. Analyze data, develop crash relationships4. Final report and recommendations |
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Urgency, Payoff Potential, and Implementation: The results and recommendations from this study would facilitate implementation of appropriate roadway design and operational measures to improve the safety and operations of roadway corridors in urban and suburban areas. The results of the study would be useful for design and operations engineers, planners, researchers, and highway safety officials. The results should be published by FHWA in the format of a guide, *Guidebook for Reducing Vehicle Speeds and Crashes on Urban and Suburban Corridors*. The results should also be published in transportation journals such as the Transportation Research Record or ITE Journal, and should be used to update the AASHTO Green Book, AASHTO Pedestrian Guide, and other design guidelines, planning manuals, highway policies, and related recommended engineering practices. In addition, the research results can be incorporated into pedestrian safety training courses that are funded by FHWA (e.g., *Designing for Pedestrian Safety*, *How to Develop a Pedestrian Safety Action Plan*, etc.).

C4. Develop Guidelines for Pedestrian Midblock Crossings

Problem: Pedestrians desire to travel from origin to destination in as near a straight line as is possible. When pedestrian travel involves crossing a street or highway, many pedestrians choose to cross at a midblock location. Midblock or non-intersection locations account for approximately half of pedestrians injured in crashes. The facts are much worse for fatalities — approximately 77% of pedestrian fatalities occur at non-intersection locations. Over 3,500 pedestrians were killed at non-intersection locations in 2007 (NHTSA Traffic Safety Facts, 2007).

In the effort to address this problem, safety engineers must identify, evaluate, and appropriately treat midblock locations that are dangerous for pedestrians. To accomplish this, information is needed on pedestrian crashes, as well as the behaviors by motorists and pedestrians at various types of midblock crossing situations. Such information will also allow for the development of guidelines for selecting and treating midblock pedestrian crossings. The study would also involve conducting a series of before-after evaluations of various midblock safety treatments to determine which treatments are effective.

Objective: The purpose of this study is to (1) quantify the safety of various types of midblock crossings, (2) evaluate countermeasures based on behavioral and conflict measures, and (3) develop a guidebook on where midblock crossings should be provided and the types of treatments that are appropriate.

Task 1 of the study will first involve a detailed review of literature on midblock crossing features and treatments and their effects on pedestrian safety and mobility. The literature review will include studies which have addressed all types of midblock crossing locations, including those which are signalized and unsignalized. Task 2 will include conducting a crash analysis of a large sample of signalized and unsignalized midblock locations to identify geometric and other features that are associated with pedestrian crash risk. Task 3 will involve field evaluation of 3 to 5 different types of midblock treatments. Task 4 will involve developing guidelines for midblock selection and treatments.

The pedestrian crash analysis in Task 2 should include collecting such variables as number of lanes, pedestrian volume, traffic volume, presence of sidewalks and shoulders, vehicle speed and speed limit, lighting conditions, number of travel lanes, driveway type and density, type and presence of medians, types and presence of pedestrian-related signs and signals, driveways and curb cuts, crosswalk placement and type, adjacent land use and presence of pedestrian attractors (such as bus stops, schools, senior centers, etc.), among others. One other question that could be addressed by this research is the relationship between the width of the road (or other features), the distance to the nearest signalized intersection, and the inclination of a pedestrian to cross at a midblock location rather than at the intersection.

Based on the results of the modeling analysis in Task 2 above, the researchers should select 3 to 5 different types of midblock crossing treatments (such as activated flashers, continuous

flashers, signals, raised speed tables, curb extensions, in-street pedestrian (“Yield to Pedestrians”) signs, advanced driver yield lines (or stop lines) on the approaches to crosswalks, etc.) and evaluate them as part of Task 3. This task should include evaluations at selected locations using behavioral measures of effectiveness (i.e., not crash-based). Video-tape will be used and analyzed to quantify how motorists and pedestrians behave for various types of midblock pedestrian crossing treatments, as well as pedestrian-vehicle conflicts before and after the countermeasures are installed. Based on the results of the analyses in the previous tasks, a guidebook will be prepared in Task 4 that recommends where midblock crossings may be suitable and the types of crossing treatments that are appropriate. If feasible, pedestrian crashes will also be considered for use in evaluating one or more of the countermeasures (i.e., if adequate sample sizes of treatments exist and whether or not the timing of the treatment installations allows for an adequate sample of “after” data).

Key Words: pedestrian safety, crash analysis, midblock crossings, countermeasures

Related Work: Pedestrian crash prediction models for intersections were recently developed through NCHRP 17-26 *Methodology to Predict the Safety Performance of Urban and Suburban Arterials*. Other studies have examined factors pertaining to midblock pedestrian safety (Sandt and Zegeer, *Characteristics Related to Midblock Pedestrian-Vehicle Crashes and Potential Treatments*, 85th TRB Annual Meeting, 2006). Studies have also examined the safety effect of various midblock treatments such as marked crosswalks (Zegeer et al., *Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations*, 2005). Another FHWA study, *Informational Report on Lighting Design for Midblock Crosswalks* (Gibbons, Edwards, et al., 2008) provides information on lighting parameters and design criteria that should be considered when installing fixed roadway lighting for midblock crosswalks. The *AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities* (2004) provides the most relevant existing information related to the planning, design, and operation of pedestrian facilities, including design issues at non-intersection locations. Finally, the *Effects of Innovative Pedestrian Treatments at Unsignalized Locations: A Tale of Three Treatments* (Huang, Zegeer, et al., 2000) summarizes past research for special pedestrian-related signs and devices at uncontrolled crossing locations.

Research Period: 5 years

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| <ol style="list-style-type: none">1. Literature review2. Evaluation of countermeasures3. Develop guidelines |
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Urgency, Payoff Potential, and Implementation: The crash analysis at midblock crossing locations will provide valuable information to safety practitioners, traffic engineers and transportation planners in identifying midblock crossings that have a high potential for pedestrian crashes on urban and suburban streets. The results of the evaluation of midblock treatment options will provide further insights into countermeasures that could improve the

safety and mobility of pedestrians who cross the street at such locations. A guidebook on midblock pedestrian crossings will summarize the results of the research and provide recommendations on dealing with various midblock crossing situations.

References:

Gibbons, R.B., Edwards, C.J., Williams, B. and Anderson, C.K. *Informational Report on Lighting Design for Midblock Crossings*. Publication FHWA-HRT-08-053. FHWA, U.S. Department of Transportation, 2008.

Harwood, D. et al. *Methodology to Predict the Safety Performance of Urban and Suburban Arterials*. NCHRP 17-26. NCHRP, U.S. Department of Transportation, 2009.

Huang, H., Zegeer, C., Nassi, R., and Fairfax, B. *The Effects of Innovative Pedestrian Signs at Unsignalized Locations: A Tale of Three Treatments*. Publication FHWA-RD-00-098. FHWA, U.S. Department of Transportation, 2008.

LaPlante, J.N. and Short, T.R. *AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities*. Institute of Transportation Engineers, Washington D.C., 2000.

Sandt, L. and Zegeer, C. Characteristics Related to Midblock Pedestrian-Vehicle Crashes and Potential Treatments. In *Transportation Research Record: Journal of the Transportation Research Board*, No. 1982, Transportation Research Board of the National Academies, Washington, D.C., 2006, pp. 113-121.

Zegeer, C. et al. *Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations*. Publication FHWA-HRT-04-100. FHWA, U.S. Department of Transportation, 2005.

C5. Pedestrian Crash Modification Factors

Problem: A Crash Modification Factor (CMF) is a general estimate of the effectiveness of a particular countermeasure and is measured as the expected percent reduction in a specific type of crash (e.g., percent reduction in total pedestrian crashes or in “walking along road” pedestrian crashes). CMFs are used by engineers to weigh the costs and benefits of a countermeasure in decision-making for safety improvements. Many CMFs are available for treatments related to vehicle safety, but few studies have been conducted that have found quantifiable CMFs for pedestrian safety treatments. The FHWA *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes* (developed by iTRANS and updated by UNC HSRC in 2008) provides tables of CMFs for certain pedestrian-related treatments. However, there is a need to determine the expected effectiveness for many other design and traffic control measures on pedestrian crashes. Developing such additional CMFs will aid transportation professionals in making sound and effective decisions regarding the cost-effectiveness of various pedestrian safety improvements.

Objective: There are two research objectives. The first objective will be to perform a comprehensive literature review to determine which CMFs are available and statistically sufficient, as well as what new research is needed. This review will identify countermeasures for which little information is known. It will also determine the need for refinement or further assessment of existing CMFs to gain a better understanding of the conditions where the treatments are most effective. A feasibility study will examine the treatments identified to determine which ones have the potential to be successfully evaluated. Such treatments may include lighting enhancements, various types of traffic signal options, and/or geometric factors. A plan will be developed to prioritize the treatments for which CRF research is most needed. The second project objective is to perform the needed research to develop CMFs for the selected treatments.

Phase 1 of the research will use a comprehensive literature review to identify the top 2 treatments for evaluation. Phase 2 will evaluate these treatments as well as two additional treatments. The FHWA *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes* will be updated based on the review of recent research and the research conducted in Phases 1 and 2 of this study.

Key Words: pedestrian safety, crash reduction factors, accident modification factors

Related Work: The FHWA *Toolbox of Countermeasures and Their Potential Effectiveness for Pedestrian Crashes* provides estimates of the crash reduction that might be expected if a specific countermeasure or group of countermeasures is implemented with respect to pedestrian crashes. The crash reduction estimates are presented as Crash Reduction Factors (CMFs), which are sometimes presented in terms of Accident Modification Factors (AMFs). For example, a treatment which has an expected 20% reduction in crashes is represented by a CRF

of 0.20 and an AMF of $(1.00 - 0.20) = 0.80$.

(<http://drusilla.hsrrc.unc.edu/cms/downloads/Pedestrian%20issue%20brief.updated.pdf>).

As an example of recent pedestrian safety research, a study for FHWA in 2008 by Fitzpatrick entitled *Safety Effectiveness of HAWK Pedestrian Treatment* provides information how this measure affects pedestrian crashes and other crash types. Such additional recent research will be reviewed as part of this study for use in updating the CRF toolbox for pedestrians.

Research Period: 3 to 5 years for phase 1 and an additional 3 years for phase 2 (project can be conducted in stages and/or overlapping)

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| <ol style="list-style-type: none">1. Literature review2. Select countermeasures and test cities3. Evaluate treatments4. Final report and recommendations |
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Urgency, Payoff Potential, and Implementation: Traffic engineers and other transportation professionals can use the CMF information to determine which countermeasures should be considered at locations experiencing a high number of pedestrian crashes and to calculate the expected improvement in pedestrian safety (i.e., reduction in crashes) with the implementation of the treatments.

C6. Accessible Pedestrian Signals

Problem: Audible pedestrian signals have been in use for many years in the U.S., but have been typically limited to an overhead speaker using a cuckoo or chirp sound to indicate the walk interval. Due to the many disadvantages of this design, a new type of accessible pedestrian signal (APS) has been used in recent years. This new type of APS is integrated into the pushbutton and incorporates vibro-tactile indications, street-level speakers, pushbutton locator tones, tactile arrows, automatic volume adjustment in response to ambient sound levels, and rapid tick or speech walk messages (all of which are now required on APS in the 2009 MUTCD). Recent research by the National Cooperative Highway Research Program Project 3-62 developed guidelines for practitioners on APS features, where APS should be installed, and how installations should be designed. However, since pushbutton-integrated APS are still fairly new in the U.S., additional questions have been raised. More research is needed on several issues such as benefits to sighted pedestrians, installation in fixed signal systems, and maintenance of APS.

While safety benefits for blind pedestrians are well-documented (Bentzen, Barlow, and Bond, 2004; Barlow, Scott, Bentzen, 2009; Scott, Barlow, Bentzen, Bond, & Gubbe, 2008; Harkey, Carter, Barlow, Bentzen, Myers & Scott, 2007; Williams, Van Houten, Blasch, & Ferraro, 2005), there has been little research on the response of sighted pedestrians to audible signals. There is some anecdotal evidence that APS improve the response of all pedestrians to the pedestrian signals. The locator tones may result in more pedestrians using the pushbuttons, and pedestrians may move more predictably at the beginning of the walk indications. English and Australian publications (Hulscher, 1976; Wilson, 1980) noted that audible signals improved the efficiency of pedestrian crossings and delay for sighted pedestrians. Such changes in behavior may result in improvements in pedestrian safety.

The newer types of APS are integrated with pushbuttons and recommended to be installed such that the device is accessible to pedestrians, particularly pedestrians with disabilities. Since actually pushing the button is not necessary when the signals operate as fixed timed, there are some questions regarding installation locations and whether more flexible location guidelines would be adequate in fixed time systems. Some of these questions may be due to misunderstanding of the flexibility of the APS devices (e.g., they can be programmed to provide the audible walk indication in conjunction with the visual signal without requiring someone to push the pushbutton). While the APS provides other information to pedestrians who are blind through the pushbutton locator tone and the tactile arrow, research to evaluate the feasibility of additional locations could provide other options.

Some practitioners have expressed concerns about maintenance of APS and have delayed installation or refused to install devices until further information is available. NCHRP Project 3-62 provided some review of maintenance issues, and found that most were being addressed by manufacturers; however, these modifications to the APS design and functioning have

continued. There seems to be a need for additional information regarding best practices in terms of maintenance.

Objective:

The objectives of the research are to:

- Determine whether and how APS offer benefits to sighted pedestrians and improvements in pedestrian safety
- Evaluate APS installation in fixed timed systems and develop guidance
- Develop guidance on maintenance audits and protocol.

Key Words: accessible pedestrian signals, blind, low vision, audible

Related Work:

- NCHRP Project 3-62 *Guidelines for Accessible Pedestrian Signals*
- NCHRP Project 3-78 *Crossing Solutions at Roundabouts and Channelized Turn Lanes for Pedestrians with Vision Disabilities*
- National Institutes of Health, National Eye Institute Project *Blind Pedestrians Access to Complex Intersections*

Research Period: 5 years

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| <ol style="list-style-type: none">1. Literature review2. Evaluate APS systems3. Develop maintenance audits and protocol |
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Urgency, Payoff Potential, and Implementation: Determining the effect and potential benefit to sighted pedestrians could foster greater acceptance of APS and potentially greater safety for all pedestrians. Developing guidance regarding maintenance could assist agencies in directing their limited funds and manpower towards the issues that are most likely to arise with APS.

References:

Bentzen, B. L., J. M. Barlow, and T. Bond, 2004. Challenges of Unfamiliar Signalized Intersections for Pedestrians who are Blind: Research on Safety. *Transportation Research Record: Journal of the Transportation Research Board*, 1878, 51 -57.

Barlow, J.M., Scott, A.C., Bentzen, B.L. (2009) Audible Beaconing with Accessible Pedestrian Signals. *AER Journal: Research and Practice in Visual Impairment and Blindness*, Vol. 2, Number 4, 149 – 158.

Scott, A.C., Barlow, J. M., Bentzen, B.L., Bond, T.L.Y. & Gubbe, D. (2008) Accessible pedestrian signals at complex intersections: Effects on blind pedestrians. *Transportation Research Record: Journal of the Transportation Research Board*, No. 2073, 94–103.

Harkey, D.L., Carter, D.L., Barlow, J.M., Bentzen, B.L., Myers, L. & Scott, A.(2007) *Guidelines for accessible pedestrian signals final report*. Contractor's Final Report for NCHRP Project 3-62, National Cooperative Highway Research Program Web-Only Document 117B, Washington, DC: National Cooperative Highway Research Program.

Williams, M., Van Houten, R., Blasch, B., & Ferraro, J. (2005). Field comparison of two types of accessible pedestrian signals. *Transportation Research Record: Journal of the Transportation* (Research Board No. 1939, 91-98). Washington, DC: Transportation Research Board of the National Academies

Hulscher, F., 1976. Traffic signal facilities for blind pedestrians. *Australian Road Research Board Proceedings* 8, 13-26.

Wilson, D. G., 1980. *The effects of installing an audible signal for pedestrians at a light controlled junction*. Transport and Road Research Laboratory, Department of the Environment, Department of Transport, U.K

C7. Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas

Problem: A lack of coordination between transit agencies and roadway agencies may increase safety risks to pedestrians using transit and, in particular, pedestrians accessing bus stops. Unfortunately, since crashes involving pedestrians using transit are classified as pedestrian crashes only, the extent of this issue is not sufficiently documented. One recent study (Pecheux, 2008) reviewed crash reports from eight transit agencies across the U.S. in an effort to quantify this issue. The data from that study showed that approximately 60% of the pedestrian-bus crashes at intersections involved a turning bus. Over two-thirds of those crashes involved a left-turning bus whereas less than one-third of those crashes involved a right-turning bus.

However, research on safe access at bus stops only addresses part of the issue involving safe access for pedestrians using or near transit. Research on pedestrian safety concerns around light rail and streetcars is also needed. The recent increases in transit use and the reemergence of the streetcars in many areas reinforce the need for a better understanding of the issues and how to address them.

Objective: There are two research objectives for this project: 1) Create a successful practices synthesis report to document excellent examples of transit agency and roadway agency coordination on pedestrian access issues to transit. This may include site selection procedures, placement and connectivity to other pedestrian facilities, and crossing treatments to access transit. The benefits of these case studies will also be described. 2) Evaluate the effectiveness of the most promising treatments discussed in the successful practices synthesis. Roadway and surrounding characteristics will be evaluated to develop guidelines for implementation of selected safety measures. This research should consider all forms of transit, but focus on light rail and street cars since the safety effects of these forms of transit have not been as extensively studied. Some forms of transit are the subject of future studies as detailed in the related work section.

This research statement consists of the following phases:

- Phase I- examine the best practices related to safe pedestrian access to transit and increasing transit ridership through pedestrian facility improvements in urban areas; (this effort is also described in “PR13. Pedestrian Safety Guide for Transit Agencies”);
- Phase II- select treatments for evaluation based on successful practices, panel of experts, and existing literature; and,
- Phase III- evaluate selected treatments.

Key Words: pedestrian safety, public transit, bus stops, bus, light rail, street cars, heavy/commuter rail, best practices

Related Work:

There are several NCHRP/TCRP research needs statements that cover subject areas similar to this study. These are:

- Improving Pedestrian and Bicyclist Accessibility and Safety at At-Grade Railroad Crossings.
- Improving Transit and Transportation Agency Coordination to Increase the Safety of Mid-Block Pedestrian Crossings near Transit Stops.
- Pedestrian Environment Improvements to Increase Transit Ridership.

The research objectives of this study need to be closely coordinated with the objectives of the related NCHRP/TCRP research needs statement. Research related to heavy/commuter rail, at-grade rail crossings, and along railways will be covered by the first research needs statement above (Improving Pedestrian and Bicyclist Accessibility and Safety at At-Grade Railroad Crossings). Research related to bus stops, at-grade light rail, and streetcars in urban areas should be covered by this project and may encompass the objectives of the second and third research needs statements (Improving Transit and Transportation Agency Coordination to Increase the Safety of Mid-Block Pedestrian Crossings near Transit Stops and Pedestrian Environment Improvements to Increase Transit Ridership, respectively).

Additional related work is as follows:

- *Compilation of Pedestrian Devices In Use At Grade Crossings*. 2008. Federal Railroad Administration.
- Fitzpatrick et al. *TCRP Report 112/NCHRP Report 562. Improving Pedestrian Safety at Unsignalized Crossings*. Transportation Research Board, Washington D.C., 2006.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf
- Nabors, D.; Schneider, R.; Leven, D.; Lieberman, K.; and Mitchell, C. 2008. *Pedestrian Safety Guide for Transit Agencies*. U.S.DOT Report No. FHWA-SA-07-017.
http://safety.fhwa.dot.gov/ped_bike/ped_transit/ped_transguide/
- Pecheux, K.; Bauer, J.; Miller, S.; Rephlo, J.; Saporta, H.; Erickson, S.; Knapp, S.; and Quan, J. 2008. *TCRP Report 125. Guidebook for Mitigating Fixed-Route Bus-and-Pedestrian Collisions*. Transportation Research Board, Washington D.C., 2008.

Research Period: 3 to 5 years (project can be conducted in stages: Phase I as one project and Phases II and III as another project)

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| <ol style="list-style-type: none">1. Examine best practices2. Select treatments/literature review3. Evaluate treatments |
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Urgency, Payoff Potential, and Implementation: The proposed research is timely and would address a growing need for improved safety to access transit. More specifically, the successful

practices document will detail specific policies, engineering, and planning efforts that have provided safer and more convenient access to transit. The effectiveness of selected treatments and implementation guidance will assist engineers and other transportation professionals in improving pedestrian safety in and around transit. The results could also be incorporated into existing and future pedestrian courses.

Problem Statement Drafted using Research Needs Statements: “Improving Pedestrian and Bicyclist Accessibility and Safety at At-Grade Railroad Crossings,” “Improving Transit and Transportation Agency Coordination to Increase the Safety of Mid-Block Pedestrian Crossings near Transit Stops,” and “Pedestrian Environment Improvements to Increase Transit Ridership.”

C8. Effectiveness of Improved Lighting in Reducing Pedestrian Crashes at Crosswalks

Problem: A high proportion of pedestrian crashes occur at night. One way to reduce night crashes is to improve the visibility of pedestrians to drivers at crosswalks. If all pedestrians wore retro-reflective clothing, it would likely reduce the incidence of night pedestrian crashes. Many joggers and cyclists wear retro-reflective clothing, but it would be difficult to get all pedestrians to always choose retro-reflective clothing whenever they walk at night. A more practical alternative for making pedestrians more visible at night is to improve the quality of lighting in areas where pedestrians are likely to walk. The Federal Highway Administration conducted the most comprehensive study of crosswalk lighting in the mid 1970's (Friedman et al., 1975). Although this research was well conducted, it did not find its way into widely used lighting recommendations produced by the American Association of Transportation and Highway Officials (AASHTO) or the Illuminating Engineering Society of North America (IESNA).

In recent years, new LED lighting and other white lighting technologies have emerged which allow for better color rendering, dynamic lighting depending on demand, lower lighting costs, improved capability of directing lighting to where it is required, and improved lighting on rural roads through the use of dynamic lighting powered by solar arrays. One question that needs to be addressed is whether color rendering associated with LED lighting and other lighting modifications will allow a driver to more easily see and respond to a pedestrian at night. Because LED lighting is more directional than other lighting sources, it is possible to direct and intensify lighting where it is needed while reducing the overall level of light pollution. This approach also allows for increased lighting continuity in the travel way while reducing lighting outside the travel way. LED also has the added benefit of being a more energy efficient source than some traditional lighting options. However, this study is intended to explore a variety of lighting options and select some of the more promising options for further evaluation.

Objective: To evaluate the effectiveness of emerging lighting technologies on night pedestrian crashes (including white lighting in general, and LED lighting in particular). Studies would include looking at the effect of white lighting on nighttime visibility, and before and after crash comparisons of monochromatic vs. white lighting.

Key Words: LED lighting, white light sources, nighttime pedestrian crashes

Related Work: More than two thirds (70%) of pedestrian fatalities occur at night (NHTSA, 2008). Research has documented that drivers' inability to see pedestrians at a safe distance is a major factor responsible for nighttime pedestrian crashes (Leibowitz, Owens, & Tyrrell, 1968; NHTSA, 2004; Rumar, 1990; and Wood, Tyrell, and Carberry, 2005). These findings are further supported by analysis of the Fatality Analysis Reporting System database, which shows that pedestrian fatalities increase as illumination decreases even when other factors are held constant (Owens & Sivak, 1996; Sullivan & Flannagan, 2002). The most direct approach to reducing nighttime crashes is to enhance the visibility of pedestrians by improving the level of ambient lighting. One problem with this approach has been the high cost associated with

lighting large areas as well as scattered light interfering with other activities. Advances in LED street lighting systems might possibly offer a solution to these problems. LED lights offer four significant advantages over other lighting systems. First, the intensity of LED lighting can be increased virtually instantaneously, thereby making it possible to adopt dynamic lighting strategies that increase illumination only when pedestrians or cyclists are present. Second, LED lighting is low cost primarily because of the low maintenance requirements and secondarily because of the low power consumption. Third, LED lighting can be better directed at the travel way than traditional light sources providing more efficient lighting continuity. Fourth, and perhaps the most important advantage of LED lighting, is the improved color rendering compared to traditional lighting fixtures.

Improved color rendering might allow motorists to better detect pedestrians using more sensitive central cone vision. Because current street lighting does a poor job of color rendering, most drivers must rely upon rod photoreceptors rather than cones. Since rod pathways are known to adapt more slowly than cone pathways, reaction time under the rapidly changing viewing conditions observed at night tend to be slower (Plainis, Murray & Charman, 2005). Plainis, Murray and Pallikaris (2006) provided a good explanation for slower reaction times at night. Processing information based on rod photoreceptors is relatively slow, and slower reaction times translate into longer stopping distances. It is also known that it is necessary to use offset rather than direct viewing when using rod photoreceptors. Most drivers and pedestrians are not practiced at looking to the side to view the road ahead. Specifically, data show that adaptation rates are four times faster for higher illumination levels compared with lower illumination levels and twice as fast for central compared with peripheral viewing (Plainis, Murray, & Charman, 2005).

Improving the quality of lighting should increase the distance from a pedestrian in the roadway ahead and, therefore, reduce the probability of a collision with a pedestrian and a resulting fatal or debilitating pedestrian injury. In addition, improved night lighting is likely to reduce nighttime vehicle-to-vehicle and single vehicle crashes. These additional crash reductions should make the treatment more attractive to cities because it benefits all road users.

Objective: 1) Conduct a thorough review of literature and identify one or more lighting strategies or innovations which have the greatest potential to improve pedestrian safety at night. 2) Determine whether such lighting options (e.g., LED white lighting of similar brightness versus traditional High Intensity Discharge (HID) light sources), can reduce night pedestrian crashes in urban areas. 3) Determine whether increasing overall lighting levels with more cost-effective lighting can reduce nighttime crashes while reducing light pollution. 4) Evaluate whether dynamic lighting can increase yielding to pedestrians. Because several cities are considering transitioning to LED lighting, it should be possible to evaluate the first two questions (if LED lighting is chosen for evaluation).

Research Period: 3 – 4 years (project can be conducted in stages)

1. Literature review
2. Evaluate effects of white lighting
3. Evaluate effects of increased lighting
4. Evaluate dynamic lighting
5. Final report and recommendations

Urgency, Payoff Potential, and Implementation: A transition from current lighting with poor color rendering to new lighting options (e.g., LED lighting) and other white light sources will be accelerated over the next decade. Since more than 70% of fatal pedestrian crashes occur at night, it is important that we learn how to best deploy these new lighting technologies to reduce these crashes. Many night crashes are associated with alcohol consumption, but efforts to influence the behavior of impaired pedestrians are not likely to be fruitful. Improving the visibility of pedestrians at night could help reduce all pedestrian crashes, including those related to alcohol consumption. The preponderance of fatal night crashes strongly suggests little opportunity for braking alone to prevent pedestrian crashes at night. This provides additional evidence that poor visibility is a large contributor to night pedestrian crashes.

C9. Effects of New Pedestrian Facilities on Pedestrian Exposure

Problem: One type of information that is needed for highway and transportation officials when selecting road improvements involves being able to estimate the effects of adding a specific treatment on crashes and on increased use by various types of road users. For roadway treatments directed at motor vehicles, there are trip generation tables which provide estimates that are widely accepted for estimating the expected increase in motor vehicle trips on a given route, such as for adding travel lanes. Unfortunately, such estimates have not been developed for pedestrian trips which would likely result from the addition of such pedestrian facilities as sidewalks, paved shoulders, signalized crossings, etc. Such information is important for setting priorities on spending limited project funds for pedestrians. This is because it is much easier to justify a pedestrian facility that is projected to result in a substantial number of “generated trips” by people who would walk on the new facility instead of drive.

Objective: The purpose of this research is to determine the effects of various types of newly retrofitted pedestrian facilities on the number of increased pedestrian trips. The estimated increase in pedestrian trips should be quantified in terms of the type of pedestrian facility to be added (e.g., sidewalk, walkway, traffic and pedestrian signal, traffic calming treatment) and for specific area type (e.g., urban, suburban, or rural) and roadway type (e.g., two-lane vs. multilane). Facilities could be analyzed in various types of situations, such as the increase in child trips to school due to adding sidewalks and safer street crossings, increases in senior pedestrian trips in downtown areas near senior centers where safer street crossings are provided, and even the increase in transit ridership where safer routes to transit stops are added to the existing street network.

Key Words: pedestrian exposure, volume generation, pedestrian facilities

Related Work: There has been only a limited amount of research that has attempted to quantify the effect of new pedestrian facilities on pedestrian exposure. An initial literature review did not uncover much relevant results.

Research Period: 3 – 4 years

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| <ol style="list-style-type: none">1. Literature review2. Identify test locations3. Collect before and after data4. Analyze data5. Final report and recommendations |
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Urgency, Potential Payoff, and Implementation: This is a very important study since there is a need for transportation agencies to have estimates of the effects of new pedestrian facilities on the amount of increased use by pedestrians. Such information is important for predicting the expected benefits of a proposed new facility. Without such information, it is difficult or

impossible to estimate the benefit/cost ratio of proposed pedestrian facilities, so they are less likely to get funded, when compared to facilities directed at motor vehicles.

C10. Increasing the Safety of Interactions between Pedestrians and Large Commercial Vehicles (Trucks and Buses) in Urban Areas

Problem: Pedestrians and large commercial vehicles (buses, tractor-semitrailers, tractor-double trailers, emergency vehicles, etc.) routinely interact in urban areas. Urban areas are the focus of this study because cities typically have more pedestrian activity and many trucks serving industry and commerce on surface streets. Many cities also have bus systems that both serve and create potential conflicts with pedestrians. Approximately 10-20% of collisions involving pedestrians and large vehicles result in fatalities and 80-90% result in serious injury (Montufar, 2005, preliminary data analysis for Transportation Association of Canada Road Safety Standing Committee).

Worldwide, pedestrians (including children, seniors, and people with disabilities) are one of the groups at highest risk of being involved in serious collisions. The National Highway Traffic Safety Administration (NHTSA) reports that pedestrians account for approximately 11.7% of U.S. roadway fatalities each year. While there are high expectations for engineers and other transportation professionals to provide an efficient, effective, and safe transportation system that moves freight and passengers while accommodating pedestrians, there is limited knowledge about the interaction of these two roadway user groups and the critical factors that increase the risk of collisions between them. Because of the limited understanding of the potential safety problems and solutions associated with the interaction of these two user groups in urban areas, few jurisdictions have developed specific engineering, education, and enforcement strategies to target this serious issue. This point was also raised by the United States Access Board at the 2005 TRB annual meeting in Washington, DC and by members of the TRB Truck and Bus Safety Committee (2005 Committee Meeting, TRB).

Objective: This project will create a best practices guide for the interaction of commercial vehicles and pedestrian accommodation in urban settings. The guide will also address this widely-acknowledged but poorly-understood source of pedestrian injury and deaths in urban areas. The main objective of this research is to conduct a detailed analysis of State and/or national data bases to quantify the magnitude and characteristics of interactions and collisions between pedestrians and buses and trucks, including identifying some of the related roadway and behavioral factors. This guide will provide an enhanced knowledge base and understanding upon which urban areas can more rationally and effectively engineer systems that safely accommodate trucks, buses, and pedestrians in urban areas. The guide will also provide case study examples and/or recommendations on education and enforcement strategies that could be used to reduce the risks of such collisions.

To the extent practical, the study and guide will review available literature regarding the issue of “crash-friendly” front ends of trucks and the types of vehicle designs that are particularly harmful to pedestrians when they are impacted by a commercial vehicle. The study will not, however, involve any original research to test different front end designs relative to their risks to pedestrians. Ultimately, the research will produce a best practices guide for commercial

vehicle and pedestrian accommodation in urban settings. This will include the development of policies and regulations for large commercial vehicles, as well as engineering, education, and enforcement strategies that can be used to accommodate these groups more safely in urban areas.

Key Words: commercial vehicles, buses, pedestrian safety, large trucks

Related Work: According to a publication by the U.S. Department of Transportation, today's transportation professionals face the "daunting challenge" of the expectation that they provide an efficient, effective, and safe transportation system that moves freight and passengers while accommodating pedestrians (Clarke, 2003). Trucks and buses hit a large number of pedestrians around the world every year (Halman, et al., 2002). In Winnipeg, for example, 12 percent of all pedestrian collisions and nearly one-quarter of all fatal pedestrian collisions involve a truck or a bus (Montufar, 2003). However, little research has addressed this critical safety issue and so, unsurprisingly, little is known about how to safely and effectively engineer systems that accommodate large commercial vehicles and pedestrians interactively in urban areas.

Middleton and Fitzpatrick (1996) found that in urban environments, trucks are increasingly required to maneuver in dense traffic streams, which increases the risk of collisions. In the case of the Canadian prairie region, one-half of all heavy truck collisions take place in urban areas, and the severity of these collisions is almost as serious as collisions on provincial highways (Montufar, 2002). Previous research has also shown that at intersections of undivided streets in urban areas, right-turning encroachment into lanes with moving traffic is a constant occurrence (Beckham, 1994; DeCabooter and Solberg, 1989). This becomes a safety problem in cases where there are high traffic volumes, pedestrian activity, and truck activity (DeCabooter and Solberg, 1989). In general, the literature does not reveal much about the interaction of large commercial vehicles and pedestrians in urban areas. Information exists on the safety issues of each of these as separate users of the system. However, there is a lack of comprehensive research or guidelines related to the characteristics and safety of their interactions.

Research Period: 2 years (24 months)

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| <ol style="list-style-type: none">1. Literature review2. Crash analysis3. Develop guidelines/case studies4. Final report and recommendations |
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Urgency, Payoff Potential, and Implementation: This project will have both immediate and long-term payoffs. A comprehensive collision analysis will establish the urgency of the project by identifying the magnitude and severity of the problem. This will be supplemented with a comprehensive review of literature of current experiences in leading communities throughout the world. This literature review will also document how pedestrians and large commercial vehicles interact, and will set the stage for devising a means of addressing current planning and design limitations that result in high-risk interactions of pedestrians and large trucks in urban

areas. Finally, this project is expected to result in initial work to devise a means to safely accommodate these two users of the transportation system.

The project will produce a best practices guide for commercial vehicle and pedestrian accommodation in urban settings. This will result in potential revisions to the national guidelines in the AASHTO design manual, the 2009 MUTCD, and other national transportation engineering and planning guidelines. The changes or modifications to these manuals could have a positive impact on the safety of pedestrians throughout the country.

Problem Statement Drafted using Research Needs Statement: “Increasing the Safety of Interactions between Pedestrians and Large Commercial Vehicles in Urban Areas” by Jeannette Montufar.

C11. Research on the Effects of Automated Enforcement to Increase Pedestrian Safety at Crosswalks

Problem: The use of automated enforcement has been applied to the problems of speeding and red-light running. The major advantage of automated enforcement is the consistency of application. Although police cannot be present each day on a 24-hour basis to detect red-light running or speeding, camera enforcement can. The addition of signs and publicity can further increase the effectiveness of camera enforcement locations and perhaps produce a general deterrence effect.

Several well-designed studies on the crash effects of red-light running cameras have found a positive benefit. The most comprehensive study to date was conducted by Council et al. (2003). The study found little difference in total crashes, with an approximate 25 percent reduction in right-angle crashes and a 15 percent increase in rear-end crashes. An economic analysis, which considered average total crash costs by crash type and severity, indicated an overall 9 percent reduction in crash costs.

Published evaluation results on the effect of automated speed enforcement on collisions vary from roughly a 9% to 18% reduction in all collisions and a 21% to 51% reduction in injury collisions. Confidence in the results of studies to date is somewhat limited based on a general lack of control for regression-to-the-mean, short study periods for some studies, issues with defining comparison groups, and other factors.

Although camera enforcement has been shown to be effective in modifying driver speeding behavior, no research has been conducted on the efficacy of camera enforcement of pedestrian right-of-way laws. Research has shown that police enforcement of pedestrian right-of-way laws can increase the percentage of motorists yielding right-of-way at crosswalks. Recent improvements in software technology have made it possible to accurately detect conflicts between motorists and pedestrians. If such a system also contained information on pedestrian signal status, it would be possible to use this information to detect motorists' failure to yield right-of-way to pedestrians in crosswalks at signalized intersections and automatically cite these motorists.

Objective: To evaluate whether an automated camera system that records violations of pedestrians' right-of-way at signalized crosswalks can reduce motorist violations of pedestrian right-of-way.

Key Words: automated enforcement of pedestrian right-of-way, crosswalk enforcement, pedestrian safety at traffic signals

Related Work: Ismail et al. have demonstrated that it is possible to accurately discriminate the presence of pedestrians and vehicles and calculate their trajectories using video analysis. This allows researchers to accurately measure several indices of conflict severity. These measures

are Time to Collision (TTC), Post-Encroachment Time (PET), Deceleration-to-Safety Time (DST), and Gap Time (GT). TTC is the shortest time to collision between the driver and pedestrian. PET is the interval between the offending vehicle leaving the area of a possible collision and the arrival of the pedestrian. GT is calculated by extrapolating the movements of the motorist and pedestrian in space and time. If signal phasing shows the pedestrian has right away, short TTC, PET, DST, or GT times could be set to indicate when a violation of right-of-way has occurred. These data would allow for a precise objective definition of violating pedestrian right-of-way in a crosswalk at a traffic signal.

Objective: 1) Determine whether automated enforcement of pedestrian right-of-way at crosswalks at traffic signal locations can increase yielding to pedestrians. 2) Determine whether automated enforcement can decrease serious conflicts at crosswalks with traffic signals. 3) Determine whether signs warning drivers of the presence of automated enforcement of pedestrian right-of-way potentiates the efficacy of photo enforcement alone.

Research Period: 3 – 4 years (project can be conducted in stages). Phase 1 would develop and validate the automated system. Phase 2 would test the effectiveness of the system.

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| <ol style="list-style-type: none">1. Literature review/identify locations2. Analyze locations3. Final report and recommendations |
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Urgency, Payoff Potential, and Implementation: The priority of this research is high. A system that could automatically detect and cite motorists that fail to yield right-of-way to pedestrians in crosswalks at traffic signals could produce a marked improvement in yielding to pedestrians. If such a system was determined to be practical, it could be installed along with warning signs and other outreach efforts. Previous research on automated enforcement of speeding behavior suggests that camera enforcement could be an effective tool.

References:

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Alena Erke (2008). Red light for red-light cameras?: A meta-analysis of the effects of red-light cameras on crashes. *Accident Analysis and Prevention*, 41, 897-905.

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Van Houten, R. & Malenfant, J.E.L. (2004). Effects of a driver enforcement program on yielding to pedestrians. *Journal of Applied Behavior Analysis*, 37, 351-363

Ismail, K., Sayed, T., & Saunier, N. (in press). Automated analysis of pedestrian-vehicle conflicts: a context for before and after studies.

C12. Evaluation of the Applicability of Lower-Speed Street Designs in Residential and Commercial Zones

Problem: Different types of slow-speed streets have been used in Europe and other parts of the world for many years. This concept, sometimes called “shared streets,” “shared space,” “home zones,” “naked streets,” and “Woonerven” (Dutch term, meaning “street for living”), etc., has been used by some agencies in limited situations in such countries as the Netherlands, Germany, Sweden, U.K., Australia, and more recently, in the U.S.. Such designs are intended to result in dramatically lower vehicle speeds. The idea generally assumes that road users not be controlled by traffic control devices, but by their observation of other road users and to some extent by the base design of the street. The idea of “shared streets” or “shared space” was made popular a few years ago by Hans Monderman, the Dutch engineer who developed the concept in an attempt to regulate urban traffic in a different manner than traditional traffic engineering methods. Some of the shared space ideas have been quite controversial. For example, researchers such as Dr. Rob Methorst (Dutch Ministry of Transport) have raised serious questions and concerns about this concept (Methorst, et al., “Shared Space: Safe or Dangerous?—A contribution to objectivity of a popular design philosophy”, Toronto Walk21 Conference, 2007). Others have questioned the safety of shared space principals, particularly under nighttime conditions and/or for pedestrians with visual and mobility impairments.

Objective: The purpose of this research is to determine the effects of various types of low-speed street designs on safety and operations for various road users and to develop guidelines for their use. The results of this research and documentation could lead to recommended guidelines for the U.S. (and perhaps other countries) on the types of lower-speed design concepts and road situations for which various design options are practical, safe, and efficient for all road users.

Key Words: model ordinances, pedestrian laws, design guidelines, zoning, home zones, shared space, public policies

Related Work: Dr. Methorst has addressed this issue and voiced concerns about the practical application of shared spaces (Methorst, et al., “Shared Space: Safe or Dangerous?”). Shared space remains an emerging and controversial topic, with context being a critical consideration.

As part of the recent FHWA/AASHTO-sponsored report “Pedestrian and Bicyclist Safety and Mobility in Europe” (Feb. 2010), a few examples were found of various lower-speed street designs in Switzerland and Germany. In Potsdam, Germany, the conditions that are used for consideration of a shared street include: (1) use them only in “special situations”, (2) the speeds of included modes must already be similar, (3) volumes of different modes should be similar, and (4) the “see and be seen” idea is the critical design element. Variations of slow-speed street designs that were seen on this European Scan included street features such as special signing to indicate entry into a “pedestrian zone” (e.g., with 20 kph posted speed limit), narrow effective street width, cobblestone or other rough street surfaces, planters, fountains, bollards installed

within in the street, and/or edge markings that indicated pedestrians should use the right side of the street, among others.

Research Period: 2 years

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| <ol style="list-style-type: none">1. Literature review2. Identify locations3. Collect data4. Final
report/recommendations |
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Urgency, Payoff Potential and Implementation: There is a need to have current and well-researched information and documentation on the effects of lower-speed street designs under different types of conditions. In the absence of objective research evaluation results, agencies in the U.S. and abroad may be tempted to implement a “shared street” or “home zone” experiment that is not based on solid information and understanding of the outcomes and consequences of such designs. Such inappropriate street design situations could lead to serious safety consequences. For example, if an agency decides to simply remove all signs, signals, and markings to produce a “naked street” situation without properly knowing the risks, the outcome could be the creation of a serious safety problem for pedestrians, bicyclists, and other road users, particularly involving nighttime travel and pedestrians with visual or mobility impairments. Therefore, there is an urgent need to conduct a thorough review of all literature, conduct sound evaluation research of this concept, and plan to properly evaluate new projects which will employ lower-speed street designs.

D1. Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network

Problem: An increasing number of communities are working to provide more comfortable and convenient pedestrian networks. They seek greater pedestrian safety and security to improve access to activity locations and public transit, mitigate growing traffic congestion, and reduce the community costs of private auto travel. Walking is also being encouraged to improve personal and public health, provide recreation, and create economic benefits. The communities that have been most successful at promoting pedestrian transportation options recognize that a safe and usable pedestrian environment requires much more than meeting minimum national standards. High-quality pedestrian environments are places where pedestrians are anticipated, encouraged, and actually congregate. These communities are developing new ordinances and design guidelines to encourage mixed-use development patterns and streets that serve a variety of transportation modes. There is a need to share information about the tools used by leading communities to develop transportation systems and alter development patterns to support pedestrian activity.

Objective: The objective of this research is to provide examples, highlight best practices, and discuss advantages, effectiveness, and any shortcomings of provisions supporting vibrant walking environments in zoning ordinances, subdivision regulations, and design guidelines. The growing number of communities interested in implementing new tools for pedestrian-oriented places will benefit from the best practice case studies and research summary report. It is important for this study to have supporting, quantifiable data and information on pedestrian safety, amount of walking, economic development, and other measures of success for the agencies that are highlighted as having exemplary policies and ordinances.

This research will document the regulatory, financial, and administrative tools used by communities to create vibrant pedestrian networks. Case studies should be collected from selected agencies (i.e., local municipalities, counties, and states) which have a well-documented vibrant pedestrian environment as supported by data on pedestrian safety, amount of walking, economic development, etc. These case studies should identify the tools and methods being employed; fully document the approaches used; cite the purpose and justification behind the initiatives; discuss political opposition or support; summarize the final ordinances that were adopted; and provide overall reflections on the process.

The range of tools will include roadway design guides and subdivision, zoning, parking, or other ordinances that support pedestrian safety and mobility. Specific elements to be included in the case studies may include topics such as:

- Zoning overlays and transit-oriented zones
- Form-based codes and traditional neighborhood design rather than use-based codes
- Parking location, provision ratios, reduction incentives, and mitigation opportunities

- Use of impact fees and developer contributions for pedestrian amenities
- Design guidelines regulating building setbacks, orientation, height and massing, window and entry placement
- Qualitative rather than quantitative green and open space requirements
- Requirements for amenities in commercial and employment zones, such as showers and changing facilities
- Landscape and shade elements, street furniture and sidewalk characteristics to permit resting and gathering
- Street widths, curb radii, and road elements to reduce vehicle travel and turning speeds
- Access control, driveway width and spacing, and signalized/non-signalized intersection spacing (block size)
- Pedestrian safety laws (what are the fines, penalties, etc. for hitting a pedestrian or failing to yield)
- Enforcement of pedestrian safety laws
- Local funding measures (and/or enabling State tax law) for greater investment in pedestrian infrastructure

This research should also describe areas of disagreement between State and local agencies when developing model ordinances. The case studies should discuss how the agencies address differences and concerns to cooperate in developing and implementing the model ordinances.

Key Words: model ordinances, pedestrian laws, design guidelines, zoning, public policies

Related Work: NHTSA published the *Resource Guide on Laws Related to Pedestrian and Bicycle Safety* in 2002. This document discusses effects that a variety of laws have on the causes of bicycle or pedestrian crashes with motor vehicles, the prevention or reduction of bicyclist or pedestrian injuries, and possible effects on pedestrian and bicyclist injury-producing situations that do not involve motor vehicles, such as falls. Many research documents, including TCRP Report 102 *Transit-Oriented Development: State of the Practice, and Future Benefits*, peripherally address the need for pedestrian networks to support transit-oriented development. Many evaluate the effectiveness of strategies based on transit ridership.

Over 500 statutes related to pedestrian and bicycle networks were categorized based on the governmental approach to managing mobility options in a 2005 report sponsored by STPP and AARP titled *Legislating Mobility Options: A Survey of State Laws Promoting Public Transit, Walking, and Bicycling*. The document draws conclusions about the most effective approaches based on physical improvements, funds allocated, and population benefits associated with the statute. This analysis did not consider aggregate effects of State programs, but rather considered statutes independently. It did not specifically evaluate contributions to a vibrant pedestrian network. This report also includes a more in-depth analysis of four State programs. These programs are evaluated based on associated safety and transit ridership improvements. This study identified the importance of local and regional cooperation, but does not analyze any local ordinances.

Much of the existing research related to pedestrian networks focuses either on pedestrian safety or design guidelines for multimodal communities. Much of the research that addresses design for multimodal communities identifies desirable design characteristics, but does not study the effectiveness of ordinances in achieving the desired environment. Little research was found that specifically addressed the role of local ordinances in fostering pedestrian-friendly communities. There is a need for research that evaluates the aggregate effects of local ordinances on the pedestrian environment.

Research Period: 2 years

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| <ol style="list-style-type: none">1. Literature review2. Panel evaluation3. Document findings |
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Urgency, Payoff Potential and Implementation: A renaissance of interest in walkable places has been occurring in many parts of the U.S. in the past 5 to 10 years. Signs of this trend include growth in residential markets in a variety of U.S. cities and small towns with pedestrian-friendly environments as well as increasing commercial financing available for mixed use and lifestyle center retail products. Post-Katrina rebuilding efforts along the Gulf Coast during the past year sought the planning assistance of New Urbanist planners, engineers, and architects to re-develop communities that are more supportive of pedestrian activity. While a number of leading communities have brought new tools online to address changes in community design, many more are considering similar options. This work would provide a timely response to growing interest and offer a needed resource for integrated transportation and land use development that supports pedestrian activity.

References:

Ernst, Michelle and Barbara McCann, *Legislating Mobility Options: A Survey of State Laws Promoting Public Transit, Walking, and Bicycling*, STPP and AARP, Washington, DC, 2005.

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Robert Cervero et al. *TCRP Report 102, Transit-Oriented Development: State of the Practice, and Future Benefits*, TCRP, Washington, DC, 2004.

Problem Statement Drafted using Research Needs Statement: “Case Studies of Model City/County Ordinances that Support a Vibrant Pedestrian Network” from the 2005 TRB Pedestrian Research Circular.

D2. Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference

Problem: An estimated 50% of all trips less than 2 miles in length are made by private automobiles. It is these trips that local advocates and pedestrian/bicycle planners most want to convert to walking and cycling trips. It is important to understand the extent to which the safety of pedestrians and bicyclists may be sacrificed in order to improve the movements and passive storage (parking) of motor vehicles.

The over-provision of free automobile parking creates disincentives to creating healthier, safer, and more sustainable public environments. Parking-intensive facilities are not merely inhospitable to pedestrians, but can be dangerous in certain cases. The negative characteristics of parking facilities may be obscured in part because such great cultural weight is attached to the positive aspects of convenient, cheap, and plentiful parking. Furthermore, because of a sense of social importance attached to free and easy parking, and also the apparent and hidden costs of subsidizing parking, the development of more inclusive and sustainable transportation alternatives has been largely forgotten in many towns and cities.

Higher-quality walking environments have been made more difficult by the over-concentration on the need for vehicle storage, and walking for transportation has been made more difficult because parking is too easy. Also, the health and safety of pedestrians has been compromised in automobile-dominated environments that stand apart from the public right-of-way, and beyond the regulation of traffic engineers and traffic law. Traditionally, on-street and off-street parking facilities have rarely been designed and built to safely accommodate pedestrian travel to and from motor vehicles, and this has resulted in substantial numbers of pedestrian crashes in many areas. Many older pedestrians are particularly at risk from vehicles backing out of parking spaces and while crossing travel lanes within parking lots. A study is needed to quantify some of these adverse effects of parking facilities on pedestrian safety, mobility, access, and its social and economic implications on towns and cities.

Objective: The proposed research will look for connections between the widespread provision of free and subsidized parking and the limited provision of high-quality pedestrian environments, including the pedestrian safety implications of on-street and off-street parking facilities. The American car has the equivalent of three parking places dedicated to it; there are 19 million more cars than drivers in the United States. This equates to an area the size of Connecticut that has been paved to provide parking. Thus, this study is intended to examine the safety record associated with present parking policies. Some of the specific questions to be addressed include:

- How frequent and serious are pedestrian crashes, injuries, and deaths in parking lots? (This question will likely point to the lack of robust record keeping for vehicle crashes and pedestrian injuries in parking facilities generally.)

- What are the causes and characteristics of pedestrians crashes with motor vehicles, as well as pedestrian injuries from trip and fall events at various types of on-street and off-street parking facilities?
- What attempts have been made to improve and standardize traffic control devices for parking facilities in order to enhance pedestrians' safety and convenience? (Since many parking facilities are on private property, local authorities exercise only limited control over them.)
- What efforts are underway to better integrate hospital-based injury and fatality data with traditional records (motor vehicle and roadway-based police reports) to provide a more complete picture of pedestrian exposure and risk?
- What advances of the last decade can be applied to the findings of the FHWA hospital-based data to bring the work up to date in the era of "active transportation." What were called "non-motorized" modes in 1999 can now be regarded in a more holistic, community-based framework. Transportation is no longer about corridors alone, but how it shapes and is shaped by quality of life. Streets are not just means of getting from A to B, but environments in their own right. Parking is no longer invisible, but the subject of intense scrutiny.
- What are some recommendations regarding changes in requirements for the planning, design, and operation of on-street and off-street parking lots and parking decks. Such guideline recommendations should account for all types of pedestrians which are at risk in parking lots, and particularly older pedestrians.

Key Words: parking lots, pedestrian safety, economics, urban sprawl

Related Work: In *The High Cost of Free Parking*, (2005, American Planning Association) Donald Shoup catalogs the many ills that derive from the over-prescription of free parking, as well as the benefits that might follow from more equitably managed parking resources. Shoup describes a variety of problems associated with current parking practices including: skewed travel choices (from over-reliance on private automobiles); distorted urban form (acres of often-empty parking facilities); degraded urban design (public space optimized for automobiles, not people); damaged urban economies (downtowns abandoned, and sprawl-inducing greenfields developed); increased housing costs (because houses are made to include storage space for cars); and restricted opportunities for creative re-use of buildings (older buildings that do not accommodate cars must be reconfigured at great cost to make room for them).

In contrast, he argues that when automobile parking is managed more transparently and intensively, hidden costs are made visible, parking pays its own way, and parking revenues can accrue to the places where they are generated (in a virtuous circle he calls "Parking Benefit Districts"). In this vision, localities stand to gain: a healthier citizenry; denser, cleaner, quieter, more efficient and vibrant urban districts; energy savings; reduced negative consequences from the entire cycle of automobile dependence; as well as a dependable source of revenue to reinvest in the public environment.

Overall, the strength of Shoup's arguments derives from his economic logic. Over-concentration on automobile parking and over-investment in parking provision has starved public budgets to the detriment of more benign modes of active transportation, especially walking and cycling.

A further spur to research comes from comparing overall safety levels in central cities with those in more auto-centric suburbs and exurbs. When automobile-related fatalities are weighed together in the same frame of reference with homicides, and both considered as different forms of violent death, it has been found to be more dangerous to live in the suburbs than in central cities. William H. Lucy found that traffic deaths are much more common where cars are provided with the best accommodation. This is perhaps not surprising, given that environments engineered to optimize motor vehicle movements put pedestrians and others at a fundamental disadvantage. What is new is the realization of the magnitude of the damage that is done.

In central cities, where cars are considered less necessary, far fewer people die as a result of auto crashes. Even the greater number of people killed by strangers in urban homicides is far outweighed by the numbers killed in motor vehicle crashes outside of cities. (Lucy, 2003) This finding has the effect of overturning commonly held views of the relative danger of different environments. Lucy concludes: "Traffic fatalities are largely unrecognized as a danger to be factored into residential location decisions."

An additional insight along similar lines comes from examining pedestrian and bicyclist injury and fatality data collected by hospital emergency departments. A major FHWA study found that standard methods of tracking pedestrian and bicyclist deaths and injuries (principally police reports, which typically record only crashes involving motor vehicles, and usually count only those occurring on public right-of-way) capture less than a third of all pedestrian and bicycle injury events (Stutts and Hunter, 1999). A key finding of the report is that "efforts toward creating a safer environment for ... non-motorized modes ... need to move beyond the roadway and beyond thinking about bicyclists and pedestrians only as they interact with motor vehicles. ... Parking lots need to be built with pedestrians and bicyclists in mind..."

This observation from an official study could have the effect of spurring a major re-evaluation of the degree to which auto-dependency is built into public environments, and of the distributed and hidden consequences of that dependency. For example, it is not immediately obvious that pedestrians who slip and fall in icy parking lots during wintertime are being deprived of due care because resources are diverted instead to the needs of automobiles. Yet this study found that: "The vast majority of these injury events occurred off the roadway and did not involve a motor vehicle. In addition to clearing roadways and making them safe for motor vehicle travel, sidewalks, driveways, and parking lots need to be made as safe as possible for pedestrian travel. **Too often, roadways are cleared at the expense of sidewalks, and little, if anything, is done to help pedestrians negotiate parking lots once they arrive at their destinations.**" (Emphasis added) It must be noted that this report was published a decade ago, and the research on which it is based was conducted even earlier, between 1993 and 1997.

Research Period: 3 years

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| <ol style="list-style-type: none">1. Literature review2. Data analysis3. Recommendations4. Final report |
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Urgency, Payoff Potential, and Implementation: It is important that more information be developed and compiled on the adverse effects of car-friendly policies relative to parking lots in our towns and cities. Then, model policies need to be compiled, documented, and translated into a guide of action items for jurisdictions to use when establishing their own policies and procedures for parking lot planning, design, and operation. This should include off-street as well as on-street parking facilities and should also include consideration of all pedestrians, particularly older pedestrians.

References:

William H. Lucy, 2003, *Mortality risk associated with leaving home: recognizing the relevance of the built environment*, American Journal of Public Health, Sept., 93(9): 1564-1569

J.C. Stutts and W.W. Hunter, *Injuries to pedestrians and bicyclists: an analysis based on hospital emergency department data*, 1999, Washington, D.C.: Federal Highway Administration, FHWA-RD-99-078

Problem Statement Drafted using Research Needs Statement: "Automobile Parking and Pedestrian Safety: A Search for a Unifying Frame of Reference" by Jason Patton.

D3. Best Practices for Pedestrian Facility Maintenance

Problem: Governmental agencies have severely constrained resources for monitoring and maintaining sidewalks and other pedestrian facilities such as trails, paths, and traffic control devices for pedestrians. Not only is this a problem relating to walkability and accessibility to individuals in wheelchairs, but there can be a severe liability consequence related to poor, inadequate, or infrequent monitoring or maintenance of pedestrian facilities. Agencies would benefit from an investigation into the best practices for sidewalk, pathway, and trail maintenance, as well as the maintenance of other pedestrian traffic control devices and how to overcome barriers such as the lack of funding and resources. Sidewalk maintenance is defined as monitoring, preserving, repairing, and restoring a sidewalk and keeping it in condition for safe, convenient, and accessible use. Maintenance includes repairing surface defects and changes in level (e.g., heaving) as well as snow/ice, debris, and vegetation removal. Although sidewalks are not subject to the same “traffic loads” as roadways, in some ways maintenance of them can be more challenging than roadway maintenance. The situation is complicated by the wide variety of parties responsible for sidewalk maintenance (e.g., State governments, different levels of local jurisdictions, developers, Home Owners Associations, and individual property owners). Many jurisdictions have laws or ordinances addressing sidewalk maintenance, typically requiring the adjacent property owners to remove vegetation encroaching into sidewalks and to maintain and repair damaged sidewalks adjacent to their property. However, the property owner requirements and the enforcement of these regulations may vary widely from jurisdiction to jurisdiction.

Objective: Develop a synthesis to identify best practices and barriers for sidewalk and other pedestrian facility maintenance: what works and what does not work based on experience from State and local agencies. The best practices and barriers would be compiled in a guidebook. The guide would have two main elements: policies and procedures. One element would provide examples and experiences from jurisdictions that have developed effective sidewalk maintenance policies in terms of responsibilities, enforcement, allocation of costs, and related issues. This would include a literature review and survey of State and municipal laws/ordinances, as well as case law regarding sidewalk and other pedestrian facility maintenance. The other element would identify best practices in terms of inspection and routine maintenance, maintenance needs of different types of sidewalk surfacing materials, truncated dome tactile surfaces, wheelchair ramps, geographic differences in sidewalk maintenance, types of equipment used, and other issues of this nature. Monitoring and maintenance of pedestrian facilities will also include trails, paths, and crosswalk markings as well as other traffic control devices for pedestrians. This effort would be accomplished by a critical review of published literature, an internet search of agency websites, interviews of governmental entities and professional/technical associations, and a survey of jurisdictions regarding sidewalk and other pedestrian facility maintenance experience and practices. The synthesis project will also identify potential topics for further research where best practices may not be developed but are needed.

Key Words: sidewalk, pathways, trails, maintenance, snow removal, ordinances, pedestrian facilities, funding, barriers

Related Work: Most local jurisdictions have ordinances requiring property owners to clean and repair sidewalks adjacent to their property while local governments are responsible for maintaining sidewalks along public property and traffic control devices in the right-of-way. The level of enforcement and compliance varies greatly. There are a number of jurisdictions that are using innovative practices to accomplish high-quality, cost-effective sidewalk maintenance. For example, some communities have initiated cost-sharing arrangements with private property owners or have developed equipment, materials, and procedures specifically designed for the sidewalk environment. Unfortunately, much of the information about these policies, procedures, and equipment may not be documented in the published literature. The FHWA website contains some limited information on practices related to sidewalk facility maintenance, assessment techniques, responsibilities, record keeping, and citizen reporting relating to maintenance (Chapter 10).

Research Period: 5 years

- | |
|--|
| <ol style="list-style-type: none">1. Literature review2. Panel evaluation3. Survey agencies4. Develop guide |
|--|

Urgency, Payoff Potential, and Implementation: The urgency is high due to the large amount of missing or inadequate sidewalks and other pedestrian facilities that exist and the very limited resources agencies have to repair or retrofit those missing facilities. Furthermore, many agencies lack the funds or resources to provide adequate maintenance of traffic control devices for pedestrians such as pedestrian signals, pushbuttons, and crosswalk markings. The best practices and barriers guide can be implemented by all State and local agencies immediately to start prioritizing projects and identifying funding sources and other resources.

References:

Designing Sidewalks and Trails for Access Part 2, Best Practices Design Guide, Chapter 10, FHWA Website on Sidewalk Maintenance and Construction Site Safety
<http://www.fhwa.dot.gov/environment/sidewalk2/sidewalks210.htm>

Problem Statement Drafted using Research Needs Statement: “Best Practices for Pedestrian Facility Maintenance” by Ronald Eck.

D4. Survey of Procedures for Implementing and Evaluating Experimental Treatments

Problem: While current procedures exist for implementing and evaluating experimental treatments, State and local agencies are often unaware of how to go about soliciting information on the subject. Guidelines are needed to instruct these agencies on how to implement and evaluate these treatments.

Objective: There are three primary objectives: (1) provide information and guidelines in an easily accessible document such as a brochure or guide, (2) identify venues for disseminating this information, and (3) improve coordination between FHWA and State/local agencies who seek this guidance.

The guidelines that exist for evaluating experimental treatments should be made available in a format that can be easily understood by the State and local officials who will be responsible for evaluating these treatments. A brief, yet comprehensive, brochure or guide should be developed that outlines this process. The guide should also include examples of similar projects from around the country, such as case studies, which provide examples of costs and procedures.

Secondly, these brochures or guides must be distributed to the appropriate audiences. Appropriate venues, such as State and regional conferences, should be targeted for distribution and/or presentations.

In order for the first two objectives to be successful, FHWA must promote improved coordination with State and local agencies and division offices.

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Key Words: experimental treatments, product delivery, evaluation guidelines.

Research Period: 2 years

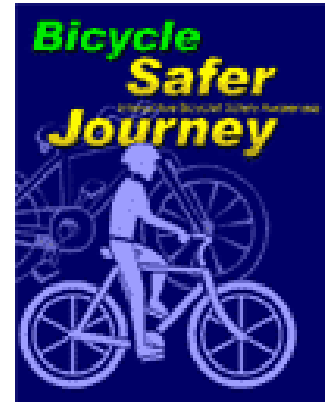
Urgency, Payoff Potential, and Implementation: This work will be of interest to State and local engineers and planners who would like to implement and evaluate treatments that have not been extensively researched. Results could then be used to inform future editions of the MUTCD.

Appendix C. Existing FHWA Product Recommendations

Presented in this section are detailed descriptions of the products evaluated as part of this project. Each description is assigned a project recommendation number (PR1, PR2, etc.) for reference. Also included in this section is a sampling of results from a product survey conducted by FHWA.

PR1. Bicycle Safer Journey

Overview/Purpose of Product: The purpose of Bicycle Safer Journey is to increase awareness of bicycle safety. The product is an interactive CD-ROM that is intended to educate all road users including children, the general public, and safety advocates. The user is invited to take a journey with John, a 14 year-old boy, as he rides his bicycle through a community and encounters bicycle safety situations. The user must use their knowledge of bike safety to help John make critical safety decisions as he travels by bike.



Status of Product: The interactive CD-ROM can be ordered from FHWA.

User Feedback: This project is geared for widespread use by a more general audience, compared to the more technical materials, and is specifically targeted for children, so the high ease-of-use rating is not surprising. One respondent, a K-8 school guidance counselor said, "The students loved the interactive nature of the materials," while another respondent commented, "It was very well thought out and presented."

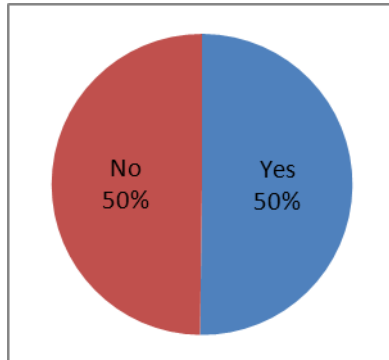
Selected Feedback

- "Helped us to win a major judgment in Federal Court for failure to provide accessible curb ramps for recently developed streets."
- "I have found it useful for health professional who are not ardent bicyclists to

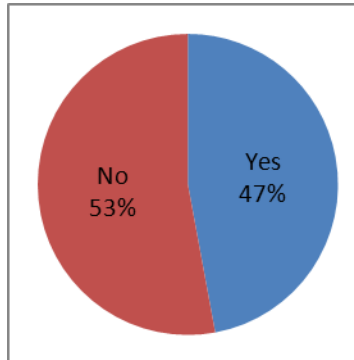
In terms of impact, Bicycle Safer Journey received an average score of 5.1 out of 9 (9 being the greatest impact). One user commented, "No regional effect on injury but the knowledge clearly makes a difference with educated individuals." The nature of this product is one that can easily be shared, as multiple users can complete the "journey" together.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

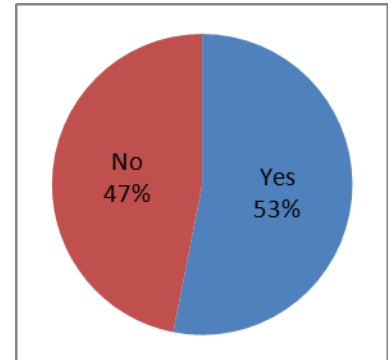
Are you familiar with this product?



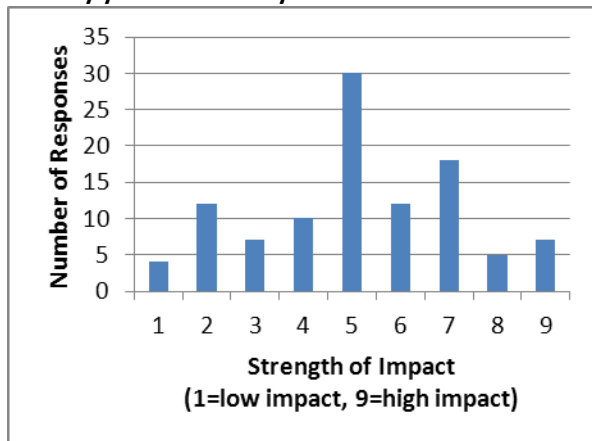
Have you used this product in the past three years?



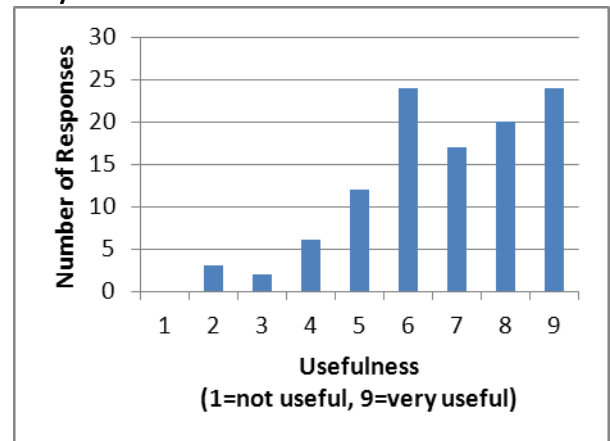
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



With regard to Bicycle Safer Journey, a large portion of product users are employed by the government in a professional capacity (50.4 percent), at the Federal, State, and local levels. In addition, the majority of product users are located in urban areas (84.0%).

Recommendations: Overall, Bicycle Safer Journey is seen as a useful way to teach road users about bicycle safety. Several users commented that they appreciated having a CD they could distribute, but several others commented about having it available online. While several users commented that Bicycle Safer Journey was a good tool for teaching children there were comments that “CD looks at idealized situations vs. hard realities” and it was “Sesame Street like”. A version geared towards adults in more complex situations would be useful. Several users also commented that having examples of bicycle safety in rural areas would also be useful. Comments included “In a rural area flexibility is limited, do not have as many choices and CD is limited in that area” and the “assumption is that you have a bike lane and in some areas you do not have choices.”

Based on feedback received from users, the recommendations for updating this product include:

- Have the materials available through a website or some downloadable format in addition to the CD.
- Create a more realistic/"real-world" version of the information, perhaps with some information on rural road bike safety.
- Make a version geared more for adults in more complex situations.

Urgency/Payoff Potential: Increasing bicycle safety awareness is important for all road users, young and old. Having a physical CD available as well as on online versions will help to maximize exposure of the product. Providing educational materials for younger and older riders will help to increase bicycle safety awareness.

Timeline: Making the current CD available online should be relatively soon, within the next 12 months. Developing additional versions of the CD (possibly DVD) should be done within the next 5 years.

PR2. Bicycle Compatibility Index

Overview/Purpose of Project: The Bicycle Compatibility Index (BCI) was developed to provide a measure of how comfortable roadways are for bicyclists. A bicyclist's decision to use a certain roadway is often influenced by the traffic operation and geometric conditions of that roadway. By examining the curb lane width, traffic volumes, vehicle speeds, and other factors to assess the "bicycle friendliness" of a roadway, the BCI fulfills the important role in the planning and implementation of bicycle facilities of providing a methodology to determine the potential of roadways to adequately accommodate both motorists and bicyclists. The Index, intended for use by practitioners, focuses on urban and suburban roadway segments and evaluates existing facilities for possible

improvements. This type of evaluation helps determine which geometric and operational standards that



benefit bicyclists can be retrofitted on existing roads or implemented on new facilities. Before this project, there was not a widely accepted methodology among planners, engineers, and bicycle coordinators for determining the compatibility of a roadway for use by bicyclists along roadway sections.

Status of Product: The Bicycle Compatibility Index was published in December of 1998. The state of practice in terms of bicycle facility design has advanced considerably since 1998. Similar measures have been incorporated into the 2010 Highway Capacity Manual (HCM) through the multi-modal level of service methodology.

User Feedback: In a more targeted survey, users of the BCI were generally satisfied with the tool and noted that it was easy to use compared to other models, provided objective results, and was sensitive to traffic flow. On the other hand, one respondent mentioned that it was difficult to implement on a regional basis due to a lack of regional data.

In terms of the BCI's impact, some professionals that used the product incorporated the results in planning analyses or used the results as a catalyst for discussions surrounding bicycle safety. The product was also used at Metropolitan Planning Organization and Pedestrian and Bicycle Committee meetings as a reference according to survey respondents.

Selected Feedback

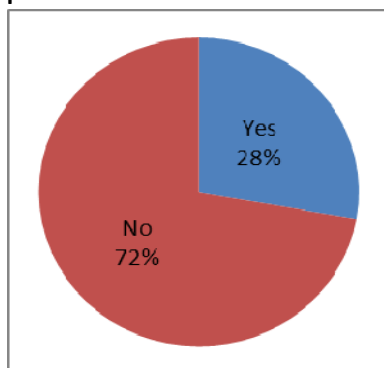
- "Bicycle Compatibility Index is helpful as a concept, but difficult to implement."
- "I regularly recommend it when appropriate."
- "It is a flexible tool for planning safe bicycle facilities."

Other respondents considered the BCI only as a reference or advocacy tool and did not find it to be particularly useful for implementation. While many found the tool very valuable as a

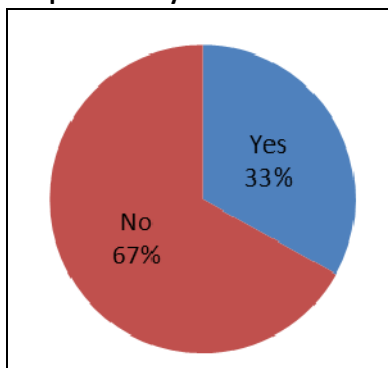
concept, many noted that it was difficult to use and that it often required more data than was available. In addition, one survey respondent found that the BCI “measures perception, not reality. It measures comfort, not safety.” This respondent recommends using the Bicycle Level of Service as a better alternative to the BCI.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

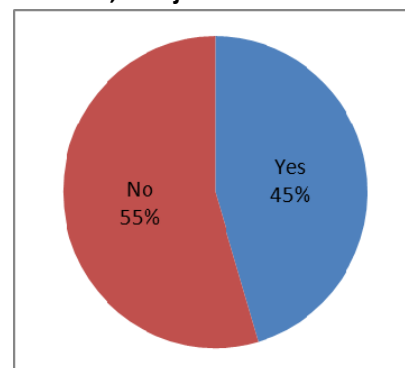
Are you familiar with this product?



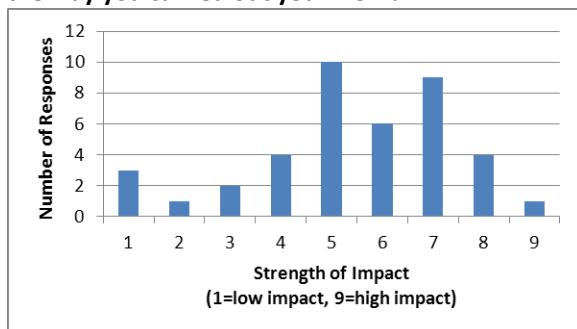
Have you used this product in the past three years?



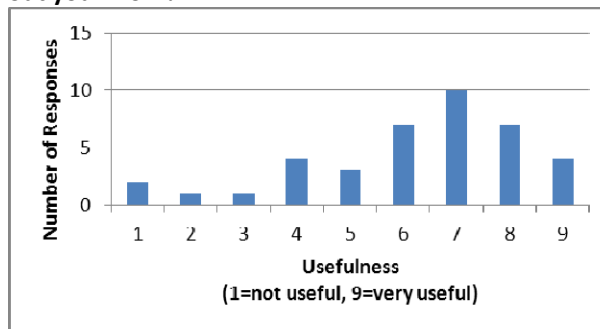
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Of the potential end-users that evaluated the BCI, the largest percent (54.5 percent) indicated that they are employed as city planners, with most working for Metropolitan Planning Organizations (18.2 percent), and State and local governments (29.5 percent). Also, nearly 75 percent of the participants work in medium to large cities.

Recommendations: Although the BCI is not used as widely as some of the other analytical tools for pedestrians and bicyclists, it is still being used by some planners and engineers to analyze roadway sections for bicyclists. There are also other tools that have been developed to quantify the level of service for bicyclists, including the updated Highway Capacity Manual. Therefore, we do not recommend any further updating or revision of the BCI at this time.

Urgency/Payoff Potential: It has been determined by the project team that the potential payoff is not justified at this time for updating the BCI.

Timeline: Not applicable.

PR3. Bicycle Safety Guide and Countermeasure Selection System

Overview/Purpose of Product: The Bicycle Safety Guide and Countermeasure Selection System (BIKESAFE) is a helpful resource for selecting appropriate countermeasures to specific problems relating to bicycle safety. Using known site characteristics, the type of safety problem, or the desired behavior change, the system refines the selection of possible countermeasures and treatments for the user with the intent of providing the most useful information to uncover the safety and mobility needs of bicyclists and to improve the conditions for bicyclists in the public right-of-way.

By focusing on engineering treatments, but also incorporating education and enforcement elements, BIKESAFE provides a detailed analysis of treatments that can be used to mitigate a known crash issue or achieve a performance objective for bicycles. Designed for use by transportation officials, planners, engineers, and safety professionals, it can also be used by the general public to aid in generating support among local decision-makers for bicycle improvements or in identifying problems.

In addition to the identifying countermeasures, the system also includes a number of case studies of communities that have implemented treatments. Another section of the BIKESAFE tool contains resources including sections on background, which explain what is needed to create a viable bicycling system; crash factors; crash typing, the process of selecting the most appropriate countermeasures; objectives, which includes information about how treatments will improve the bicycling environment; and implementation.

The functionality of the BIKESAFE tool also allows users to either view all the treatments associated with a specific problem or objective, or to view the treatments associated only with distinct operating or geometric conditions, as defined by the user. Overall, the BIKESAFE product seeks to

- Provide information and guidance about bicycle crash types and other background information.
- Link users with information about which countermeasures are available for specific types of crashes or for specific performance objectives.
- Define the important aspects in the selection of a countermeasure.
- Include case studies of countermeasures that have been implemented across the country.



Status of Product: The BIKESAFE tool has been in existence since 2006 and is a helpful resource for many transportation professionals as well as for the public. An update on this project is overdue.

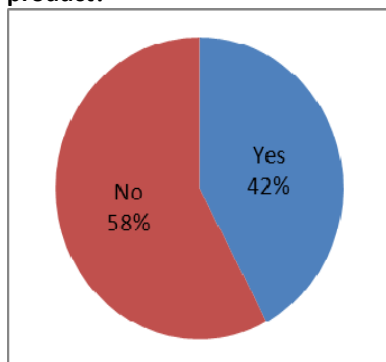
User Feedback: Of the survey respondents, a large number were satisfied with the product, while others were not satisfied, considering the BIKESAFE tool as too advocacy oriented, not in accordance with accepted standards, or not accommodating of vehicular cyclists. Others felt it was too technical for the general public and one respondent considered the resources to be harmful. On the positive side, many survey respondents commended it as a useful resource and recommended it to other transportation professionals or used the system as a guide to best practices. Other comments included the need to update the resource regularly, to ensure that more detail about the safety impacts of the countermeasures are incorporated, and to not lose sight of the application of the resource in rural areas and smaller communities.

Selected Feedback

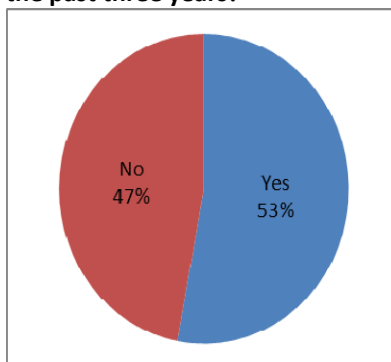
- “The online version was extremely helpful.”
- “It was useful to see a range of examples with cost information. The images also helped to convey the concepts to other professionals.”
- “Useful information for all new planners and DOT workers.”

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

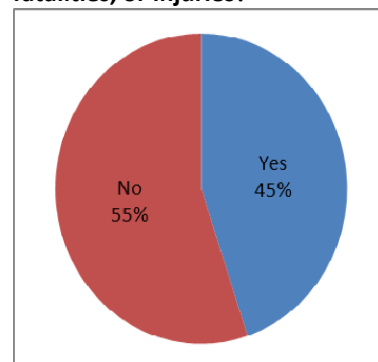
Are you familiar with this product?



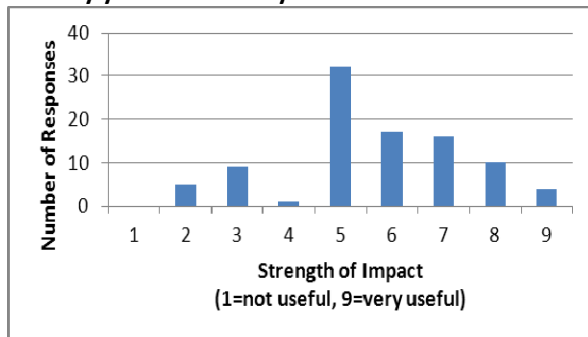
Have you used this product in the past three years?



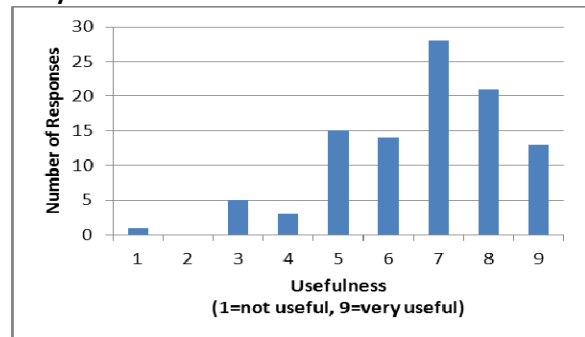
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Of the survey participants, 61.7 percent work primarily in urban areas and are mostly employed as professional staff. However, the 18.7 percent of those who evaluated the Bicycle Safety Guide and Countermeasure Selection System product work for for-profit companies. Local and State governments are the second and third largest employers, respectively.

Recommendations: Overall, the Bicycle Safety Guide and Countermeasure Selection System is viewed as a helpful resource for determining the correct countermeasures to mitigate known crash problems or achieve specific performance objectives. Some key recommendations are to improve the ease of use and impact, which could necessitate a redesign of the system. In addition, updating the resource on a regular basis to reflect the current state of practice in bicycle facility design and mitigation procedures would increase its impact. In terms of the BIKESAFE tool as an advocacy instrument, ensuring that all of the countermeasures are in accordance with the accepted bicycle facility design practice will alleviate this concern. Including details about the effects on safety will also improve this resource.

Urgency/Payoff Potential: This system is a helpful resource for transportation officials, planners, engineers, and safety professionals. Updating and marketing this resource will increase awareness of bicycle facility design modifications.

Timeline: The revisions to this resource do not necessitate a large time commitment and can be completed within 0 to 1 year.

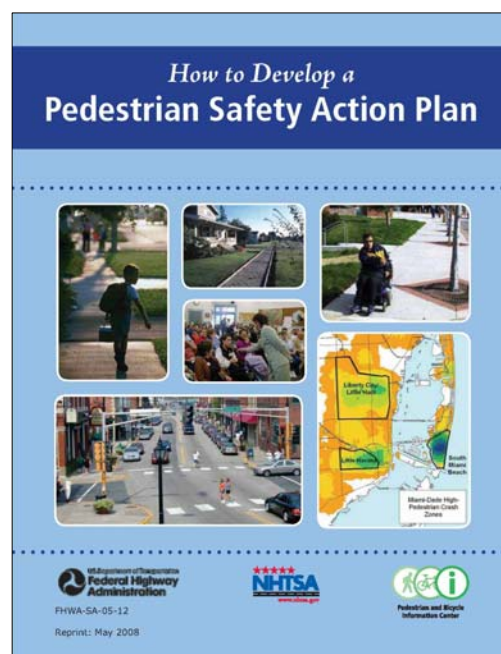
PR4. How to Develop a Pedestrian Safety Action Plan

Overview/Purpose of this Product: The FHWA Report entitled: *How to Develop a Pedestrian Safety Action Plan* was originally developed in February, 2007. It contains information on planning and engineering policies (e.g., street design, land use, site design, access management), as well as such topics as involving stakeholders, collecting and analyzing data, analyzing information and setting priorities, selecting safety treatments, funding sources, and putting all of the elements together into a comprehensive Pedestrian Safety Action Plan (PSAP). In May of 2008, the PSAP Guide was updated using funding from NHTSA to add more detailed information on education and enforcement strategies. The Guide contains dozens of photographs, examples, and illustrations of pedestrian safety measures, practices, and programs.

The PSAP Guide development was conducted as a part of a larger technical assistance project for the FHWA Office of Safety. That larger project also involved developing and teaching a series of PSAP training courses (2 days each) to the 13 FHWA focus states and 4 focus cities. A companion 2-day course on “Designing for Pedestrian Safety” has also been presented as part of the FHWA overall technical assistance project. To date, more than 140 courses have been presented to more than 4,000 engineers, planners, educators, enforcement personnel, public health officials, city, State, and safety officials, advocates, and community leaders, among others.

In the past year, a PSAP “Template Course” has been developed and presented in several of the focus states.

This template course consists of having two PSAP instructors meet with a small group of stakeholders in a State or city to work through the development of that agency’s PSAP on a structured “outline” or template. At the conclusion of this 3-day session, the agency has the essential ingredients of their agency’s PSAP.



Status of Product: The updated PSAP Guide was published in May of 2008, or approximately two years ago. It is still fairly up to date at the present time, but it should be considered for updating in the future.

User Feedback: Based on the user surveys, the FHWA PSAP Guide was rated highly in terms of it playing an important role in the future, giving users the most knowledge, its impact (on the way that they carry out their work), and respondents’ familiarity with it.

Some of recommendations for changes and improvements include development of a summary table/tip card to summarize all strategies. Another respondent recommended wider

distribution and inclusion in public relations and local governmental education campaigns to educate public officials and the public about the large numbers of pedestrian injuries and fatalities and how to prevent them.

Another comment was as follows:

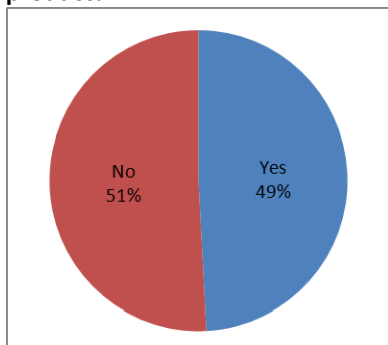
“It will really make an impact if we can get pedestrian safety action plans developed and implemented at various levels especially at the Metropolitan Planning Organization (MPO) and State levels. It will provide a strategic framework for addressing pedestrian safety, rather than chasing the high media profile fatalities where emotions become the driving force rather than data.”

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented on the following page.

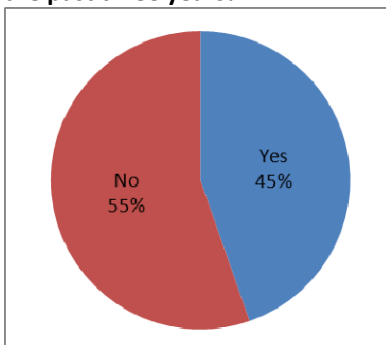
Selected Feedback

- “Excellent resource guide. Very helpful. ...provided good processes and best practices. It is very useful to pedestrian safety advocates.”
- “Contains useful ideas to help advocacy groups and sponsoring agencies that should promote safety.”
- “The public works departments and university staff now have the information and training they needed to improve pedestrian safety. The impact is dramatic on campus.”
- “...a wonderful guide in helping to create materials for parents, students and to raise awareness to staff members.”
- “...really liked the encyclopedia (“cook book”) of moving people to and from center and bus stops...”

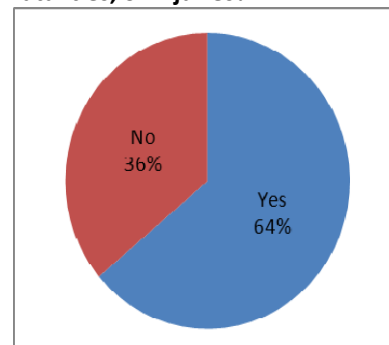
Are you familiar with this product?



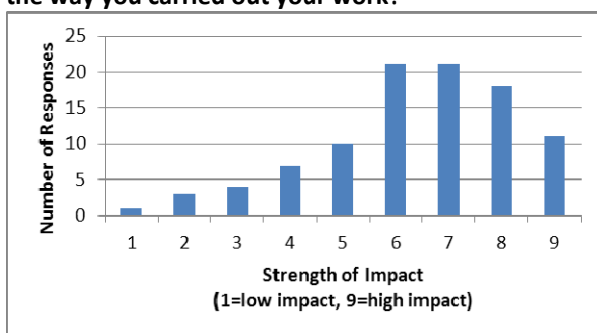
Have you used this product in the past three years?



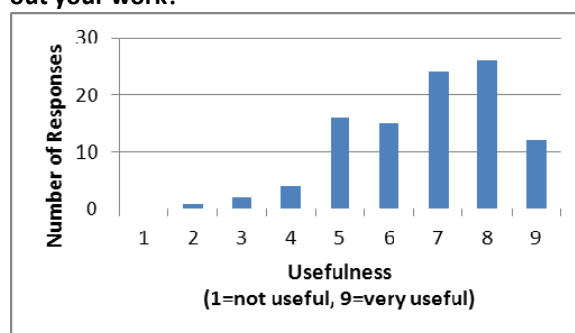
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



With regard to the use of this product, 21 percent of survey respondents indicated that they are employed by State government as professional staff, with 41.9 percent of respondents working in large urban areas.

Recommendations: The PSAP Guide is fairly up to date at the present time, but will likely need to be updated in approximately five years (i.e., in year 2015). This will allow for incorporation of the latest pedestrian safety examples, programs, policies, and analysis tools, as well as the results of more recent research. We also recommended that the PSAP Guide be more widely distributed and that the various PSAP courses be taught more widely in the non-focus states, as well as the focus states. We also recommend the development of a higher-level, 2-hour PSAP presentation to be given to top management officials in cities and State DOT's, who do not have the time to attend a full 2-day PSAP course.

Also, more intense efforts are needed to encourage states and cities to develop their own specific PSAP, and there should be new efforts to monitor the pedestrian crashes, injuries, and deaths in each State. Based on pedestrian crash trends and characteristics, training and/or technical assistance should be provided to agencies in need of help.

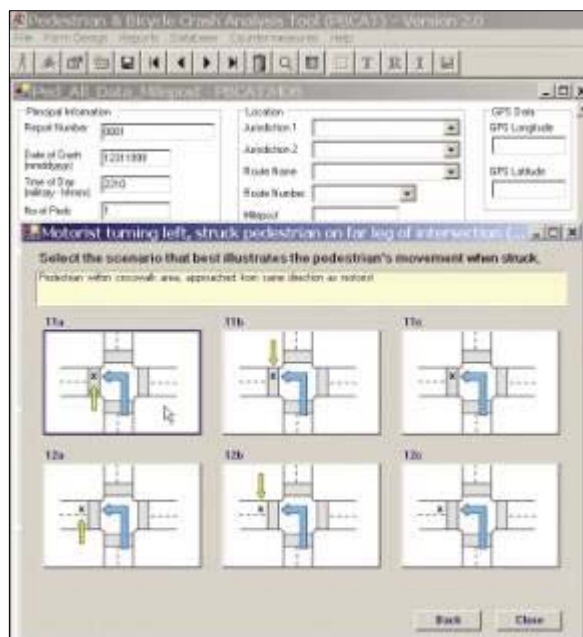
Urgency/Payoff Potential: There is a high degree of pedestrian safety “pay-off” for continuing to promote and distribute the PSAP Guide and related training.

Timeline: This should be an ongoing program for the foreseeable future until pedestrian crashes, injuries, and deaths are dramatically reduced in the U.S..

PR5. Pedestrian and Bicycle Crash Analysis Tool

Overview/Purpose of Product: The Pedestrian and Bicycle Crash Analysis Tool (PBCAT) is a software application that assists users in developing a database for crashes that occur between pedestrians and bicyclists and motor vehicles. In order to analyze the crashes, the user inputs the crash details, including some information regarding the situation, what occurred, and the actions of the involved parties before the crash. The summation of the actions leading up to the crash is commonly referred to as crash typing. Following the development of a crash database, PBCAT analyzes the crash data, produces reports, and selects countermeasures to address the issue at the crash location.

In terms of the functionality of the PBCAT tool, it incorporates a number of features. Among the most important are a form designer for inputting crash data to match the police crash reports in the community; group crash typing, if communities are not interested in the individual level of detail; the ability to record specific location data; detailed descriptions of possible countermeasures; importing and exporting capabilities; and links to other system tools including the PEDSAFE and BIKESAFE countermeasure selections systems. These features, corresponding to the PBCAT Version 2.0, provide a helpful support system for selecting countermeasures and refining the analysis to the community's specifications.



This product is particularly helpful as many computerized crash files maintained by states or municipalities do not contain sufficient details to adequately recommend countermeasures at crash locations. Many of the typical crash files used by states include information on where pedestrian and bicycle crashes happen, when crashes occur, and characteristics of the victims, including information regarding age, gender, and level of injury. These crash files do not, however, include information about what actions lead to and caused the crash. This information is crucial in developing effective countermeasures at crash locations and this method of crash typing is helpful in gaining a better understanding of how and why crashes are occurring.

PBCAT has been used as an online tool in North Carolina and as a useful analysis support for a study conducted in Metropolitan Orlando. The tool was very helpful in providing an idea of which countermeasures to implement and which countermeasures were ineffective.

Status of Product: PBCAT has been in use for several years and has had favorable reviews.

User Feedback: PBCAT provides a helpful service and is used as a reference tool and as a method of measuring crashes. The tool is particularly helpful in cost versus benefit analyses and in providing empirical justifications for implementing pedestrian and bicycle crash countermeasures. In addition, the tool was helpful in coordinating pedestrian safety efforts and in facilitating the dissemination of pedestrian safety materials to communities.

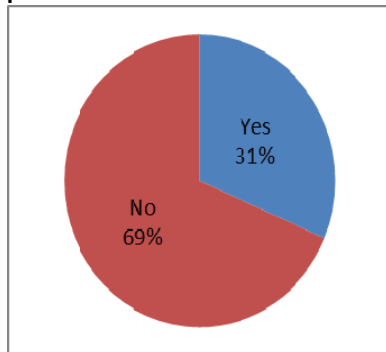
According to respondents, it would be helpful to create an online version of the product, to interface the product with GIS, and to create a measurement of countermeasure impact on safety. In addition, one respondent felt the tool was irrelevant from a political standpoint while another felt that the PBCAT was helpful in identifying intervention type countermeasures, but not engineering type countermeasures. While it seems that the PBCAT provides a helpful service, it also suffers from some limitations. The survey elicited some responses on the functionality of the tool, including that it crashes often and that data files are not easily placed in servers and folders. Another comment was that the PBCAT does not replace the need for a solid understanding of bicycle, pedestrian, and safety fundamentals.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

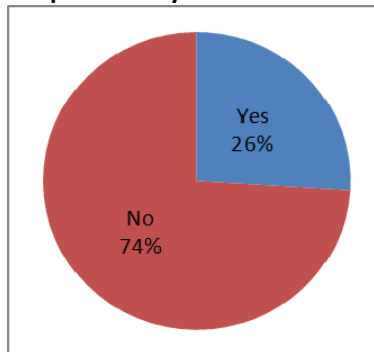
Selected Feedback

- Used “to substantiate a reason for better pedestrian safety in the community.”
- “Greater degree of knowledge and accuracy creates better quality work.”
- “Was able to ascertain needed data to make argument at meetings.”

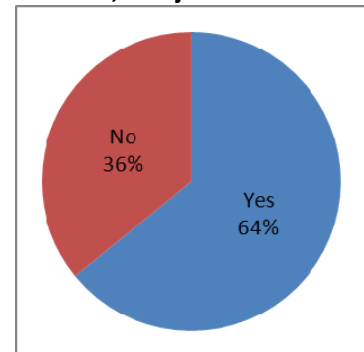
Are you familiar with this product?



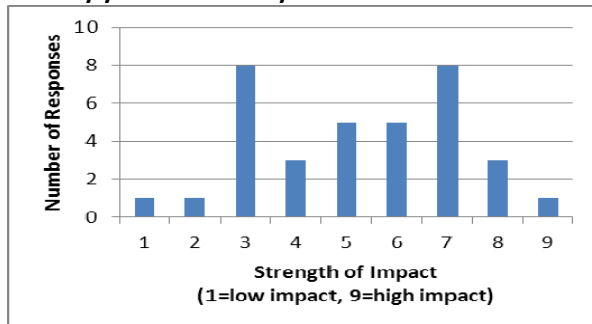
Have you used this product in the past three years?



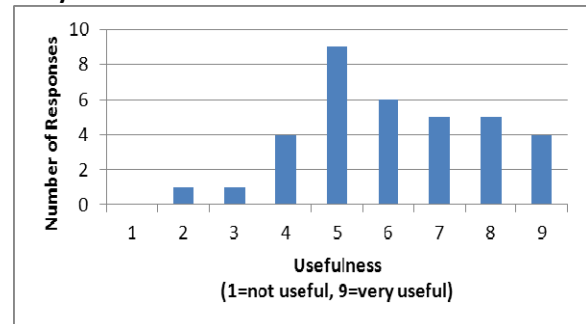
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



For the Pedestrian and Bicycle Crash Analysis Tool, 41 percent of survey participants indicated that they are employed by State and local governments, while 33 percent live in urban areas.

Recommendations: Overall, the PBCAT is seen as a useful tool for determining countermeasures at crash locations. One issue, however, is a lack of distribution and availability of the resources. Another issue is the simplicity of the analysis tool. The PBCAT could be enhanced by reviewing the current program, updating the countermeasures to reflect current practice, improving the section on engineering countermeasures, and upgrading the software. In addition, creating a web application of the PBCAT would increase the potential distribution and availability of the resource and encourage the use of the tool.

Urgency/Payoff Potential: The survey results indicate that the PBCAT is an important resource in terms of providing useful information to the user. By enhancing the program according to the recommendations, the PBCAT could reach a larger audience and could provide a more in depth analysis.

Timeline: As an update to the program would be necessary to fulfill the recommendations, a reasonable timeline is one to three years for this resource.

PR6. Pedestrian and Bicyclist Safety Materials for Hispanic Audiences

Overview/Purpose of Product: The Pedestrian and Bicyclist Safety Materials for Hispanic Audiences include a collection of flyers, brochures, and posters that contain safety messages targeted specifically at Hispanic audiences.

Each of the posters, flyers, and brochures targets specific pedestrian safety concerns, including:

- Crossing the street
- Walking along the roadway
- Pedestrian signals
- Effects of alcohol
- Bicycle safety tips

are available online at

http://safety.fhwa.dot.gov/ped_bike/hispanic/materials/index.cfm.



User Feedback: Based on the survey results, the safety materials scored well in terms of ease of use. Many of the responses complimented the design and quality of the images. Some also pointed out that these materials have addressed a growing portion of their population. These materials were used by roughly 23 percent of respondents in the past three years, making it one of the most used products.

However, results show that respondents question the effectiveness of these materials. Of those who recently used the materials, only 37 percent felt that the materials gave them useful knowledge that could be used to reduce crashes, injuries, and fatalities. Some pointed out that the Hispanic audiences might have trouble understanding the text of the messages, and the images alone might not effectively communicate the safety messages.

Several survey respondents also indicated that the posters were too large, and were unable to post them at certain establishments due to the size. Others indicated that the distribution seems to be limited.

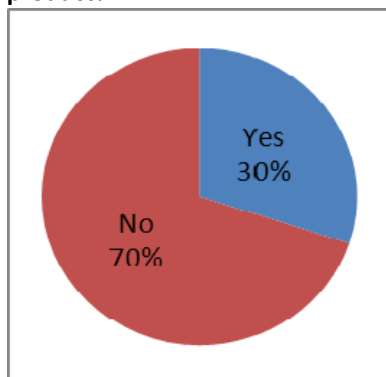
Follow-up phone interviews gleaned more detailed responses from individuals who use these materials. Many of the respondents indicated that the materials have been displayed at local community centers, festivals and other events, and establishments that sell alcohol. These interviews reinforced the survey findings that indicated a smaller poster size would be helpful in distribution. In fact, a smaller poster size was designed by FHWA, so this problem could be addressed by making this poster size more readily available.

Selected Feedback

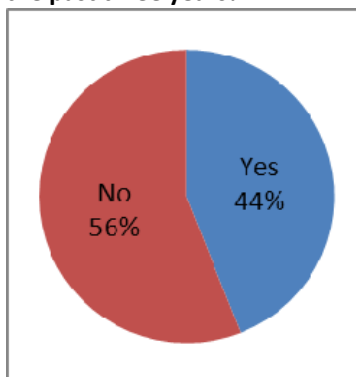
- “Highly important as it is hard to provide safety materials for non English speaking families.”
- “Graphics [are] very effective.”
- “Simple for both adults and kids to understand.”

End-User Analysis: For each product, survey participants were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

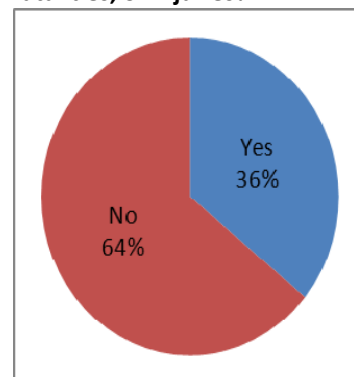
Are you familiar with this product?



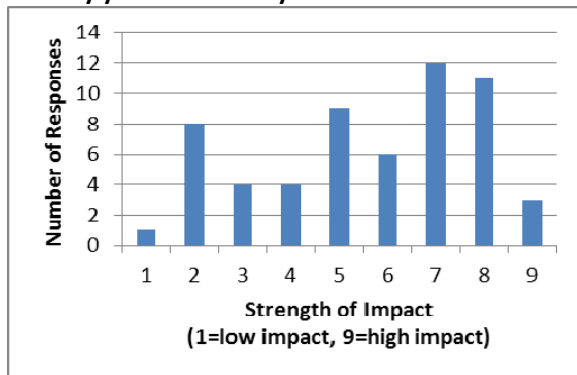
Have you used this product in the past three years?



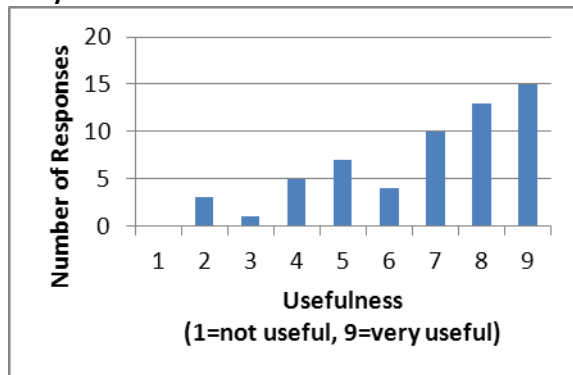
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



The Materials for Hispanic Audiences were mostly used by professionals in large metropolitan areas (36 percent), followed by medium and small cities (26 percent each). The majority of users were government employees and traffic engineers, while only 7 percent were advocates.

Recommendations: To address the survey responses, steps should be taken to redesign the posters so that they can effectively communicate safety messages to populations with a lower rate of literacy. These newly-developed materials could include design templates that allow individual agencies to tailor the messages to specifically address the needs of the local population.

Since many of the responses addressed the need for smaller posters and flyers, it would be helpful to produce the materials in different sizes.

Urgency/Payoff Potential: The findings of the [Background Report](#) point out that the bulk of the population growth in the U.S. over the next twenty years will be a result of the rising Hispanic population. The Hispanic population is expected to grow at a much faster rate than the white, non-Hispanic population—68 percent by 2020 and 105 percent by 2030. These materials, if made available and distributed to a wide audience, will address pedestrian safety concerns within that group.

Timeline: The proposed changes could be implemented immediately, within the first five years.

PR7. Pedestrian and Bicycle Intersection Safety Index Report and Guide

Overview/Purpose of this product: The FHWA study entitled “Pedestrian and Bicyclist Intersection Safety Index” resulted in a final research report and a separate User Guide. The primary objective of the study was to develop a safety index for use by engineers, planners, and other practitioners to prioritize intersection crossings with respect to pedestrians and bicyclist safety in a proactive manner (so officials don’t have to wait for pedestrian or bicycle crashes to occur before identifying problem locations and considering corrective treatments). The study involved collecting and analyzing data related to pedestrian and bicyclist behaviors and conflicts, as well as getting subjective ratings of intersections by pedestrian and bicycle safety experts. Prioritization models were developed for rating intersections on a 6-point scale (where a rating of 1 is a low risk location and a rating of 6 is a potential high-risk location). The models include traffic and roadway variables for pedestrian safety (e.g., type of traffic control, traffic volume, number of lanes) and bicycle safety (e.g., volumes of bicycle through and turning movements, presence of bicycle lane, main and cross street traffic volume, type of signal control) for use in rating intersections. A User Guide was developed to allow for applying to large numbers of intersections and selecting the intersections with the highest risk values for consideration for needed safety enhancements.



Status of Product: This report and User Guide were published in April of 2007 and therefore, are not in need of updating.

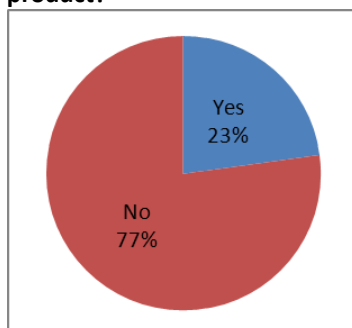
User Feedback: Some of the suggestions for improvement include making the FHWA Pedestrian and Bicycle ISI Guide more user friendly, since it was reportedly too technical for some potential users. One respondent recommended setting up a spread sheet similar to the “Bicycle Compatibility Index” so it is easier to use.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented on the following page.

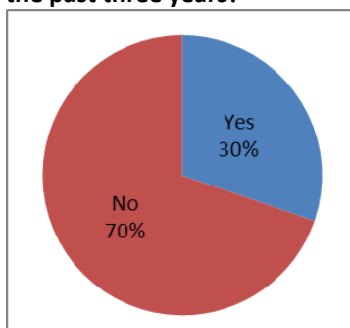
Selected Feedback

- “I frequently receive inquiries related to pedestrian and bicycle safety at intersections. This is a useful tool for engineers and planners.”
- “This is a safety-based analysis model, which will have an even more direct effect on pedestrian and bicycle safety than other (also important) comfort-level-of service models.”

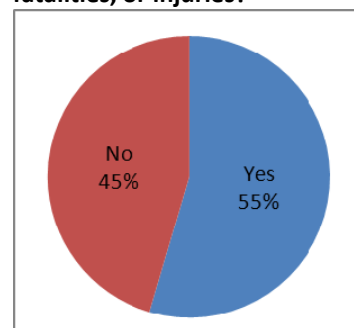
Are you familiar with this product?



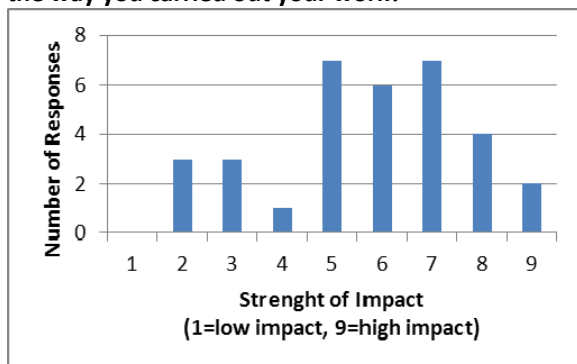
Have you used this product in the past three years?



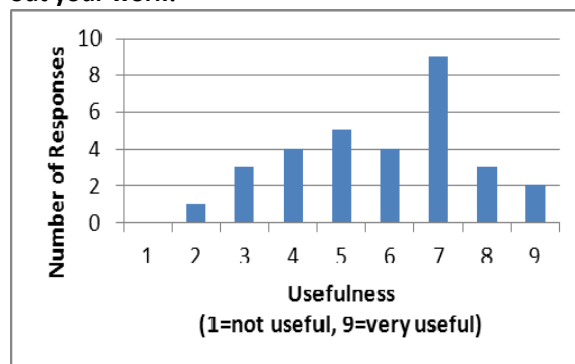
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



The Pedestrian and Bicycle Intersection Safety Indices were reviewed mostly by individuals working as traffic engineers (27 percent), government employees (18 percent), and consultants (12 percent). Nearly half (48 percent) of the individuals surveyed worked in large metropolitan areas.

Recommendations: The FHWA Ped/Bike ISI report and Guide were published fairly recently (April, 2007), so there is no need to update these documents. However, this Guide was rated fairly low in terms of its usefulness, and users recommended that it be modified to make it more user-friendly. It is proposed that a limited effort be made to thoroughly review the ISI User Guide and attempt to modify the way that the ISI tool is presented to make it easier to use. We also recommend a series of webinars to the pedestrian/bicycle community to help explain the purpose of the ISI tool and how to use it.

Urgency/Payoff Potential: This modification to the ISI tool should be done soon, along with several webinars.

Timeline: The development of a simpler Ped/Bike ISI tool and presentation of two or three webinars could be done in 6 to 12 months.

PR8. Pedestrian and Bicycle University Course

Overview/Purpose of Product: Integration of pedestrian and bicycle facilities into transportation plans and designs is essential in creating safe, sustainable, and livable communities. The FHWA University Course on Pedestrian and Bicycle Transportation contains 24 modular lessons on topics ranging from facility development and safety to design and advocacy. The course (which includes slides with instructor speaking notes and a printed student manual of readings and exercises) was designed to educate future planners and engineers about critical pedestrian and bicycle considerations and best practices in planning and design. The training objectives of the course are as follows:

- Recognize the legitimacy of the bicycle and pedestrian modes in a balanced transportation system.
- Understand the policy, planning, and engineering tasks related to pedestrian and bicycle planning as well as how these practices can be improved to create a more balanced transportation system.
- Become familiar with the concepts and functionality of the fundamental tools, policies, design principles, and practices related to bicycles and pedestrians and should know how to implement this knowledge in the field.



Status of Project: The FHWA University Course on Pedestrian and Bicycle Transportation was originally developed by UNC's Highway Safety Research Center and subsequently updated in 2005 by the Texas Transportation Institute (TTI). Since 1999, it has been taught, in whole or in part, at nearly forty universities, including the University of North Carolina, the University of Wisconsin-Madison, the University of West Virginia, the University of Maryland, Portland State University, the University of Texas at Arlington, and the University of Florida, among others. In 2008, UNC partnered with FHWA's Pedestrian and Bicycle Information Center (PBIC) to develop a modified university-level course (incorporating some materials from the original FHWA course), focused more heavily on graduate students in urban planning programs. This course was piloted at UNC in 2009 and revised with student and instructor input, and released in early 2010. To date, close to 50 university professors/instructors have requested the PBIC course materials. The PBIC tracks the pedestrian and bicycle courses

Selected Feedback

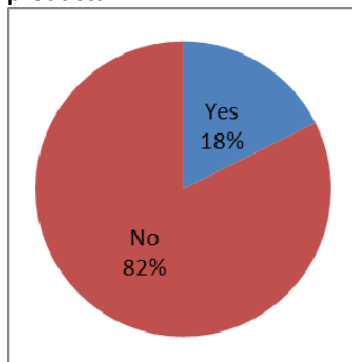
- "I loved it!... I think it's a great reference."
- "Helpful because this information is extremely difficult to access through any other means."
- "I already knew most of the information, but it is all important and the course has it organized very well."
- "It should be required reading for all planners and engineers!"

actively being taught across the U.S. on its website:
<http://www.walkinginfo.org/training/university-courses/contacts.cfm>.

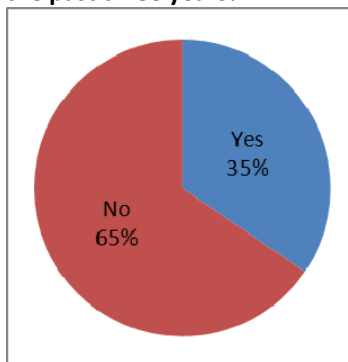
User Feedback: Of the 17 FHWA products evaluated for this project, the FHWA University Course on Pedestrian and Bicycle Transportation was rated as useful, but also as one which respondents were least familiar. This may be due to the nature of the product and its intended audience in relation to the make-up of the survey participants, which may not include a large sample of this product's intended audience. The University Course was developed primarily for use by university professors in engineering and planning programs and their undergraduate or graduate students. However, the information in the course may be used by professionals outside of an academic setting, so it is important for a broader audience to be aware of the resources. The initial course offerings (from 1999) were evaluated in an informal instructor survey conducted by TTI in 2004, and feedback was incorporated into the 2005 edition. Other respondents commented that the course had not been updated recently, which could help increase its impact, and that new, updated materials could be necessary to cover recent developments within the field of pedestrian and bicycle planning, which is developing and changing rapidly. Survey respondents noted that the course index/table of contents was helpful for locating specific materials quickly. Several stated that the photos in the course slides provide excellent examples of pedestrian and bicycle treatments, and having PowerPoint presentation templates was helpful in piquing the interest of students visually. In addition, one survey respondent requested that more video content be added to the course and that it be regularly updated to reflect the current state of practice. Another respondent mentioned that additional information about pedestrian/bicycle design/operational considerations in different weather situations (i.e., snowy climates) would be helpful.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

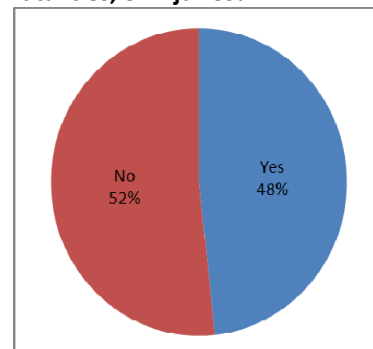
Are you familiar with this product?



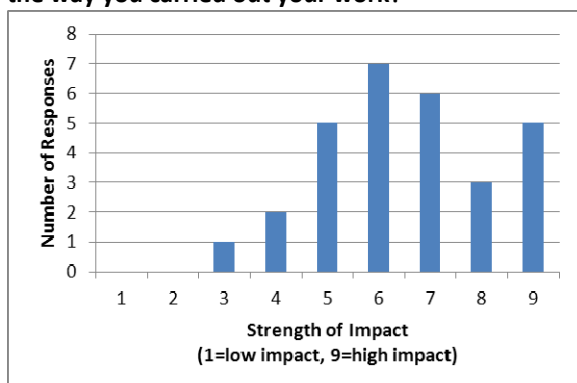
Have you used this product in the past three years?



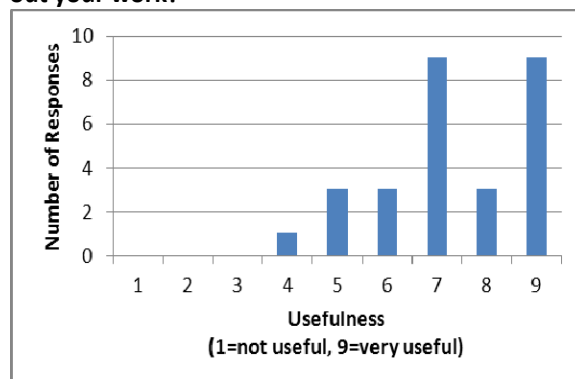
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Users of the University Course materials represented large metropolitan areas and small cities (65 percent), as well as medium cities (24 percent). Just over 27 percent of these individuals worked for universities, while others represented State governments (17 percent) and private companies (17 percent).

Recommendations:

1) Extensively market the course to increase product up-take in universities across the U.S..

Overall, the University Course on Pedestrian and Bicycle Planning should continue to be offered at universities around the United States. Elements of the FHWA course could be incorporated into City Planning, Engineering, Public Health, and Public Policy/Administration programs and could enhance those courses of study. According to a study by Dill and Weigand (2009), 59% of courses taught in the fields of transportation planning or engineering included information about pedestrians and bicycles (p. 5). One important goal would be to ensure that 100% of accredited engineering and transportation planning programs incorporate (and/or require) pedestrian and bicycle transportation curriculum, so that all future generations of transportation professionals have adequate knowledge, training, and appreciation of

pedestrian and bicycle issues. By increasing marketing initiatives and ensuring that professors, department chairs, and incoming students are aware of the available course materials, the percentage of schools offering such courses and students receiving training can be increased.

Marketing strategies could include targeting professors /universities through ITE's Education Council, TRB's Committee on Transportation Education and Training, or other professional organizations; posting information about the course in journals, trade publications, or websites read by engineering and planning professors; or coordinating with the accreditation boards to re-examine core course requirements. Strategies to reach potential students could include the use of student-based listservs, journals/clubs, or events to disseminate information about the course.

2) Update or supplement materials with best practices and recent changes to design standards. For professors to choose to teach the course, it must be in synch with the latest research and design guidance. As the MUTCD and AASHTO's guidance on pedestrian and bicycle design best practices are ever-evolving, the University course materials should also be regularly updated (or supplements developed) to reflect major changes.

3) Reduce barriers to (and/or increase opportunities for) teaching the course. In a related effort, the TRB Pedestrians Committee organized a series of workshops at conferences (ProWalk/ProBike in 2008 and the TRB Annual Meeting in 2010) to discuss the state of pedestrian and bicycle university-level education. An important outcome of these discussions was a better recognition of the barriers instructors face in teaching the program (such as limited time, expertise in the subject, student demand, or departmental support), as well as what resources may enable instructors to provide more (and higher quality) pedestrian and bicycle instruction. Activities or resources that could support instructors in teaching the course could include:

- Materials and supplements (e.g., updates or example student assignments and grading keys) in various file formats (e.g., PowerPoint and Word files) that can be modified or tailored by the instructor.
- An outlet for inter-departmental/inter-university exchange, whereby professors can learn from others as to how to plan and teach a pedestrian or bicycle course; find and coordinate with expert guest lecturers; share lesson plans, new readings, or student assignments; and facilitate course delivery.
- Materials to fit various lengths of time available to introduce the topic into other existing courses (e.g., a one- or two-lecture overview of key concepts, if the entire semester course cannot be taught).
- Materials specific to different student audiences (e.g., separate courses, reading lists, or lectures primarily for undergraduate engineering students, graduate engineering students, and graduate planning students).
- The provision of mini-grants to departments or other resources to support staff in teaching the course.
- Alternatives to university-based teaching (e.g., web-based, self paced courses, opportunities for distance learning, summer short courses, etc.).

With the development of support materials such as these, it is more likely that instructors across the U.S. will be able to effectively teach the course, and additional course options can engage a broader spectrum of students.

Urgency/Payoff Potential: As many of the respondents indicated this was one of the most important FHWA products, and filling the pedestrian/bicycle education gap among future practitioners is a critical need, there is a high urgency and long-term, sustainable pay-off potential for implementing the above recommendations.

Timeline: The course marketing/dissemination could be part of any ongoing marketing efforts routinely conducted by FHWA (e.g., disseminate materials at conferences, on websites, in newsletters, etc.). Additionally, updates or supplements should be developed and marketed at a minimum of every five years, or in line with the release of new design guides (such as AASHTO or MUTCD). Since it has been 5 years since the last edition was released, the 2009 MUTCD has several new pedestrian and bicycle related treatments, and the National Cooperative Highway Research Program is currently sponsoring the update of the AASHTO *Guide for the Planning, Design and Operation of Pedestrian Facilities*, it is recommended that new course materials or supplements describing changes be developed in the near term.

References:

Dill, J. & Weigand, L. (2009). *Incorporating Bicycle and Pedestrian Topics In University Transportation Courses: A National Scan*. Portland, OR: Center for Transportation Studies, Portland State University.

PR9. Pedestrian Forum Newsletter

Overview/Purpose of Product: FHWA produces a quarterly newsletter that highlights recent pedestrian safety activities, research, and resources that relate to the 4 E's: Engineering, Enforcement, Education, and Emergency services. The newsletter is a short document, generally three to four pages, with articles highlighting the latest activity in pedestrian safety. It also provides announcements of upcoming guides, toolboxes, and software, updates or revisions to existing guides, and dates of free pedestrian safety webinars. The newsletter can be accessed through an email subscription, or online at the FHWA Office of Safety website.



Status of Product: Users can choose to subscribe to the newsletter via email, or view the newsletter online at FHWA's Office of Safety website. The website has archived issues of the newsletter dating back to Winter 2002.

User Feedback: The Pedestrian Forum Newsletter had mixed reviews from the key stakeholders that evaluated the 17 FHWA products. Only 43 percent of the respondents felt the product gave them helpful information. Of the respondents, 66 percent of the users felt the product would play an important role in the future. However, it did rate a 7.3 out of a scale of 9 for ease of use, and it received multiple positive comments from users. One user wrote, "I like that it comes electronically and I can easily share it with others," while another responded, "I presume that I will be learning about more applications in the future. This is an excellent informational tool." Respondents said it gives good information about what is accepted practice, and that the pictures are well-done and the details give good examples.

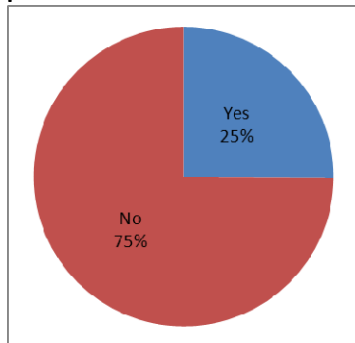
Selected Feedback

- "Great resource, well written and includes wonderful information."
- "Very good useful information."
- "Innovative, current."
- "It provided information that I have been able to use to try to raise the knowledge base of local engineers."

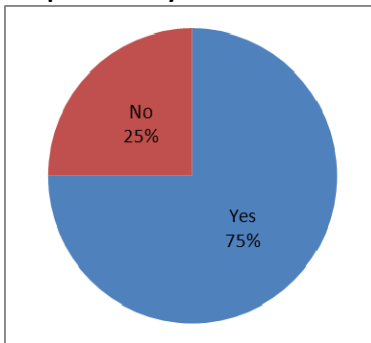
End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the

measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

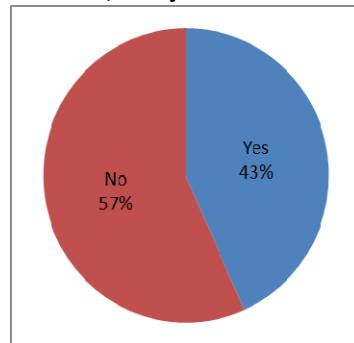
Are you familiar with this product?



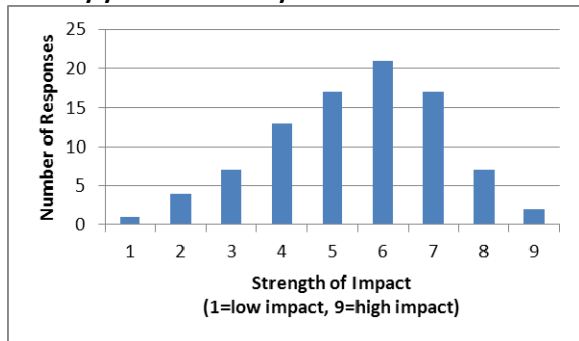
Have you used this product in the past three years?



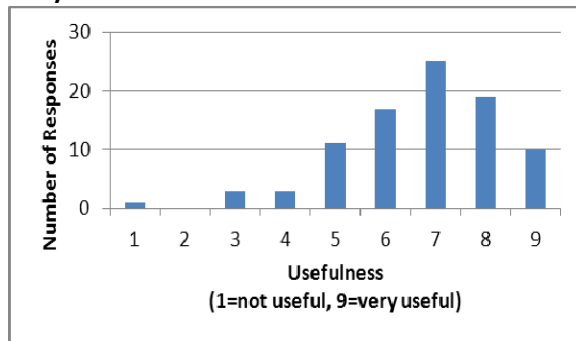
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Those who responded to questions about the Pedestrian Forum newsletter represented large metropolitan areas (48 percent) and medium-sized cities (25 percent). A variety of fields were represented, including engineers (22 percent), government employees (18 percent), and planners (14 percent).

Recommendations: This newsletter can be a useful way to provide many people with easy access to the latest information on pedestrian safety research and activities, however, improvements to the newsletter could be made by expanding it to include more State DOT and local news. Some users noted the newsletter was too wordy and long, and suggested that the importance of the produce could be improved if it were streamlined to get the message to the users in a quick and easy format, such as having smaller captions embedded in the email so it is not necessary to open the link to see inside the newsletter. For example, one user commented that they “Would like for the emails to include small captions about the content of the newsletter, so you can know what the articles are about before opening the link”.

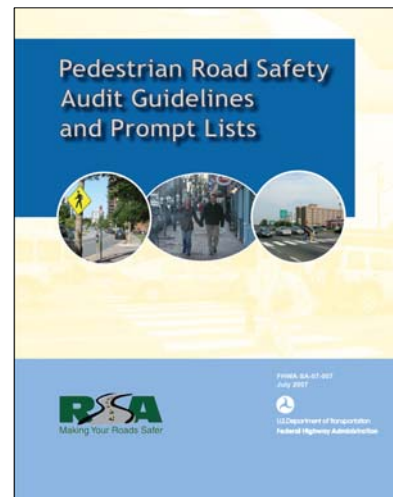
Urgency/Payoff Potential: The newsletter is a great resource that not only promotes pedestrian safety, but provides helpful resources, and information on current research and ongoing activities. Through email subscription, this newsletter is a quick and easy way to distribute the latest pedestrian safety information.

Timeline: The changes could be made immediately for the next issue of the Newsletter.

PR10. Pedestrian Road Safety Audit Guidelines and Prompt Lists

Overview/Purpose of Product: The purpose of this guide is to provide road safety audit/assessment (RSA) teams and transportation agencies with a better understanding of the needs of pedestrians in the transportation system when conducting RSAs.

The document has two basic components: the guidelines and the prompt lists. The guidelines section discusses the basic concepts with which the RSA team should be familiar before conducting an RSA, such as understanding pedestrian characteristics, pedestrian crashes, pedestrian considerations in the eight-step RSA process, and use of the Guide.



The Guide provides two prompt lists: the master prompt list and the detailed prompt lists. The master prompt list presents the least detailed prompts and is the key to the Guide's organization. It is a general listing of safety topics by facility type. The detailed prompt list presents more specific issues to be considered. The prompt lists are designed for RSA team members with varying levels of experience and skill sets; the more detailed prompts may be useful to less-experienced RSA team members.

Status of Product: The Guide was available on-line in July 2007 and was featured in several pedestrian safety webinars conducted by FHWA. In 2010, the Guide was printed by FHWA and is now available from the report center. The printed version includes section tabs to enable users to reference materials more quickly.

User Feedback: Interviews with end users revealed information on the use and effectiveness of the Guide and related products. In Florida, the Guide was given to participants of a RSA forum. The 2-day training course was modified to a ½-day class for the forum participants. The Guide was described as “the backbone of their work” in addressing pedestrian safety.

Selected Feedback

- “It is an important addition to the body of knowledge about pedestrian safety.”
- “We hope to continue to use this document as a part of our studies and to educate and train new staff.”
- “[A] great concept.”
- “[The Guide serves as] the backbone of their work [in pedestrian safety].”

It was also noted that hard copies of the Guide were preferred. One respondent believed that “...people will spend more time with it, more willing to read it, if it is a hard copy.” This has been addressed by FHWA with the recent publication of the Guide but needs to be marketed through various media. Publication of the Guide may also address one comment that the report was too “long and complicated” as the printed version is tabbed.

**A TECHNICAL GUIDE
FOR CONDUCTING
PEDESTRIAN SAFETY
ASSESSMENTS
FOR CALIFORNIA CITIES**

University of California Berkeley
Institute of Transportation Studies
Technology Transfer Program



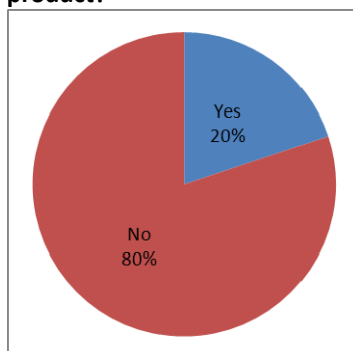
SAFETY ASSESSMENTS EVALUATING SAFETY ON LOCAL ROADS

Safety Assessments can lower crash rates, reduce injuries and save lives. They have been proven effective in practice, easy to administer, and low in cost to implement.

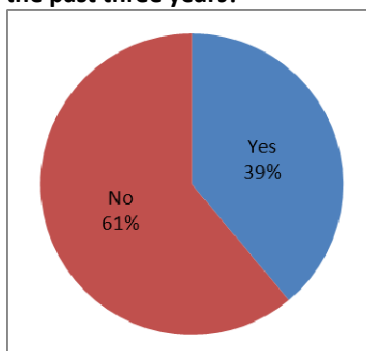
In New York State, 60% of reported crashes and over half of the state's fatal crashes occur on local roads. Communities now have a cost effective and reliable tool to address safety.

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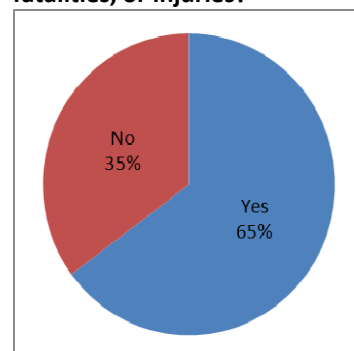
Are you familiar with this product?



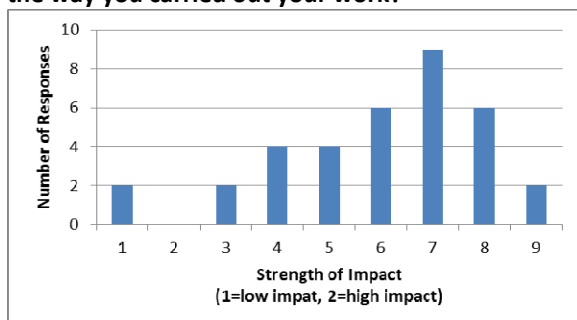
Have you used this product in the past three years?



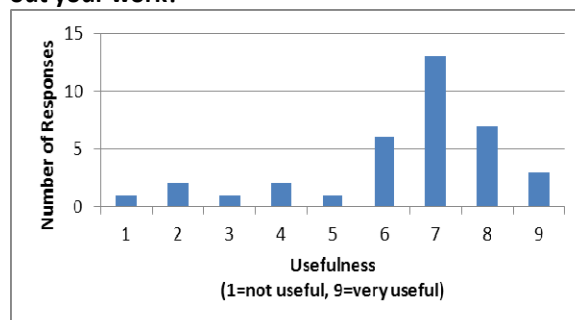
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Of the participants that evaluated the Pedestrian Road Safety Audit Guidelines and Prompt Lists, the 29.7 percent indicated that they were employed as traffic engineers, while 37.8 percent worked for State and local governments.

Recommendations: Overall, the Guide is seen as an effective tool in helping agencies reduce pedestrian fatalities and injuries. FHWA recently has printed the Guide and efforts should be made to provide information as to where to obtain a printed copy and distribute the Guide at selected conferences relating to pedestrian safety and road safety audits/assessments at both the State and local level. Conferences for 2010 could include:

- ProWalk ProBike: September 13-17 in Chattanooga, Tennessee. There will be a session on Pedestrian Road Safety Audits.
- Safety 2010: September 19-21, 2010 in Newport, Rhode Island. RIDOT is hosting this conference in conjunction with FHWA & NHTSA.

Several agencies have taken the Pedestrian RSA Course and are working on implementing findings from the course, establishing their own RSA program, or modifying the course and delivering it throughout the State. However, some agencies are still having trouble implementing the Guide, either because they find the material too complex or they lack the resources to conduct and document a pedestrian RSA. Therefore, the Pedestrian RSA Course

should be offered by FHWA to State and local agencies that have pedestrian safety issues and a commitment to improving safety for pedestrians. The course can be added to the Pedestrian Design and Pedestrian Planning Courses offered as part of the Pedestrian Safety Action Plan Courses or could be offered as a standalone course.

The next step in assisting agencies using RSAs to reduce pedestrian fatalities and injuries is the creation of a successful practices guide for implementing pedestrian RSAs. This guide should evaluate existing programs and include information on how programs are initiated, funded, and how pedestrian RSA locations are “screened.”

In summary, the desired outcomes for this product include:

- Disseminate the printed Guide through conferences and other media.
- Continue delivery of Pedestrian RSA Guidelines and Prompt Lists through courses and conferences.
- Offer pedestrian RSA course to State and local agencies.
- Offer pedestrian RSA support independent of or in conjunction with pedestrian RSA course.
- Develop a successful practices report on conducting and implementing a pedestrian RSA program.

Urgency/Payoff Potential: Pedestrian RSAs are seen as a useful tool in reducing pedestrian fatalities and injuries. The RSA process is a flexible approach that can be tailored to agency resources and pedestrian safety issues. A Pedestrian RSA Program enables an agency to systematically address pedestrian safety issues.

Timeline: The Pedestrian RSA Course and the Pedestrian RSA Technical Assistance can be immediately delivered to agencies with a demonstrated need for improving pedestrian safety. The successful practices report on conducting and implementing a pedestrian RSA program would take about a year to complete and would have greatest benefit if conducted immediately.

PR11. Pedestrian Safety Campaign

Overview/Purpose of Product: The Pedestrian Safety Campaign is a toolkit of materials that State and community leaders can use to communicate pedestrian safety messages to a variety of audiences. The campaign is intended to

- educate drivers about the rights of pedestrians,
- deliver safety messages to pedestrians, and
- provide educational information to explain the operation of pedestrian facilities.

Campaign materials include messages designed for television, radio, cinema, and print advertising.

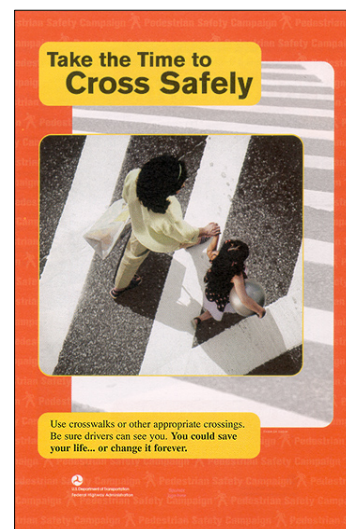
Status of Product: The Pedestrian Safety Campaign is based on findings from focus group testing and technical working group meetings between 2001 and 2002. The materials were developed in 2003 and are available at <http://www.walkinginfo.org/library/details.cfm?id=3464>.

User Feedback: The Pedestrian Safety Campaign was used by a relatively small portion of respondents (six percent) in the past six years. Of those respondents, a majority indicated that they believed the Campaign could play an important role in reducing pedestrian crashes, injuries, and fatalities.

While the survey respondents had positive comments about the materials, many indicated that they have had problems developing partnerships with local media outlets to distribute the materials/messages. Issues were identified with both availability of media opportunities and funding.

Several phone interview responses indicated that different formats could be helpful, such as smaller poster sizes. Others pointed out that more dated formats like CD ROMs could be replaced by downloadable PDFs or interactive web tools.

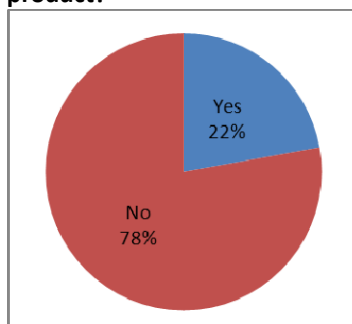
End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.



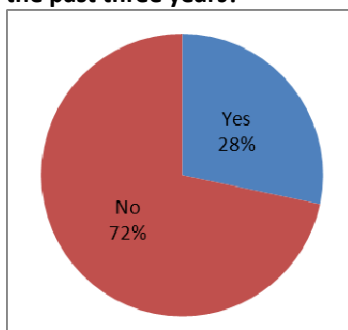
Selected Feedback

- “Many components which can be used as needed, which can easily be modified to answer most any type of pedestrian safety question.”
- “Liked it, it is reader and user friendly.”

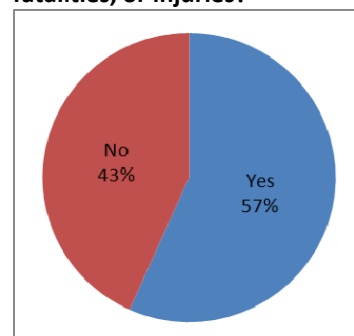
Are you familiar with this product?



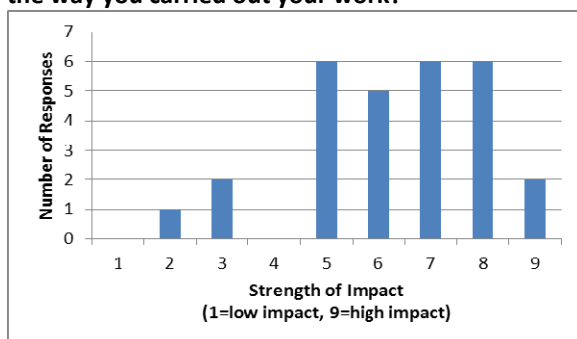
Have you used this product in the past three years?



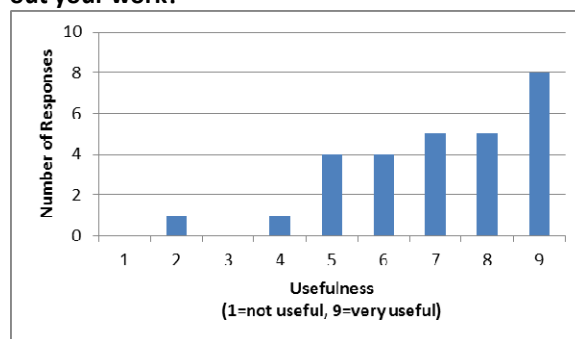
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Individuals who used the Pedestrian Safety Campaign materials primarily worked as government employees (20 percent), city planners (13 percent), and educators (10 percent). They represented large metropolitan areas (36 percent), small cities (30 percent), and medium cities (26 percent).

Recommendations: Since the primary concern related to the Pedestrian Safety Campaign seems to be an individual's ability to properly distribute the materials, there should be a focus on assisting States and local agencies with dissemination. Specifically, guidelines should be produced that give states a step by step process for engaging the media and building partnerships.

In addition to these guidelines, the materials should be frequently updated with current research, safety messages, and images. Target audiences should be developed for more targeted messages – this will rely upon frequent updates based on crash trends.

Due to the survey respondents' relative unfamiliarity with the Campaign, the materials should be more directly marketed to agencies that may find the materials to be helpful. Using distribution strategies such as email lists, web trainings, and conference presentations could make more people aware of this resource.

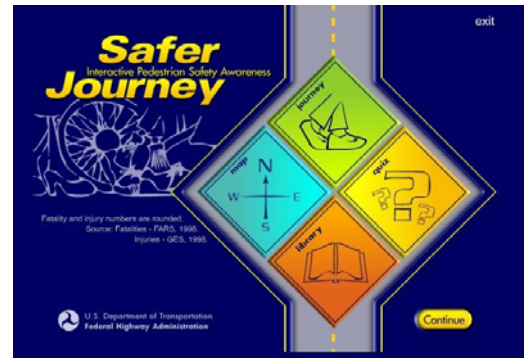
Urgency/Payoff Potential: As many agencies indicated that the Campaign could be effective if it were distributed widely through media channels, there is great potential for an improved resource. Guidelines that are produced to guide agencies through the process of coordinating with the media and securing air time could also be used to enhance other similar programs.

Timeline: In order to develop guidelines for engaging the media, FHWA would need to conduct background research to identify those agencies that have done this successfully. This research could result in guidelines after three to five years.

Periodic updates of this resource could begin immediately, and be revisited every two to three years.

PR12. Pedestrian Safer Journey

Overview/Purpose of Product: Pedestrian Safer Journey is an interactive CD that takes the user through various pedestrian safety scenarios encountered every day across America. The tool is intended to improve the level of pedestrian knowledge for all road users (including schools, driver education groups, enforcement, etc.) and safety practitioners. This CD is also easily included in larger pedestrian safety toolkits for community members.



The web version of the tool has three major sections:

- Journey – an interactive scenario that allows the user to select routes and explore different pedestrian safety
- Quiz – the quiz tests users on the knowledge they gained during the Journey portion of the tool.
- Library – the library provides additional resources and tools that could be useful in identifying concerns and promoting safety.

Status of Product: The Pedestrian Safer Journey is available in CD-ROM format and at the website <http://safety.fhwa.dot.gov/saferjourney/>.

User Feedback: The Pedestrian Safer Journey was one of only two products that were familiar to a majority of respondents.

Survey respondents indicated that they generally used Pedestrian Safer Journey by distributing it to colleagues and for incorporation in safety outreach programs.

Several of the respondents indicated that there is an issue with using the CD-ROM version of the tool on newer operating systems. They suggested updating the program to make it compatible with newer computers.

When asked about the ease of the product's use, the survey respondents gave mixed feedback. While some indicated that the product was easy to use, others pointed out that it can be difficult for some technical audiences (engineers, etc.) to find it useful.

Selected Feedback

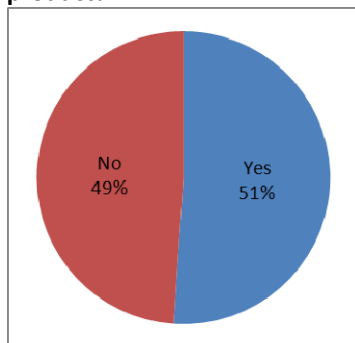
- "Very educational."
- "Raised awareness regarding design."
- "Increased awareness of other stakeholders."

Several phone interview responses reinforced the idea that the materials were marketed to a wide audience, but were really only suitable for young children. Those respondents wanted to see a similar resource for a more technical audience.

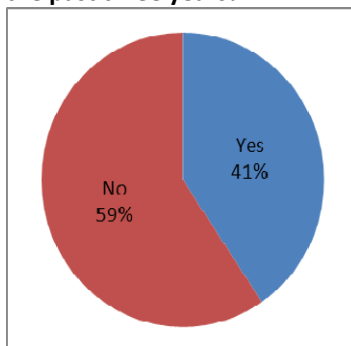
Other phone interviews revealed that accompanying materials in various formats (such as posters, video games, and other resources) would help market the materials and make them appealing to a wider audience.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

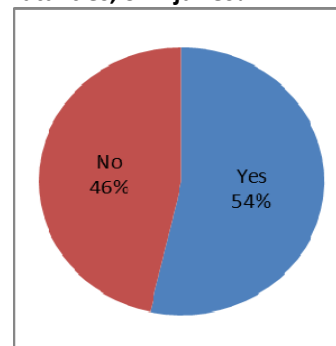
Are you familiar with this product?



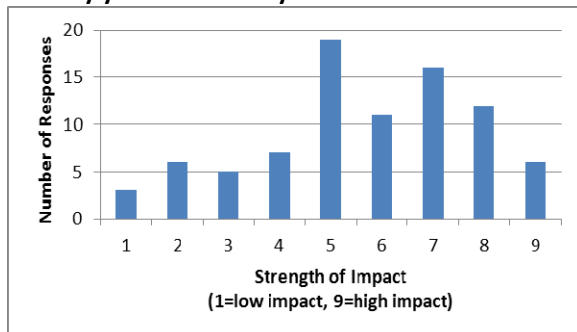
Have you used this product in the past three years?



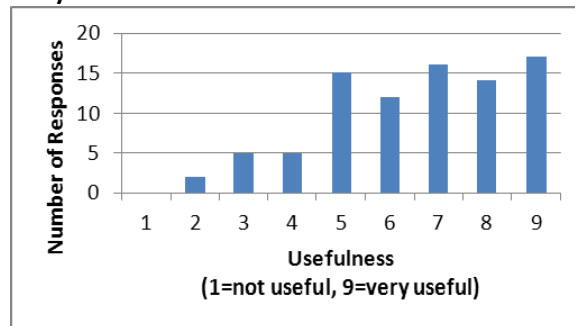
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



As with many of the other products, the majority (56.5 percent) of the Pedestrian Safer Journey product analysis participants are employed in Federal, State, and local governments.

Recommendations: The primary concern related to Pedestrian Safer Journey seems to be that it addresses only a small audience, mainly young children. To promote use among all audiences, FHWA should consider developing a similar tool that includes content that is more appropriate for older and more technical audiences.

To address format concerns, FHWA should update the CD-ROM so that it is compatible with more current operating systems. Also, supplemental materials should be developed (such as posters) to enhance the messages contained in Pedestrian Safer Journey and promote its use by a wider audience.

Urgency/Payoff Potential: Promoting safety by providing educational materials and tips to multiple audiences can help reduce crashes and increase safety among many audiences. With the updates mentioned above, FHWA can increase the use of an already widely recognized safety product.

Timeline: Developing newer versions of the software could be completed within three to five years, but additional materials could be developed within one year of plan implementation.

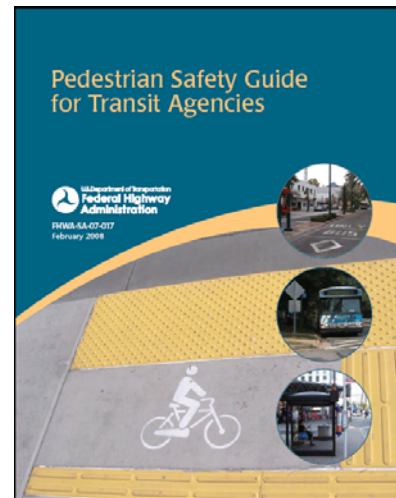
PR13. Pedestrian Safety Guide for Transit Agencies

Overview/Purpose of Product: The purpose of this product is to provide transit agencies with an easy-to-use resource for improving pedestrian safety.

The Guide includes a description of common pedestrian safety issues near transit locations (e.g., stations, bus stops), and information about engineering, education, and enforcement programs to help alleviate these issues. References to the latest publications, guides, and other tools that can be used to identify pedestrian safety problems are also included in the Guide.

Status of Product: The Guide was available on-line and in print in February 2008. Upon completion of the Guide, a marketing effort was undertaken to inform potential end-users of the product's availability and to obtain feedback. Over 150 people representing nearly 100 agencies were contacted by phone and email to inform them of the Guide's release. Written feedback on the Guide was provided by about 25 individuals. The Guide was also featured in several pedestrian safety webinars conducted by FHWA. The Guide is saddle-stitched for portability and ease of use in the field.

User Feedback: Since many of the individuals who provided feedback were not transit specialists, there were a wide range of comments on this Guide. Many respondents stated they had used the Guide in developing programs and policies, such as using the Guide "to develop criteria for [which] amenities to put at which bus stops." Similar statements were made by others illustrating the usefulness of the Guide as a resource, reference, and as a training document. Popular aspects of the Guide included the booklet format and the case studies, although one comment was made that the case studies did not address programs that did not work and found the case studies "conflicting and misleading." While it is a valid point that agencies can find value in "what not to do," these cases are difficult to find as many agencies are unwilling to admit mistakes and publish them in a national document. In terms of additional information requested, one respondent offered to be part of future updates to the Guide and a couple of respondents requested information on streetcars. Others stated that they desired the information in the Guide in a

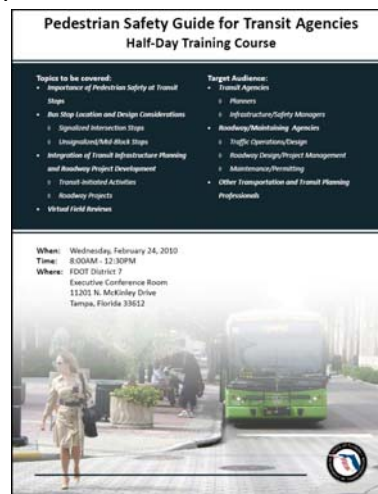


Selected Feedback

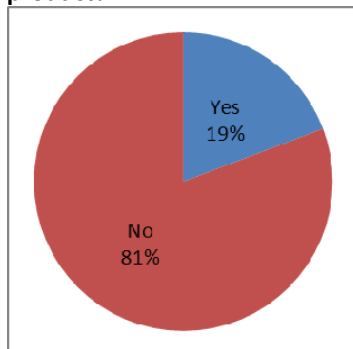
- "Most publications do not include public transit/bus stops. This guide covers this subject in detail."
- "...it helped us to provide design guidance to the local transit agency."
- "It enables us to insure safer designs for new transit stops or modified transit stops. The transit agency seems to "buy into" the value of the report's recommendations."
- [I] liked the emphasis on coordinating efforts when agency does not have the resources to project independently.
- Respondent suggested online version and power point slides would be helpful.

presentation format to use during meetings with the public and public officials.

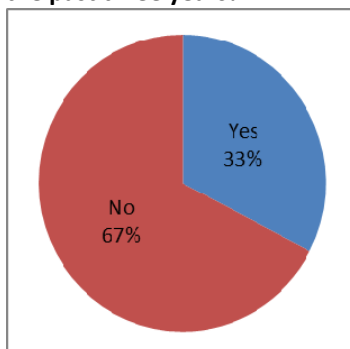
End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.



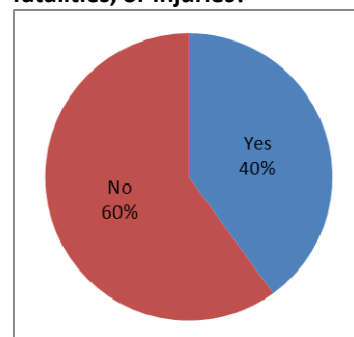
Are you familiar with this product?



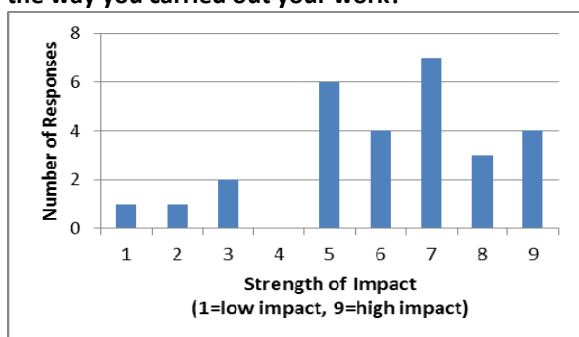
Have you used this product in the past three years?



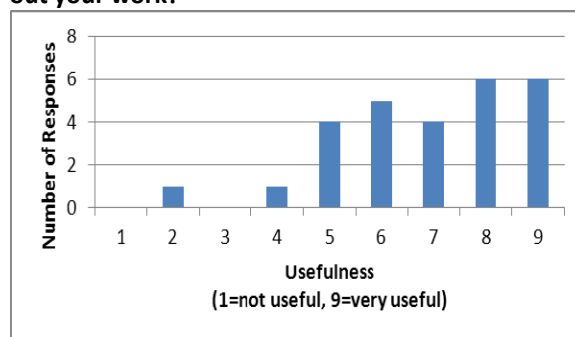
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Of the participants that evaluated this product, the majority (60 percent) are employed in urban areas as professional staff. While many are employed by State and local governments, some participants are also working in for-profit, non-profit, and university organizations.

Recommendations: Several agencies have been working on establishing practices described in the Guide, updating their bus stop programs, and presenting findings from the Guide to officials and the public in order to garner support for improving transit access for pedestrians. At least one State created a training module from the Guide and has been actively providing that training throughout the State. For example, a four-hour training course based on the Guide was developed and is being presented in Florida (see flyer, right). FHWA may develop a similar course for a national audience. This may be a one-hour module that can be offered as part of the Pedestrian Design and Pedestrian Planning Courses which were developed as part of the Pedestrian Safety Action Plan. The course could also be offered as a standalone two- or four-hour course for a more specific audience such as transit providers.

Transit agencies are facing even bigger challenges today as the infrastructure in many regions becomes even more stressed. Agencies are continually trying to find better ways to ensure safety of their riders. Therefore, the case studies in the Guide should be updated to provide information on the most recent successful practices to safely accommodate pedestrians. The update can be released when the first edition goes out of print. It is suggested that part of the project funds be set aside to include a one-time honorarium for agencies that provide a case study, similar to what was offered as part of the PEDSAFE and BIKESAFE projects.

Streetcars are also making a comeback in the U.S. and many cities now have plans to expand transit service to include streetcars. Therefore, a transit guide focusing on providing safe pedestrian access to streetcars should also be developed. This may also include guidance on pedestrian safety accessing light rail. These efforts were described as part of the Best Practices and Pedestrian Safety Concerns Related to Transit Access in Urban Areas problem statement.

Finally, efforts to distribute the guides should be undertaken as part of the development of the guides. One of the biggest conferences for transit providers is the Community Transportation Association of America (CTAA) annual bus conference.

In summary, there are four desired outcomes for this program:

1. Develop a one-, two-, and four-hour training course on providing safe pedestrian access to transit.
2. Update the Pedestrian Safety Guide for Transit Agencies with additional recent case studies.
3. Create a companion Streetcar Pedestrian Safety Guide.
4. Disseminate the printed guides through conferences and other media.

Urgency/Payoff Potential: The proposed projects are timely and would address a growing need for improved safety to access transit. More specifically, the training courses will increase the technical skills of transit providers and enable them to communicate with officials and the public. The successful practices documents will detail specific policies, engineering and planning efforts, and will provide case studies that highlight safer and more convenient access to transit. The effectiveness of implementation guidance will assist engineers and other transportation professionals in improving pedestrian safety in and around transit.

Timeline: The development of the courses can begin immediately; course materials can then be easily updated upon the completion of other products. Timeline for the update and development of the guides is 1 to 3 years.

Detailed Feedback from Initial Marketing Effort:

"One important issue - role of State DOTs - they play a very heavy role in where bus stops are located. We [should] send out announcements to State DOT officials and publish and distribute a shortened version to elected officials."

– Fairfax Department of Transportation

"I will personally use information in this guide (re: Mid-Block Stops) to bolster efforts to improve the Civic Center MARTA Station transfer area to provide pedestrian safety. The booklet is comprehensive and consequently quite long. It could benefit from a summary section, to the effect "10 Steps A Transit Agency Needs to Do NOW to Ensure Ped Safety" or something like that."

– Georgia Regional Transportation Authority

"Excellent pedestrian safety guide. I'm interested in whether specific light rail lines are more pedestrian safe than others? Center running vs. side? Or the dangers of having parking and side running trolley cars within the same vicinity as well as busses utilizing the trolley stops?"

– City of Detroit Department of Transportation

"I think this is a good guide as a learning tool, refresher or even to cross check to make sure you've thought of all the elements when placing or positioning bus stops, benches, or shelters or when working with passengers during travel training."

– Fort Smith Transit

"I felt that it was a well crafted document with some helpful hints."

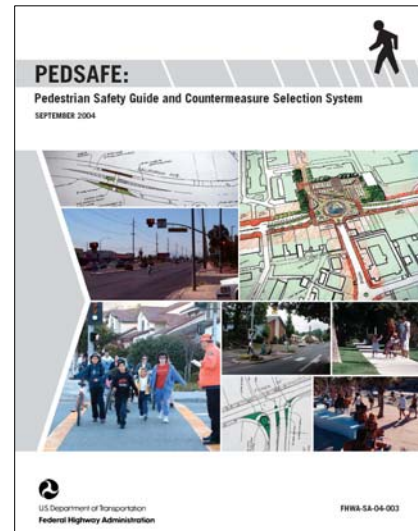
– Iowa City Transit

"We find this a very useful tool. I have disseminated it throughout the agency and would like to get some hard copies to take to various State conferences."

– Washington State DOT

PR14. Pedestrian Safety Guide and Countermeasure Selection System

Overview/Purpose of Product: The Pedestrian Safety Guide and Countermeasure Selection System (PEDSAFE), published in 2004, is the next generation of the “Pedestrian Facilities User Guide- Providing Safety and Mobility”, which was developed for FHWA in 2004. The purpose of the PEDSAFE Guide is to provide the most applicable information for identifying safety and mobility needs and improving conditions for pedestrians within the public right-of-way. The printed PEDSAFE Guide and online Guide and tools provide the user with a list of 47 different engineering treatments along with education and enforcement programs that can be used to improve pedestrian safety and/or mobility at a specific location. For each of the engineering treatments, the Guide provides description, the treatment purpose, considerations, and estimated cost to implement.



The Guide also has details of 71 Case Studies (i.e., success stories) of various treatments that have been implemented primarily in the U.S. For each case study, there is information on the original problem, background, selected solution, the results, and information to talk to the local contact person. There is also PEDSAFE “expert system” software (on a CD inserted in the printed Guide and also on the website) that allows for obtaining a short list of appropriate roadway treatments for a given location, based on inputting the characteristics about a problem location (e.g., number of lanes, speed limit, type of traffic control, types of pedestrians crossing) and the type of problem that exists (e.g., speeds too fast, crossing too wide).

The PEDSAFE Guide is intended primarily for engineers and planners, safety professionals, and decision-makers, but it may also be used by citizens for identifying problems and recommending solutions for their communities.). The guide is available on-line at: <http://safety.fhwa.dot.gov/pedsafe> and at www.walkinginfo.org/pedsafe.

Status of Product: The latest version of PEDSAFE was released in September 2004. Since that time, numerous studies have evaluated various countermeasures for improving pedestrian safety. The guide should be updated with these findings and new countermeasures (along with their costs and crash reduction factors). Also, there have been dozens of Pedestrian Case Study write-ups that have been developed by the PBIC (with our APBP partners), which could be added to the list of PEDSAFE Case Studies. There are other potential case studies which could be identified and selected for detailed write-ups for inclusion into the PEDSAFE Guide. Also, since the PEDSAFE Guide is the document that is distributed to all attendees of the FHWA “Designing for Pedestrian Safety “ (DPS) course, it is especially important to keep this document up to date with the latest research and best available engineering treatments.

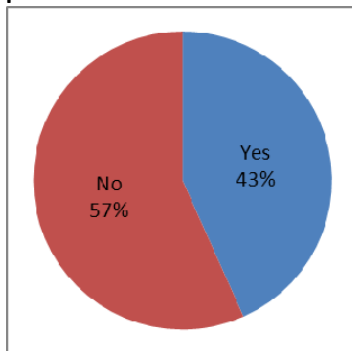
User Feedback: Some of the suggestions for future changes or improvements include providing information in a format that could be printed for distribution at meetings and forums. One respondent suggested that there be a separate training course developed to go along with the PEDSAFE Guide. Another comment was that FHWA should distribute such information from the PEDSAFE Guide to the public.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

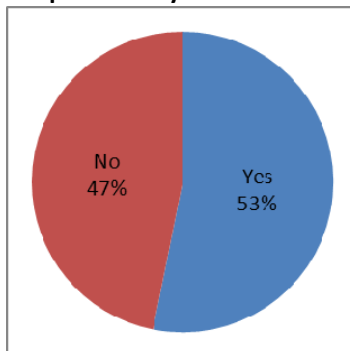
Selected Feedback

- “Confirmed using best practices and reinforced continued use. We have seen a decrease in pedestrian crashes.”
- “Guidelines help keep the pedestrian in mind during the design and construction processes. Research (is) helpful in giving planners ideas.”
- “On-line version very helpful. Great graphics. Great classroom tool.”
- “The book is a good reference”
- “Well received by municipalities when made available.”

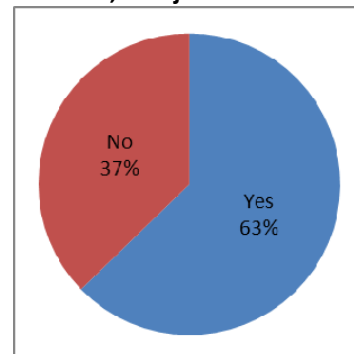
Are you familiar with this product?



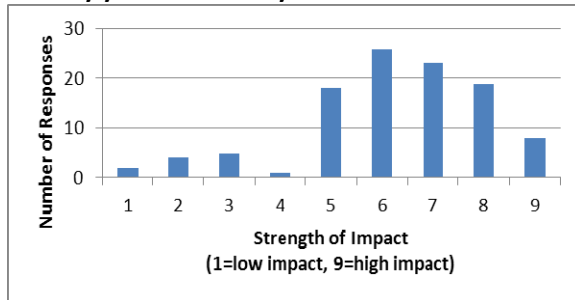
Have you used this product in the past three years?



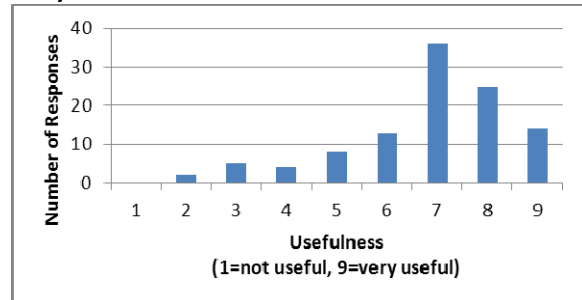
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Individuals who responded to questions about the PEDSAFE Guide mostly worked in large metropolitan areas (37 percent) and small cities (25 percent). Most of the users identified themselves as government employees (21 percent), consultants (12 percent), and traffic engineers (10 percent).

Recommendations: It is recommended that the PEDSAFE Guide be updated as soon as possible. This would include updating the countermeasure descriptions based on updated pedestrian safety research from the past six years. It should also include adding pedestrian case studies (success stories), such as “newer” case studies written by the PBIC (and currently on the PBIC website) and also selectively adding case studies of “best practice” treatments from the U.S. and abroad .There is also a need to update the “expert system” software to add some of the more recent engineering strategies (e.g., HAWK signal, advanced yield lines on multi-lane roads, rectangular rapid-flash beacon) into the countermeasure options. Based on some of the reviewer comments, it might also be useful to prepare subsets of information from the updated PEDSAFE Guide for distribution at public meetings, etc. A half-day or full-day training course might also be developed with focuses more directly on the content of the PEDSAFE Guide.

Urgency/Payoff Potential: The PEDSAFE Guide has been very popular document to a wide variety of users and it has also been used as the major technical resource when delivering the FHWA course on “Designing for Pedestrian Safety”. Although the Guide has been one of the most used FHWA resources on pedestrian safety, much of the information in the Guide is now more than six years old and there has been much important pedestrian safety research and best practices in the past six years that need to be incorporated into the PEDSAFE Guide. Therefore, we consider the updating of the PEDSAFE Guide (printed version and web version) as a very high priority for FHWA to keep the best and latest technical information and resources in the hands of engineers, planners, community leaders, and others.

Timeline: This should be a high priority for immediate update and should be updated approximately every four or five years.

PR15. A Resident's Guide for Creating Safe and Walkable Communities

Overview/Purpose of Product: This guide is intended for use by residents looking to improve pedestrian safety and walkability in their community.

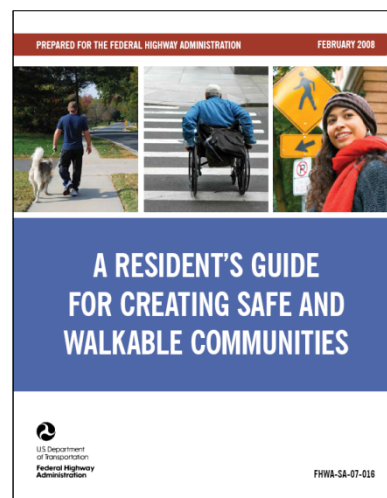
The Guide includes facts, ideas, and resources to help residents understand traffic safety issues that affect pedestrians and find ways to help address these issues and promote pedestrian safety. The Guide provides success stories from communities that were able to address pedestrian safety.

Status of Product: The Guide was available on-line and in print in February 2008. Upon completion of the Guide, a marketing effort was undertaken to inform advocacy groups and potential end-users of the Guide's availability. Emails were sent to all agencies on PBIC's distribution list to inform them about the Guide's release. The Guide was also featured in several pedestrian safety webinars conducted by FHWA.

User Feedback: NHTSA initiated a project to evaluate the Guide through feedback from community members. This project entitled "A Resident's Guide for Creating Safe and Walkable Communities: Mini-Grant Demonstration Evaluations", is piloting the Guide in 10 communities throughout the U.S.. This project will result in detailed evaluations of the contents of the Guide by chapter. To date, feedback has been received on the first two chapters; results on the other chapters will be provided by August 2010.

There have been 18 respondents in the 10 communities who have been interviewed so far regarding the content of Chapter 1. Responding to questions about Chapter 1 of the Guide, 72% (13) stated that they had not found significant safety problems that were not discussed in Chapter 1, while 28% (5) stated that they had. One comment was made that it would be helpful to have worksheets throughout the book that have to be annotated with information, not just checked off, to make this a "living" document.

Project participants were asked if Chapter 2 of the Guide helped to raise awareness of pedestrian safety in their community. Of the 22 respondents, 82% (18) answered "yes" to this



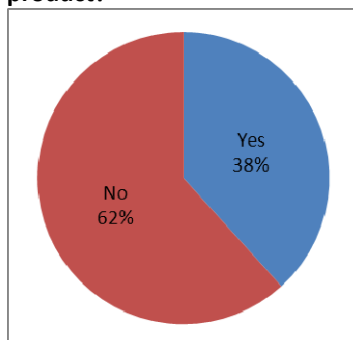
Selected Feedback

- "This is designed for community members, so it is easy to read and easy to find what you are looking for."
- "It provides a simple summary of key research findings over the last 15 years, so it is a valuable resource."
- "It is a useful tool for community advocates and planners."
- Would like it available in a format so that the blind community can read these materials as well.
- Liked that it is clear, concise and easy to read. Nice break out blocks with community success stories.

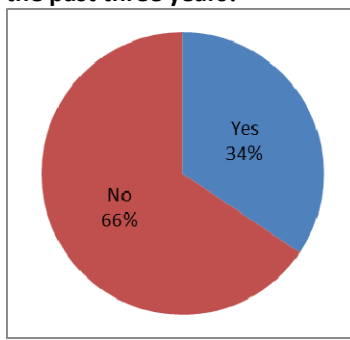
question, while 18% (4) answered “no” to this question. The case studies seemed to be one of the most popular aspects of the information presented in this chapter.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

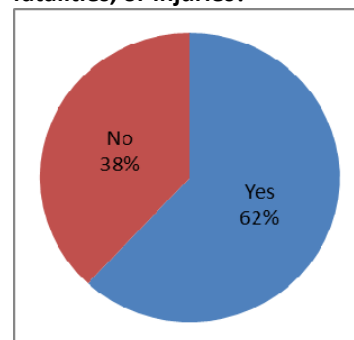
Are you familiar with this product?



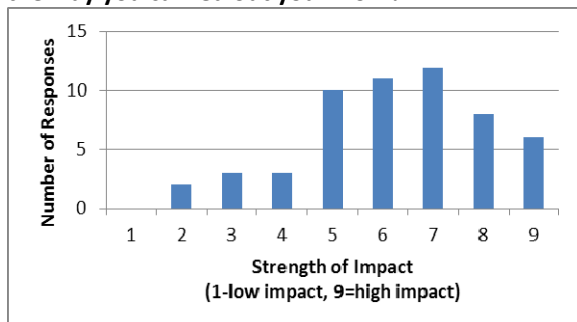
Have you used this product in the past three years?



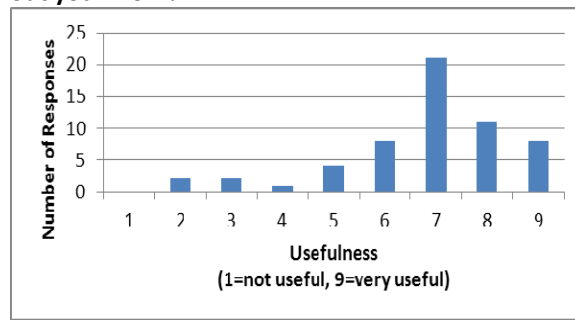
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Of the respondents to the questions related to the Resident’s Guide, 34.9 percent worked for metropolitan planning organizations (MPOs) and non-profit organizations. Most respondents represented large metropolitan areas (43 percent) and small cities (32 percent).

Recommendations: In many areas, residents are becoming more aware of how to work together to address pedestrian safety issues in their communities. Often, they have been able to form formal groups that are engaged with road owners to effect positive change. These success stories can serve as models for communities who have been unable to establish sophisticated programs. This Guide has helped communities overcome these challenges. More specifically, the NHTSA project to support 10 communities in implementing processes and

programs presented in the Guide have helped communities address pedestrian safety in their communities. Moreover, the results of this project will provide detailed feedback on the content of the Guide so that future editions can be updated with materials that specifically address the needs of communities. A project to update the Guide should be initiated once the findings of the NHTSA project are complete. One of the key features to the update should be additional detailed case studies.

FHWA and NHTSA may also work together to fund another demonstration project. This may focus on implementation of measures rather than obtaining feedback on the Guide. Many communities, including those in the current NHTSA project, find it difficult to fund measures to improve pedestrian safety. Therefore, a demonstration project in several communities that provides Federal funding to implement measures may be initiated. This would require commitment and coordination with multiple offices within FHWA and NHTSA, as well as require a rigorous selection process to ensure that areas selected for the project have buy-in from both the community and the local transportation agency.

Urgency/Payoff Potential: The proposed update to the Guide would address a growing need for more sophisticated techniques to involve the public in addressing pedestrian safety. The implementation of a demonstration project that would result in changes to the built environment should target areas with a demonstrated pedestrian safety problem; thus, the project will result in reducing pedestrian crashes.

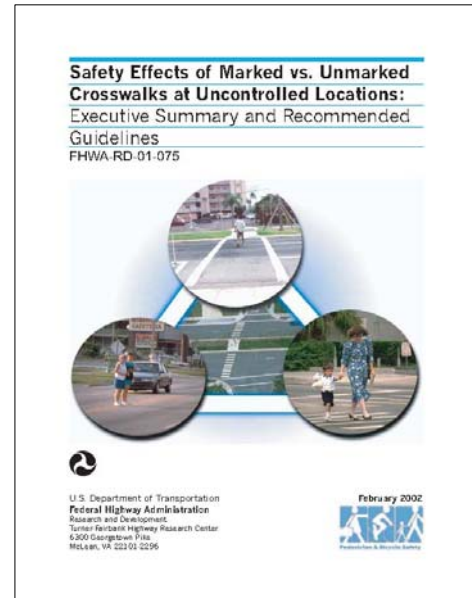
Timeline: The update of the Guide can begin in one or two years so that a new edition is released no sooner than five years after the original document's release. The timeline for the demonstration project is much longer with selection of the communities occurring after five years.

PR16. Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations

Overview/Purpose of Product: The FHWA Report entitled: “Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations” was developed for FHWA first as a report containing the executive summary and recommended guidelines (dated March, 2002) and later as the full published research report and recommended guidelines (September, 2005). The reports contain guidelines for when it is or is not acceptable to install marked crosswalks. Specifically, the study found that on two-lane roads, the presence of marked crosswalks alone at an uncontrolled location was associated with no difference in pedestrian crash rate, compared to an unmarked crosswalk. Furthermore, on multi-lane roads with traffic volumes above about 12,000 vehicles per day, having a marked crosswalk alone was associated with a higher pedestrian crash rate (after controlling for other site factors), compared to an unmarked crosswalk. Raised medians provided significantly lower pedestrian crash rates on multi-lane roads, compared to roads with a raised median. Older pedestrians had crashes that were high relative to their crossing exposure.

More substantial improvements were recommended to provide for safer pedestrian crossings on the higher-volume multi-lane roads, such as adding traffic signals with pedestrian signals (when warranted), providing raised medians, speed-reducing measures, and others.

Status of Product: The FHWA Crosswalk report has been distributed widely over the past few years, through printed reports and also via the PBIC website (www.walkinginfo.org). In December of 2009, the National Committee on Uniform Traffic Control Devices (NCUTCD) made changes to the pavement marking section of the MUTCD which essentially took the recommendations from the FHWA Crosswalk report and included them as the new MUTCD crosswalk guidelines. Therefore, all 50 states (after they each adopt the 2009 MUTCD) will be subject to these recommended guidelines on crosswalk markings.



Selected Feedback

- “If this study hadn’t been done, I wouldn’t know what to say about when marked crosswalks are sufficient on their own or when they need to be supported by additional treatments to improve pedestrian safety. Now I do.”
- “This report has probably saved many lives and will continue to benefit pedestrian safety for many years into the future.”
- “This is arguably the best study and most useful report to come from FHWA in the last decade. I refer to it and use it all the time, whether in the classroom, conducting research, or advising practitioners.”

User Feedback: Based on user surveys, the FHWA Crosswalk Study rated highly in terms of its usefulness. The product’s ease of use, however, did not yield as high of a rating.

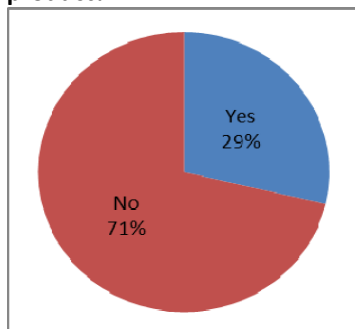
The user interviews resulted in positive comments, including:

- “It is the key study to which I refer clients of the State’s Pedestrian Safety Assessment program.”
- “New crosswalks and several pedestrian refuge islands have now been installed at key locations in the community...”
- “This is excellent research and we need more of this type.”

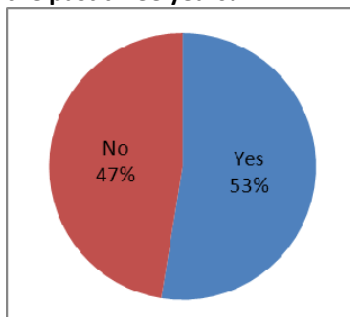
In terms of suggestions, one respondent asked that this information be presented in a webinar to clarify misinterpretations.

End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented below.

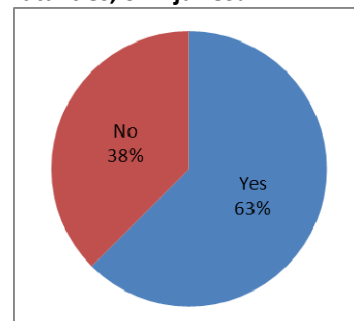
Are you familiar with this product?



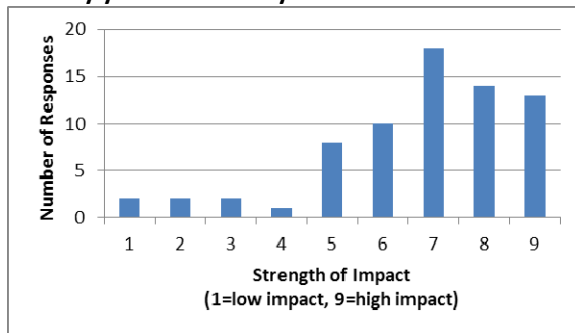
Have you used this product in the past three years?



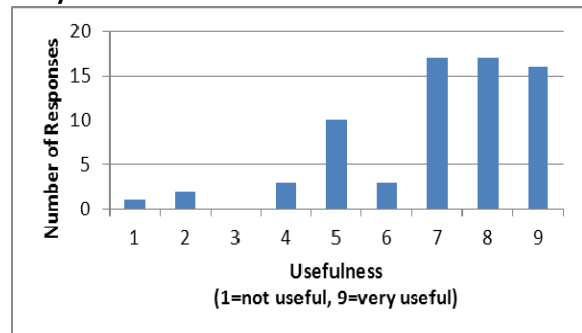
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



The Safety Effects of Marked versus Unmarked Crosswalks report was used primarily by traffic engineers (34 percent), government employees (15 percent), and consultants (14 percent). These individuals tended to work for local governments (24 percent), State governments (22 percent), and private companies (15 percent).

Recommendations: The FHWA Crosswalk study was a research report which resulted in specific guidelines and recommendations that have now been incorporated into the 2009 MUTCD. Any recommendations for further technology transfer from this document would be to consider opportunities for further presentation of the study results, even though the results have already been presented at international conferences (i.e., TRB, ITE, State safety conferences), in one recent webinar (for the FHWA PSAP project), among others. Certainly, there is much more that needs to be learned about the best manner in which to treat pedestrian crossings at uncontrolled locations. More research is needed to accomplish that, and several of the 28 recommended research studies relate to this topic (e.g., safety at midblock crossings, development of crash modification factors, etc.).

Urgency/Payoff Potential: There is not a specific action that is recommended for a technology transfer activity related to this document, since the results have already been incorporated into the 2009 MUTCD.

Timeline: Not Applicable

PR17. Walkability Checklist

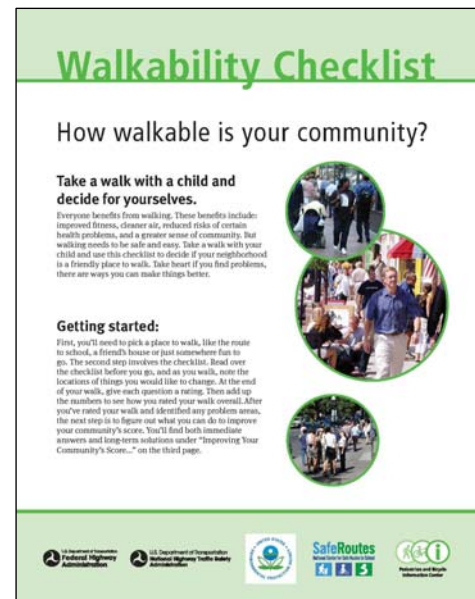
Overview/Purpose of Product: The Walkability Checklist is intended to provide citizens and advocates with an easy-to-use guide for identifying local pedestrian safety concerns.

The checklist provides users with a series of guided questions that allow citizens to score the walkability of their neighborhood. The scores can then be used to rank the neighborhood's overall safety and walkability. Finally, the checklist provides links to resources that could help address safety needs.

Status of Product: The checklist is available online at <http://www.walkinginfo.org/library/details.cfm?id=12>.

User Feedback: The survey results indicate that the checklist is one of the more user-friendly and helpful pedestrian safety products developed by FHWA. Results also indicated that the checklist was the most commonly used product in the last three years (31 percent of respondents had used it). Detailed survey responses indicated that individuals used the checklist to serve a variety of needs. Many individuals indicated that the checklist was used during community outreach events and during local training workshops. Overall, the checklist is a commonly used and readily accessible resource.

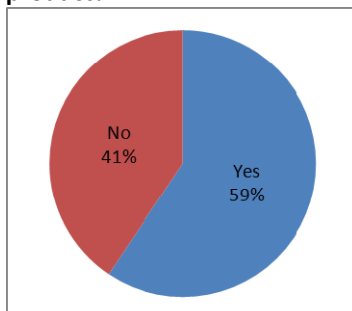
End-User Analysis: For each product, potential end-users were asked questions pertaining to the usefulness, impact, ease of use, and how long they had been familiar with or used the product among other questions. While this evaluation is included in the [Background Report](#), the measures of usefulness, impact, use within the last 3 years, familiarity, and success in reducing crashes have been included here. Findings from the FHWA end-user analysis are presented on the following page.



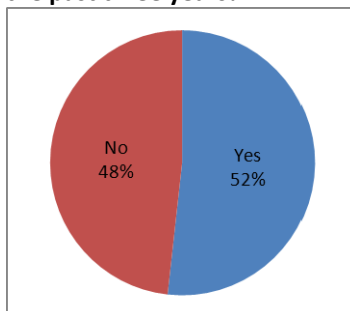
Selected Feedback

- "Easy to use, useful information."
- "Provides tools that are quantifiable, hard data to document importance of walkability."
- "Application viable for many areas."

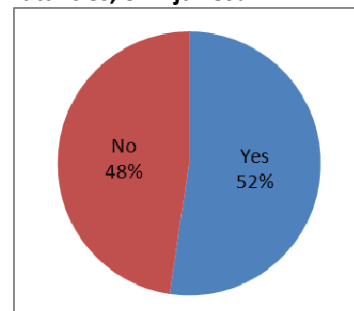
Are you familiar with this product?



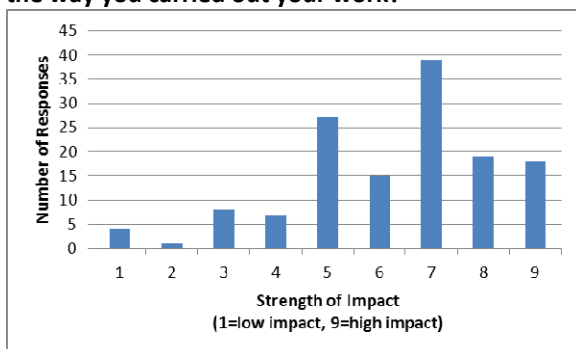
Have you used this product in the past three years?



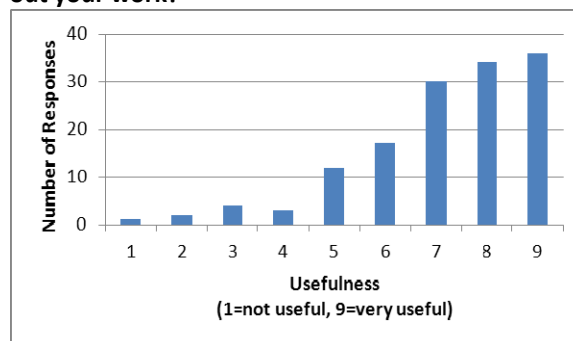
Did this product provide knowledge that contributed to a reduction in crashes, fatalities, or injuries?



How much of an impact did this product have on the way you carried out your work?



How useful was this product in helping you carry out your work?



Of the individuals providing feedback on the Walkability Checklist, 33 percent indicated that they worked in local or State government. Nearly half (40.1 percent) of the respondents worked in large metropolitan areas.

Recommendations: No substantial changes are recommended for the Walkability Checklist. However, the product should be routinely revised and updated with new links and resources.

Urgency/Payoff Potential: Updating the tool with new links and information will ensure that community members and citizens have access to this information as it becomes available.

Timeline: Routine updates and changes could begin immediately, and be revisited every 2 to 3 years.

Appendix D. New Product Delivery/Strategy Recommendations

Included in this appendix are detailed descriptions of possible product delivery formats and strategies, as recommended in the Strategic Plan. Each of these new products has been assigned a new product number (NP1, NP2, etc.) for reference.

NP1. Direct Mailing/Emailing

Purpose of Product: Direct email and mailing lists would be used to distribute the findings of new research, products that have been developed, training opportunities, and other announcements.

Overview: FHWA currently distributes the Pedestrian Forum newsletter on a regular basis to its distribution network. Individuals can also register to receive updates from various FHWA offices and programs via email. Those programs include: FHWA Safety Program, Highway Safety Improvement Program, Intersection, Local and Rural Road Safety Program, Pedestrian and Bicycle Safety, and others.

Recommendations: Professionals should be alerted to the research findings via mailing list or listserv. Numerous organizations distribute weekly, monthly, or quarterly newsletters to their members. These organizations often circulate requests for announcements, which would allow FHWA and researchers the opportunity to share news of recently completed research and findings. Guides, training courses, webinar opportunities, and conference announcements (which also serve as potential deployment options for new research) could be included in these newsletters as well.

In addition to including announcements in these newsletters, FHWA could use its own mail and email lists (and those operated by FHWA programs like the Pedestrian and Bicycle Information Center (PBIC)) to distribute news releases announcing recently completed projects.

To reach individuals at the State, local, and regional levels who may not readily have access to an email listserv, FHWA could distribute materials directly through division offices and State DOTs.

FHWA should also explore emerging technologies and social media services, which have become increasingly popular among professionals looking to network and share information. For example, FHWA could set up an automated web/email alert for recently released products and publications.

In summary, recommendations include the following:

- FHWA should identify relevant professional email listservs and post announcements for research findings, training opportunities, and new products to those lists.

- Generate email lists for local and State DOTs to distribute relevant research and tools.
- Explore emerging technologies and social media services to distribute updates.

Urgency/Payoff Potential: The results of the survey indicated that 77 percent of respondents prefer to receive materials via email – the most commonly used method identified. Of those who responded, 69 percent indicated that they typically share materials with others. By utilizing email lists and other alert systems, FHWA could tap into networks of professionals and expand the distribution of the products it develops.

Timeline: Announcements of new research and training opportunities could be sent out through email lists almost immediately. These announcements should be made continuously as new tools, research findings, and scheduled trainings are released.

NP2. Event and Conference Marketing

Purpose of Product: Professional conferences, meetings, and presentations provide an opportunity to share the results of a study or a recently produced tool with a variety of professionals simultaneously.

Overview: There are many conferences related to pedestrian safety each year. Some of the most high-profile conferences include:

- Transportation Research Board (TRB) Annual Meeting
- Institute of Transportation Engineers (ITE) Annual Meeting and Exhibit
- Pro Walk/Pro Bike
- Walk 21
- New Partners for Smart Growth Annual Conference
- American Planning Association

Recommendations: The results of research projects could be developed into a workshop or panel discussion at conferences for professionals in the field, such as the Transportation Research Board (TRB), Pro Walk/Pro Bike, or the Institute of Transportation Engineers (ITE) annual meetings. These conferences, among others, draw a large number of engineers, planners, and other professionals who address pedestrian safety concerns on a daily basis. Within a conference setting, there could be multiple options for presenting the results of a particular study:

- Presentation/panel discussion
- Poster session
- Distribution of report, guide, or technical brief at an informational booth
- Pre-conference workshop

In order to effectively reach the conference attendees, these methods should be combined with marketing efforts prior to the conference.

To reach a more broad audience of professionals, FHWA should consider marketing its resources at conferences that address related fields, such as health, transit, and smart growth. Offering materials and sessions at these conferences would allow FHWA to reach a broad audience and ensure that pedestrians are considered in multiple fields.

In addition to hosting sessions at existing conferences, FHWA could explore the possibility of hosting its own conferences at the State, regional, and local levels. Many professionals who work at these levels may not have access to national conferences, so bringing that information to them could be an effective strategy.

In summary, recommendations for FHWA include:

- Identify conference marketing opportunities and strategically plan presentations, sessions, and workshops based on relevant audiences and recently developed tools and completed research.

- Market conference sessions and presentations prior to the conference, to increase attendance.
- Host conferences at the local and State levels to reach audiences at State and local transportation agencies.

Urgency/Payoff Potential: Though conferences and marketing were not identified by survey respondents as the preferred method for receiving updates and information, there are certain types of presentations that are most suited for in-person presentations, poster sessions, and/or exhibit booths. Complex research findings can sometimes be best explained during a poster session or panel presentation at the TRB Annual Meeting, for example, rather than through an email or brochure. In this way, research findings can be delivered to professionals in the medium that is most appropriate.

Timeline: Once a research study is complete, the findings can be submitted to various conferences to be considered as a panel presentation, poster session, mobile workshop, or other presentation. This could generally be completed within one year of the project's end date.

NP3. In-Person Training Course

Purpose of Product: In-person training courses are intended to bring expertise and information to individual State DOTs, cities, and communities, using one or more days of training to engage local officials and present critical information related to pedestrian safety. The purpose of in-person training, as opposed to web training or conference presentations, is to address the specific needs of engineers, planners, town leaders, educators, police, public health officials, and others, and provide one-on-one technical assistance in an interactive setting. Course elements may include a combination of in-class presentation, small group discussion/activity, and field site visits.

Overview: FHWA currently offers free training courses to four Focus Cities and 13 Focus States, based on the *How to Develop a Pedestrian Safety Action Plan* (PSAP) guide. The following course types are offered:

- How to Develop a Pedestrian Safety Action Plan (two-day)
- Designing for Pedestrian Safety (two-day)
- Planning and Designing for Pedestrian Safety (three-day)
- PSAP Template Course (two- or three-day)
- Pedestrian Road Safety Audit Course (two-day)

As of June 2010, the program has delivered a total of 148 courses to dozens of locations, representing nearly 300 days of training to more than 4,000 attendees.

Recommendations: A variation on one or more of the courses listed above could be developed to communicate the findings to groups of professionals across the country, such as top-level State DOT officials. Experts on that particular topic (which may include those involved in the original PSAP Guide and trainings) would lead the training courses in individual communities that expressed interest or need.



The two- and three-day PSAP trainings have been successful in reaching a variety of audiences, and should be used as a model for future training courses. These courses have been offered at no cost to professionals in Focus Cities and Focus States, where pedestrian safety concerns and crash trends are especially problematic. **It is recommended that expanded training should continue to be offered at no cost to Focus States and municipalities, and also non-Focus States and municipalities that have demonstrated a need for technical assistance in the area of pedestrian safety.**

An evaluation of the PSAP training program by the Volpe Center found that this training program has been effective in delivering important pedestrian safety information and resources to communities in need of such assistance. Overall, it was found that the program raised awareness of pedestrian safety issues within the agencies themselves and provided professionals with the tools and resources needed to address local concerns.

It is also recommended that Focus States and Cities be expected to present pedestrian crash data (five years, if possible) to allow for identifying pedestrian crash trends and to identify specific crash factors for use in applying more focused training and technical assistance in the near future.

Recommendations from the Volpe Evaluation, which are also included as recommendations in this Strategic Plan, include:

- Offering more courses on a regular basis, providing newly-hired employees with immediate training and understanding of pedestrian safety issues
- Creating course content that is easily customized and tailored for the intended audience and local setting
- Enhancing the outreach and education strategies included in the training
- Expanding the technical assistance elements of the course and including more frequent follow-up with communities that have received training

Further evaluation of the program can be found in the Volpe report *Evaluation of the Focused Approach to Pedestrian Safety Program* at the following link:

(http://safety.fhwa.dot.gov/ped_bike/ped_focus/efapsp020509/).

Urgency/Payoff Potential: In-person training courses have been shown to provide critical information to local and State agencies. In order to provide agencies with the tools and resources necessary to address pedestrian safety concerns, expanded in-person training courses will need to be deployed across the country.

Timeline: A new or expanded version of the current courses could be developed from research findings within two to three years after the project has been completed.

Updating existing course content and expanding existing course offerings has been an ongoing process, and this should continue provided that funds remain available.

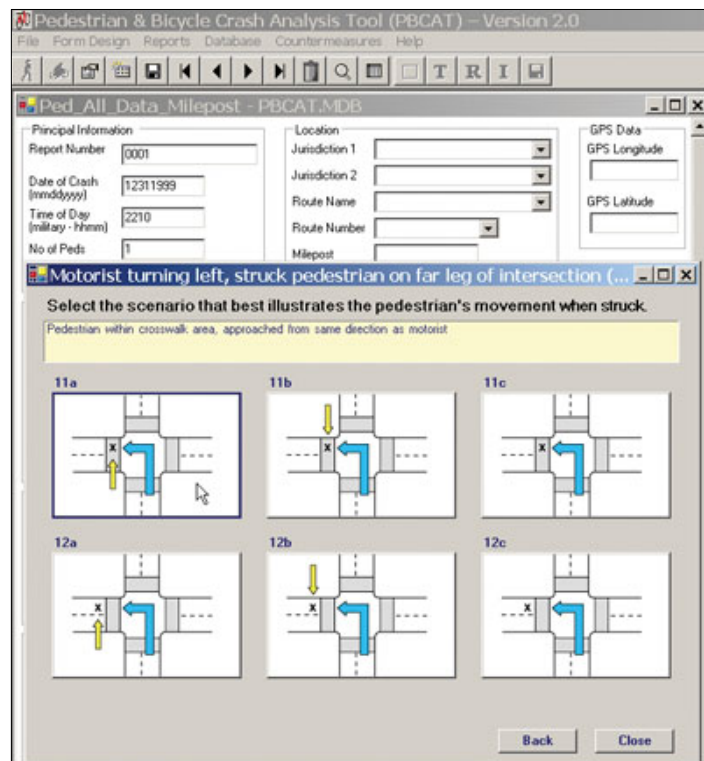
NP4. Software

Purpose of Product: Software and other applications can be developed to translate complex models and advanced selection criteria into easily accessible and usable tools for professionals working in engineering, planning, health, and related fields.

Overview: Several current FHWA products have been developed into software applications. These include the *Pedestrian and Bicycle Crash Analysis Tool* (PBCAT) and the *Pedestrian Safer Journey*. A website is currently being used to market PBCAT, which also serves as a portal for receiving orders for hard copy distribution.

Recommendations: In the follow-up phone interviews, individuals were asked the question, “Are there any other types of pedestrian safety products that would be helpful to you?” Several of the responses related directly to the types of interactive tools and software that professionals are interested in seeing. Examples include:

- “Exposure/volume analysis... Safety analysis of pedestrians and bicyclists using roadway segments.”
- “State of the art tools based on research and improvement of those tools as other things/areas develop.”
- “More interactive products like first generation video games.”
- “Educational software geared toward traffic [and] pedestrian safety.”
- “Webinar to present tool in a way that avoids misinterpretation.”



These comments illustrate both the importance of new tool development as well as the need for frequent updates and guidance on how to use new software and tools. Varying levels of complexity – from advanced software to video games – were requested, suggesting that FHWA should consider developing tools for a wide variety of audiences.

Technical research findings could be developed into software programs, similar to PBCAT (image above), and be distributed via software or websites. By collecting information from individuals who order the product, FHWA can easily follow up with updates to products when they are made.

Instead of using a guide to communicate research findings and explain complex methods, a program could be developed to allow a local or State engineer to use those findings in his or her work. Research findings and recommendations that establish criteria for facility selection or prioritize locations for improvements, for example, could be developed into an interactive web tool or CD-ROM-based software application. The tools could then be distributed to professionals via web training, conferences, or email lists.

In summary, specific recommendations include:

- Develop applicable research results into software
- Explore various software formats, including web-based interactive/open-source software that can be used without a CD-ROM
- Identify programs at varying levels of complexity to suit different audiences

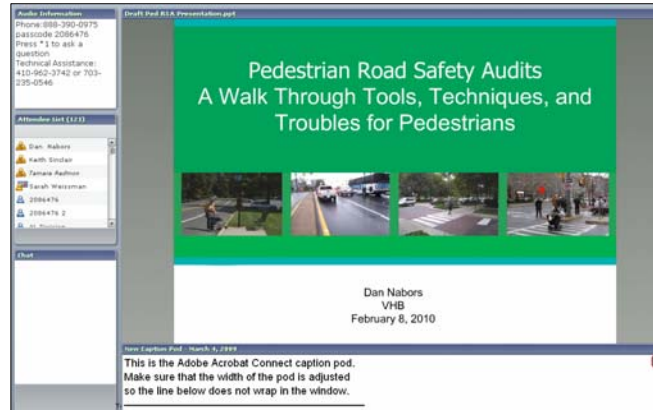
As the first phase of this effort, specific recommendations could be developed on the technical analysis software which is most needed.

Urgency/Payoff Potential: New methodologies and research recommendations will be released with each of the studies included in the Strategic Plan, but findings may not be immediately applicable to practice. A critical step in this process is the translation of research findings into a format that can be utilized by professionals, instructors, and other audiences.

Timeline: Prior to software development, staff should identify those research findings that are most appropriate for this format. Once those are identified, software development could take place between three and five years.

NP5. Web Training

Purpose of Product: Web trainings, or webinars, are used to make presentations to a large audience without having to rely on large conferences or meetings. Using an internet connection, a webinar platform can allow hundreds (or even thousands) of computers to access the presentation, which can be supplemented by a call-in number to include question/answer sessions following the presentation.



Overview: A number of organizations, including FHWA, currently offer pedestrian safety webinars on a variety of topics. Other organizations offering webinars include the Pedestrian and Bicycle Information Center, the National Center for Safe Routes to School, the Institute of Transportation Engineers, Easter Seals Project ACTION, U.S. Access Board, and others. FHWA regularly offers its Focus City/Focus State webinars to those interested in learning about pedestrian safety programs and research.

Recommendations: Agencies are increasingly looking toward distance education and web training to stay abreast of the most recent developments in pedestrian safety and to meet their employees' professional development needs. Webinars and web conferences should be utilized to present newly-released FHWA products and pedestrian research findings to a large audience via the internet. A brief presentation (or series of presentations) could be developed and delivered using web presentation software. Projects that are funded as part of the Strategic Plan include webinar development as a required marketing initiative to ensure that the findings reach a large audience.

Announcements for webinar registration could be included in newsletters and mailings, allowing a large audience access to the training. There are currently a number of organizations that offer both free and low-cost webinars, including organizations listed above. A screen shot of one of the FHWA Focus City/Focus State webinars can be seen above. These could be used as models for one-time or repeated web trainings.

Webinar presentations are made more appealing to professionals if attendees can earn continuing education credits, such as professional development hours (PDH) or American Institute of Certified Planners (AICP) credits. Content for all webinars should be submitted to these organizations so that attendees can earn these credits.

Another element of successful web training is for the organization to host the archived version of the webinar on its website. This allows individuals who couldn't attend the live webinar to access the information. Several of the organizations mentioned above, including FHWA, provide archived presentations on their websites. To maximize the

number of people who are able to attend training, it is recommended that any webinars developed by FHWA in the future be made available on demand through a web archive.

Many webinar platforms allow presenters to survey the audience and receive feedback on various issues. For example, presenters may ask the audience to respond to a polling question that relates specifically to the presentation topic. This information can then be used by FHWA in the development of future webinar topics and other products/resources. Other types of information, such as the number of attendees, can be used to measure the success of a webinar program and help FHWA design future webinars.

In summary, FHWA should consider the following activities:

- Require future research products/tools to be developed into webinars
- Widely distribute webinar announcements via mailing lists and listservs
- Offer professional development and continuing education credits
- Host all webinars in an archived web format
- Utilize survey instruments and attendance statistics to shape future webinar topics

Urgency/Payoff Potential: As mentioned, local and State budgets have been tightened due to the economic climate, and travel restrictions have prevented many professionals from attending annual conferences and meetings. Webinars present an opportunity for professionals to stay up to date on the latest pedestrian safety trends without having to leave their offices. There has been considerable growth in the number of attendees of PSAP and PBIC webinars. A growth in the number of webinars could reduce strains on travel budgets and allow agencies to be more flexible.

Timeline: Webinars should be conducted at the conclusion of each research project and/or products released by FHWA. More detailed products may require a webinar series, similar to what was conducted for the *Highway Safety Manual*.

NP6. Successful Practices Guide

Purpose of Product: The successful practices guide, or best practices guide, is intended to communicate key findings of research projects that evaluate the effectiveness of certain treatments, policies, programs, and other countermeasures. If a program or treatment is determined to be successful in reducing crashes, increasing yielding, or otherwise improving safety for pedestrians, it would be included with other effective treatments in such a guide.

Overview: FHWA has produced many successful practices guides, such as the Pedestrian Safety Guide for Transit Agencies, the *How to Develop a Pedestrian Safety Action Plan* guide, the case studies associated with PEDSAFE and BIKESAFE, and many others.

Recommendations: Research findings from projects included in the Strategic Plan could be developed into a guide that can be used by practitioners. The guide would be especially appropriate for projects that make specific recommendations for pedestrian-friendly designs and policies. It would focus on recommended policies and successful case studies and, as a starting point, it could make use of many of the case studies already developed by PBIC over the past two or three years on pedestrian facilities and programs implemented throughout the U.S. and abroad. This guide should also include an update of the *FHWA Toolbox of Countermeasures and their Potential Effectiveness for Pedestrian Crashes*, based on recent research.

Any best practices guides would need to be well-designed to ensure ease of use. Graphics and images should be incorporated throughout the guides, and the language should be relatively simple and written to an appropriate audience.

It is of critical importance that any findings included in a best practices or a successful practices guide be properly evaluated to determine whether a specific treatment or countermeasure is truly a best practice. It is not recommended that all countermeasures be included in such a guide. Rather, only those treatments that have been demonstrated to reduce crashes or otherwise increase safety should be included in such a guide.

Urgency/Payoff Potential: Local and State engineers and transportation officials are not able to sift through the findings of numerous research studies to determine the most effective policies, treatments, and programs for improving safety. A critical step must be taken to present information about effective treatments and strategies in a way that is easily understood by professionals and applicable to practice. Without such guides, the investment in research will not result in widespread crash reduction and safety improvement.

Timeline: Based on the varied subject matter contained in best practices guides, as described above, the timeline for developing a guide will depend on its intended scope.

NP7. Pedestrian Countermeasure Deployment Follow-Up Study

Purpose of Product: In 2001, FHWA issued a Request for Applications (RFA) to select one or more local jurisdictions to demonstrate and evaluate the effectiveness of a comprehensive pedestrian safety measure program. As a result, FHWA awarded three cooperative agreements to the following locations: Las Vegas, Nevada; Miami-Dade County, Florida; and San Francisco, California. Over the course of the more than six-year project 18 separate pedestrian safety measures were deployed in over 70 locations. Data were collected on:

- Safety surrogate measures of effectiveness (MOEs) (e.g., driver and pedestrian behavioral data).
- Driver mobility MOEs (e.g., travel times and speeds along corridors).
- Pedestrian mobility MOEs (e.g., average pedestrian delays) and analyzed to determine the effects of the treatments.

The results of the study are presented in *Pedestrian Safety Engineering and ITS-Based Countermeasures Program for Reducing Pedestrian Fatalities, Injury Conflicts, and Other Surrogate Measures Final System Impact Report*. While there were some promising findings from the study, overall the study's results were fairly mixed and in some cases inconsistent.

Therefore, there is a need for a more rigorous evaluation of the effectiveness of the selected pedestrian safety measures over a longer period of time. This statistically robust evaluation should not only study the previously selected MOEs, but also crash history to determine the effect of the measures on crashes. The requirements for crash data are as follows:

- Crash frequency, severity, and location.
- Three or more years prior to implementation of improvements.
- Three or more years following implementation of improvements.

The purpose of this follow-up study should be to determine the changes in pedestrian and motorist behavior over time and to create crash modification factors (CMFs) through robust statistical analysis.

Overview: Quantitative information of the effectiveness of pedestrian safety measures are needed to help decision-makers justify expenditures. This product would help gain a better understanding of the longer-term effects of the studied measures on safety.

Recommendations: A study can be initiated to evaluate the effects of many of the 18 pedestrian safety measures implemented. The categories of measures that show the most promise for further study include the following:

- Active signs.

- Pavement markings.
- Signals and signal timing.
- Physical separation.
- Lighting.

Urgency/Payoff Potential: The results of the previous study were inconsistent and with limited budgets, agencies aren't as willing to implement measures that do not have a proven track record. Furthermore, this study will help highlight the effects of pedestrian safety measures over time. Specifically, the study will compare behavioral changes over time and the resulting effect on crashes between pedestrians and motorists.

Timeline: A minimum of three crash data should be available for the statistical analysis; therefore, based on completion of the previous study, the updated study may begin after about one-year.