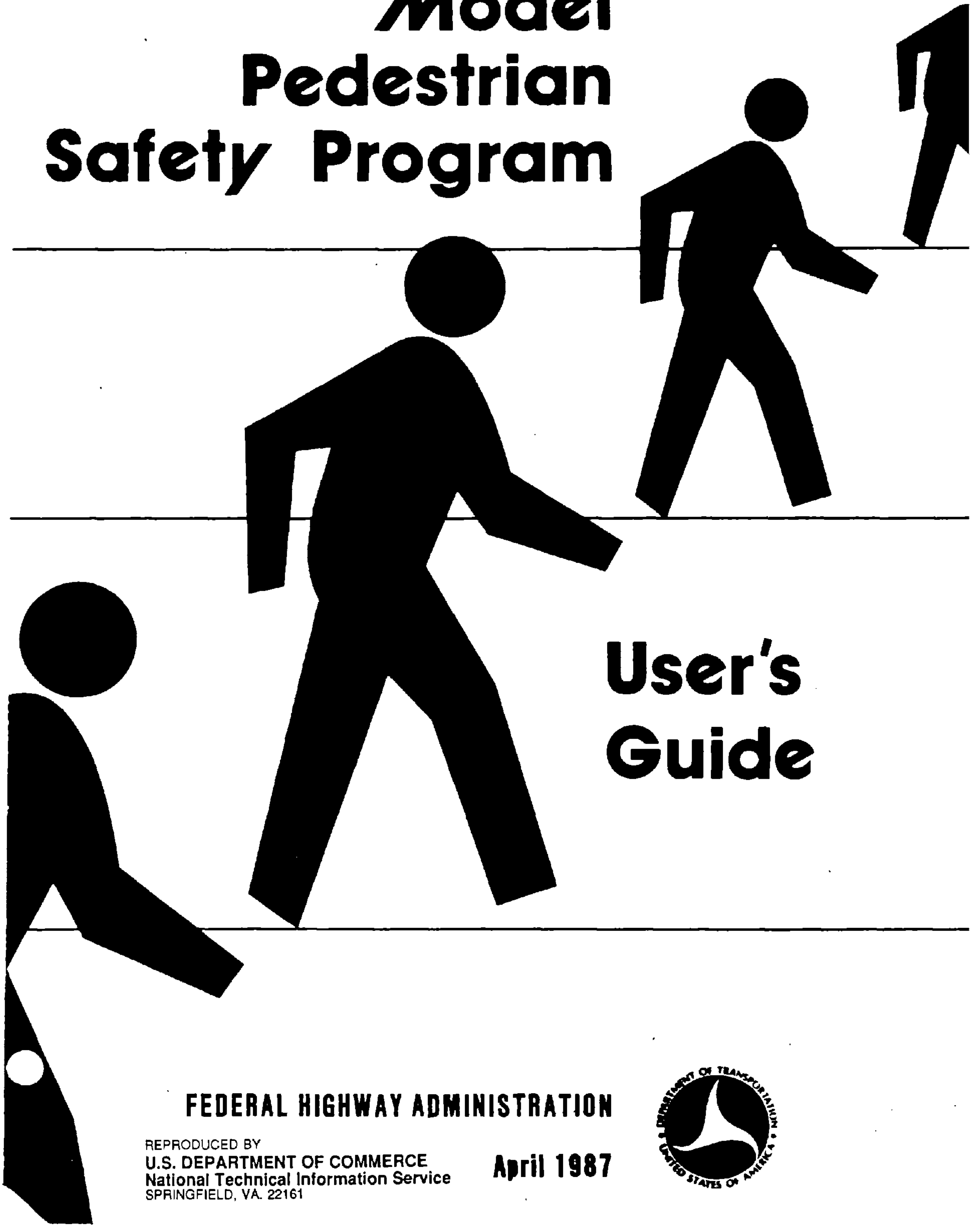
Model Pedestrian Safety Program



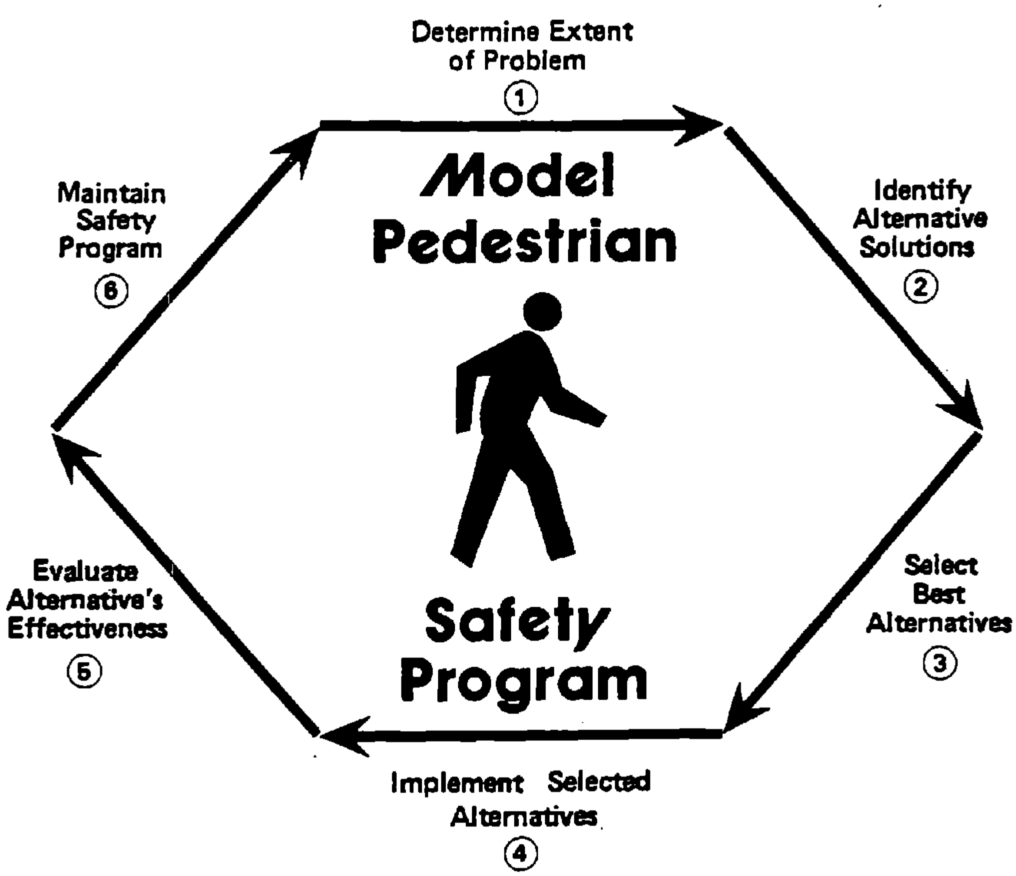
User's Guide

FEDERAL HIGHWAY ADMINISTRATION

April 1987

DEPARTMENT OF TRANSPORTATION • UNITED STATES OF AMERICA

NOTICE


Determine Extent of Problem
①
Model Pedestrian
Identify Alternative Solutions
②
Select Best Alternatives
③
Implement Selected Alternatives
④
Evaluate Alternative's Effectiveness
⑤
Maintain Safety Program
⑥
Safety Program

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A second volume, Model Pedestrian Safety Program Supplement, provides detailed information on the specific pedestrian safety countermeasures.

16. Abstract

This Guide describes how localities can plan, implement, and evaluate a pedestrian safety program. A six-step Model Pedestrian Safety Program is described:

Step 1, Problem Identification, describes techniques for determining the extent of the pedestrian safety problem through accident and behavioral data collection and evaluation.

Step 2, Identify Alternative Solutions, lists advantages, disadvantages, target populations and locations, and implementation considerations for numerous countermeasures known to be effective in solving particular pedestrian safety problems.

Step 3, Select the Best Alternative, describes a procedure for comparing anticipated benefits and costs of possible alternatives and selecting the best alternatives.

Step 4, Implement Selected Alternative, discusses the organizational, scheduling, support, and financial aspects of developing a successful safety program.

Step 5, Evaluate Implemented Alternative, identifies methods for determining the effectiveness of implemented countermeasures.

Step 6, Maintain the Pedestrian Safety Program, is the feedback to Step 1. Continual watch of the safety situation must be maintained.

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We wish to thank Brenda Hundley of the Center for Applied Research secretarial staff for her patience and support during the preparation of the manuscript.

Finally, we wish to thank the concerned individuals who take the time to read this document. The safety of pedestrians can be improved only if concerned individuals at the state and local level care enough to do something. We hope this Guide will help them decide what to do and how to do it.

Printed by the American Association of Retired Persons (AARP) in support of pedestrian safety. "Safety Steps for Pedestrians," an audio/visual safety presentation for older pedestrians, is also available from AARP. 1987.

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INTRODUCTION

A safe pedestrian environment does not just happen. Safety is created by proper design and through constant attention to detail. Unfortunately, many pedestrian safety efforts are haphazard or uncoordinated. There is a need for rational problem identification, program development, and solution implementation. This document is designed to serve that need.

The Model Pedestrian Safety Program User's Guide was written to assist individuals or organizations interested in planning and creating a safer environment for pedestrians. The Guide was designed for local associations; civic groups; school groups; municipal, county, and state governments; highway departments; safety coordinators; and police and traffic engineering departments. The Guide presents ideas, resources, procedures, and implementation suggestions to help the pedestrian.

This document is both a guide and a resource. As a guide, it identifies steps to follow in setting up a pedestrian safety program. As a resource, it lists possible solutions to safety problems and suggests additional references. The Model Pedestrian Safety Program Supplement provides more detailed information on many of the countermeasures that are listed in the User's Guide.

The Model Pedestrian Safety Program involves a six-step process:

- Step 1: Determine the Extent of the Pedestrian Safety Problem. This step involves determining where pedestrian accidents and unsafe behaviors are occurring, what data are important in selecting solutions, and how this data can be collected.
- Step 2: Identify Alternative Solutions. This step involves selecting countermeasures known to be effective in solving particular safety problems.
- Step 3: Select the Best Alternative. A procedure is described for comparing the advantages and disadvantages of the possible alternatives and for selecting the best alternative.

- Step 4: Implement Selected Alternative. This step discusses the organizational, scheduling, support, and financial aspects of developing a successful safety program.
- Step 5: Evaluate the Effectiveness of the Implemented Alternative. This step identifies methods to determine how effective a chosen alternative was in aiding pedestrian safety.
- Step 6: Maintain the Pedestrian Safety Program. Since a successful safety program is a never-ending loop. The safety situation must be continually re-examined and modified as needed.

This Guide does not attempt to describe all of the detailed procedures needed to perform all of these six steps. In some instances it is suggested that additional references, user's manuals or implementation guides be obtained. When references are listed with a "PB" number, they can be purchased from the National Technical Information Service (NTIS):

- National Technical Information Service (NTIS)
  5285 Port Royal Road
  Springfield, Virginia 22161
  Telephone Number (703) 487-4650

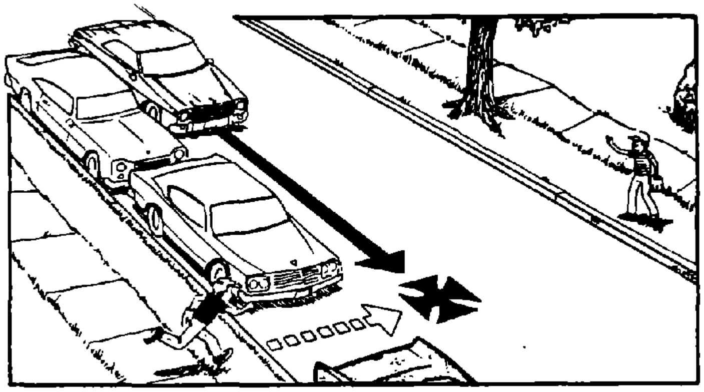
Other documents are available from the following sources:

- Federal Highway Administration (FHWA)
  Office of Safety and Traffic Operations
  Safety and Design Division
  6300 Georgetown Pike
  McLean, Virginia 22101
  Attention: John C. Fegan (HSR-20)

- National Highway Traffic Safety Administration (NHTSA)
  Office of Alcohol and State Programs
  400 Seventh Street, N.W.
  Washington, D.C. 20590
  Attention: Dr. Virginia Litres (NTS-23)

- National Cooperative Highway Research Program (NCHRP)
  Transportation Research Board
  National Academy of Sciences
  2101 Constitution Avenue, N.W.
  Washington, D.C. 20418
  Attention: Director, Cooperative Research Programs

- American Automobile Association (AAA) - Information, pamphlets, posters, and many of the referenced materials are available from your local AAA office.



STEP 1
DETERMINE THE EXTENT OF THE PEDESTRIAN SAFETY PROBLEM

The goal of every pedestrian safety program should be to reduce fatalities and injuries resulting from pedestrian accidents. The first step toward this goal is to determine the nature of the pedestrian safety problem. This is done by identifying hazardous locations and hazardous pedestrian activities. This information can be collected from three sources:

- Citizen Complaints. Complaints about problem areas from private citizens, school personnel, police, or other sources.
- Accident Analysis. Collection and analysis of pedestrian accident data.
- Behavioral Analysis. Collection and analysis of data on pedestrian behavior.

CITIZEN COMPLAINTS

It is not possible for transportation engineers, planners, and other government officials to be aware of all hazardous locations. Those who live in a particular neighborhood, cross certain streets, or pass through intersections on a daily basis are more familiar with these locations. Information from regular users can focus attention on a problem that might have otherwise been overlooked.

The importance of reports by concerned citizens to the responsible agency cannot be overestimated. These complaints act as notifications about a potentially hazardous location. Courts evaluating lawsuits resulting from accidents have historically found the responsible agency negligent if it had been "put on notice" but did nothing about the situation. Problem locations identified through citizen complaints should be further studied. Accident analysis and behavioral evaluations should be used to determine if a problem really exists and to identify potential solutions.

ACCIDENT ANALYSIS

A systematic approach to pedestrian accident reduction has been developed by the Federal Highway Administration (FHWA) and the National Highway Traffic Safety Administration (NHTSA). This approach addresses the specific causes of pedestrian accidents and the behavioral errors involved.

First, pedestrian accidents are analyzed in terms of the causal chain or sequence of events. Then, accidents that have similar causal patterns are grouped into "accident types." Once the specific problem accident types are identified, the next step is to develop specific ways of eliminating the events leading to the specific accident type.

Analyzing Accident Causes

The first step in this approach was to develop the sequence of behavioral events or functions involved in successful interactions between pedestrians and motor vehicles in situations where there is potential conflict. This behavioral event sequence is illustrated in Figure 1. A failure in this sequence can lead to a collision between the pedestrian and the motor vehicle. Six functions or events in the sequence apply to both drivers and pedestrians:

- Course. The paths the driver and pedestrian choose to follow and the manner in which they negotiate them.
- Search. Scanning the environment for potential hazard.
- Detection. The driver perceiving the pedestrian and the pedestrian perceiving the vehicle.

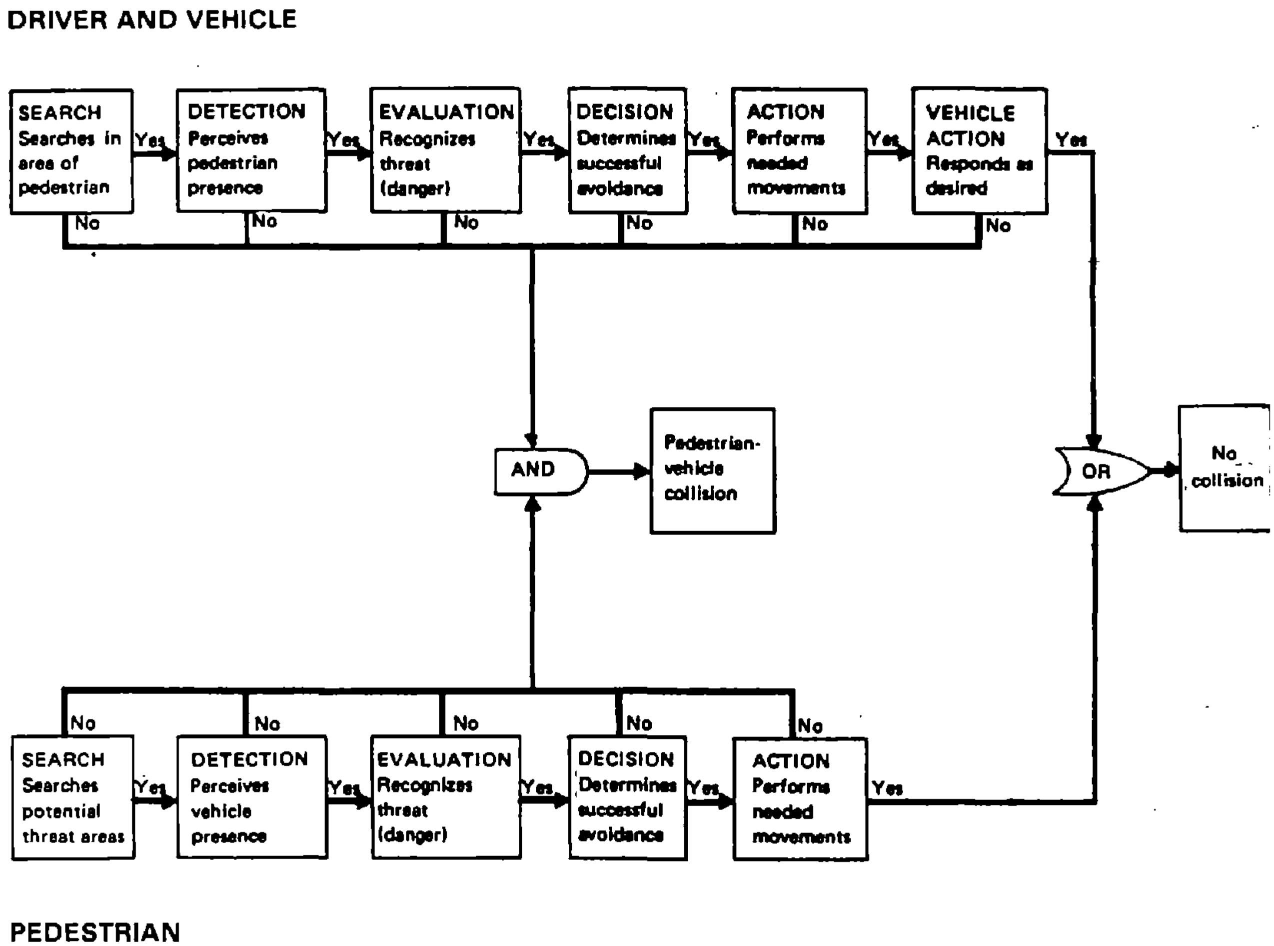


Figure 1. Behavioral event sequence.

- Evaluation. Recognizing the threat of a collision and the need for action to avoid it.
- Decision. Determining what action is needed to successfully avoid an accident.
- Action. Performing the needed body movements to carry out the decisions.

A seventh event applies to the vehicle only:

- Vehicle Response. The vehicle response to the action of the driver.

A failure at any step will result in the unsuccessful performance of the remaining steps. For example, if a driver fails to detect the pedestrian, he(she) will also fail to recognize a need to avoid the pedestrian, fail to decide how to do it, and fail to take the action needed to change the vehicle course.

Failures in the function/event sequence should not be equated with blame. For example, if a child darts out into the street from between parked cars and suddenly appears immediately in front of a vehicle, the driver of the vehicle may be blameless in the resulting collision. However, from an accident causation viewpoint, the driver experienced a detection failure. Often certain environmental, vehicle or human characteristics can cause a failure in the function/event sequence, thereby increasing the likelihood of a collision. In this example, the parked cars contributed to the driver's detection failure.

Classifying Accidents by Type

An essential part of a pedestrian safety program is to look at the local pedestrian accident picture. The most productive way of doing this is by classifying accidents by accident types.

Pedestrian accidents are assigned to causal types on the basis of similarities in their behavioral sequence and other contributing factors. Accident types are situations that have been found to occur over and over again in different areas of the country. Associated with each accident type are target groups (human populations and/or kinds of physical locations involved).

Table 1 lists 14 of the most common accident types and their critical behavioral descriptors. The percentages shown are the approximate percent of all pedestrian accidents attributable to that type in large urban areas. Different distributions are found in small towns or suburban areas. For example, suburban areas will have more "Walking Along Roadway" accidents, a type that rarely occurs in large urban areas.

To assist local communities in classifying or "typing" their accidents, NHTSA has developed two pedestrian accident typing approaches. The two approaches are:

- Computer Accident Typing (CAT). In this approach, coders complete a data form for each accident case using information provided on the police accident report. The data on the forms are input to a computer which assigns an accident type to each case and compiles a listing of percent occurrence by accident type. The listing is used to prepare an accident profile. The CAT approach is best where a computer facility is readily accessible to the local pedestrian safety program.
- Manual Accident Typing (MAT). The MAT approach is recommended for jurisdictions without easy access to computer facilities. With this approach, coders review each accident report following a step-by-step procedure contained in a coder's manual. The procedure allows the coder to determine the accident type. The accident profile is produced by manually summing the number of accident cases assigned to each type and calculating each percentage.

The first step is to determine which approach, CAT or MAT, is to be used. Detailed procedures to do accident typing can then be obtained from NHTSA (see page 2):

	DOT-HS-Numbers	
	Computer	Manual
• Administrator's Guide	806-350	806-350
• Training Manual	806-351	806-352
• Practice Cases Booklet	806-353	806-353
• Coder's Handbook	806-355	806-354

Table 1. Pedestrian accident types and critical behavioral descriptors.

DART-OUT (FIRST HALF) (24%)
Midblock (not at intersection).
Pedestrian sudden appearance and short time exposure (driver does not have time to react)
Pedestrian crossed less than halfway.

DART-OUT (SECOND HALF) (10%)
Same as above except pedestrian gets at least halfway across before being struck.

MIDBLOCK DASH (8%)
Midblock (not at intersection).
Pedestrian running but *not* sudden appearance or short time exposure as above.

INTERSECTION DASH (13%)
Intersection.
Same as dart-out (short time exposure or running) except it occurs at an intersection.

VEHICLE TURN-MERGE WITH ATTENTION CONFLICT (4%)
Vehicle turning or merging into traffic.
Driver is attending to traffic in one direction and hits pedestrian from a different direction.

TURNING VEHICLE (5%)
Vehicle turning or merging into traffic.
Driver attention *not* documented.
Pedestrian *not* running.

MULTIPLE THREAT (3%)
Pedestrian is hit as he steps into the next traffic lane by a vehicle moving in the same direction as vehicle(s) that stopped for the pedestrian.
Collision vehicle driver's vision of pedestrian obstructed by the stopped vehicle.

BUS STOP RELATED (2%)
Pedestrian steps out from in front of bus at a bus stop and is struck by vehicle moving in same direction as bus while passing bus.

VENDOR-ICE CREAM TRUCK (2%)
Pedestrian struck while going to or from a vendor in a vehicle on the street.

DISABLED VEHICLE RELATED (1%)
Pedestrian struck while working on or next to a disabled vehicle.

RESULT OF VEHICLE-VEHICLE CRASH (3%)
Pedestrian hit by vehicle(s) as a result of a vehicle-vehicle collision.

TRAPPED (1%)
Pedestrian hit when traffic light turned red (for pedestrian) and vehicles started moving.

WALKING ALONG ROADWAY (1%)
Pedestrian struck while walking along the edge of the highway or on the shoulder.

OTHER (23%)
Unusual circumstances, not countermeasure corrective.

A related tape and slide show, "Everyone Is a Pedestrian Sometime," is also available from NHTSA. The narrative describes the pedestrian accident problem and the types of behaviors responsible for many of the accidents, as well as some countermeasures that are available. Local pedestrian safety coordinators may find the slide show a useful way to introduce their own presentations.

BEHAVIORAL ANALYSIS

Accident types are defined in terms of specific participant behaviors and/or location specific characteristics. Each accident type is distinguished by the presence or absence of certain events. A collision occurs only when both participants fail to perform one of the behaviors in their behavioral events sequence. Certainly not all pedestrians who exhibit certain unsafe behaviors are hit by cars. And, not all vehicles that exhibit certain unsafe behaviors hit pedestrians. One way to effectively improve pedestrian safety is to identify specific locations where certain hazardous pedestrian and vehicle behaviors tend to happen. The collection of data on the occurrence of accident-related behaviors in a noncollision situation is called "behavioral analysis." Behavioral analysis involves:

- Making observations of specific behaviors, particularly those associated with target accident types, during several time periods at selected locations.
- Computing the percentage of target behaviors in each time period or at each location.
- Examining the percentages to see if the frequency of occurrence of any of the behaviors changes significantly between the study periods or between the potential problem locations.

Behavioral analyses are useful as short-term techniques (relative to accident analysis) to determine the relative level of hazard at a number of problem sites. Those locations with the greatest hazard should be considered for countermeasure implementation. Behavioral analyses can also be used to evaluate the effectiveness of a countermeasure once it is installed.

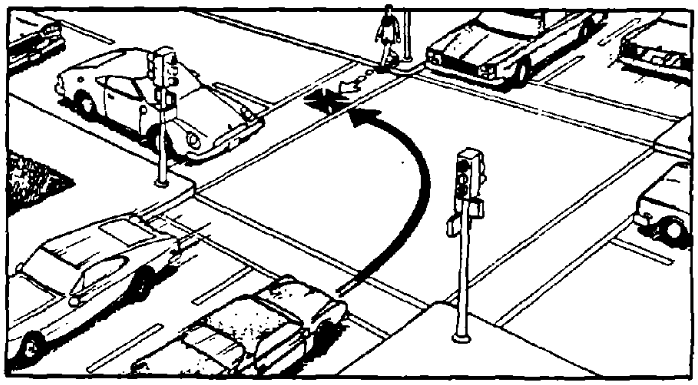
Pedestrian accidents are the result of certain pedestrian and driver/vehicle behavior sequences. Accident types can be defined by specific locational, environmental, and behavioral descriptors. Studying the occurrence of the individual behavioral descriptors can help determine the chances of that accident causal type occurring. For example, some countermeasures are designed to increase the probability of a pedestrian detecting oncoming vehicles. Thus, studying the occurrence of detection behaviors determines whether pedestrian behavior is being affected by the countermeasure. Table 2 lists some of the kinds of behavioral items that may be relevant to determining the degree of hazard at a site. Urban Pedestrian Accident Countermeasures Experimental Evaluation (Vol. I, PB-240255, and Appendix A, PB-240257, available from NTIS) describe several methods of collecting this kind of behavioral data. Manual, film or VCR techniques can be used for studying pedestrian behavior.

SUMMARY

The initial step of this program has outlined several methods for identifying hazardous locations and determining what behaviors or circumstances are causing that location to be hazardous. The three data sources discussed -- Citizen Complaints, Accident Analysis, and Behavioral Analysis -- are not mutually exclusive. Information from all sources should be collected at possible problem sites to help determine whether a pedestrian safety problem does exist. Once problem areas have been identified, the next step is to determine what to do about them. Many countermeasures known to improve pedestrian safety are described in Step 2, Identify Alternative Solutions.

Table 2. Behavioral evaluation data Items.

PEDESTRIAN BEHAVIOR	DEFINITION
Aborted Crossing:	Return to curb after having had both feet in roadway.
Pedestrian Conflict:	Pedestrian walks in front of a turning vehicle, causing the vehicle to brake or swerve.
Pedestrian Hesitation (turning vehicle):	Pedestrian hesitates because of turning vehicles.
Crossing Against Light:	Entry and exit from roadway while traffic has green signal or pedestrian signal shows flashing or steady don't walk.
Pedestrian Hesitation (through vehicle):	Pedestrian stops in roadway to allow one or more vehicles to pass.
Leaving Crosswalk:	Exiting from crosswalk area into traffic lane.
Walking Outside of Crosswalk:	Crossing all traffic lanes outside crosswalk area.
Trapped on Median:	Waiting for passage of one or more vehicles while on median.
Bus Stop Related:	Crossing (against the light) in front of bus stopped at bus stop.
Vehicle Overtaking:	Pedestrian steps into roadway and moves in front of standing vehicle into next lane of traffic (multiple threat behavior).
Running Into Roadway:	Entry into roadway while running.
Running in Roadway:	Start of running after entry into roadway.
Sudden Appearance:	Running into roadway from between parked vehicles (dart-out behavior).
Backup Movement:	Momentary reversal in pedestrian direction of travel.
Approach Search Behavior:	Looking for oncoming traffic before stepping off curb.
Crossing Search Behavior:	Looking for oncoming traffic while crossing the roadway.
Gap Size Accepted:	Distance to closest vehicle in lane as pedestrian enters lane.
Delay:	Length of time spent waiting for acceptable gap.
VEHICLE BEHAVIOR	**DEFINITION**
Delay:	Length of time spent waiting for pedestrians to clear roadway.
Approach Speed:	Travel velocity.
Turning Conflict (vehicle):	Number of turning vehicles having pedestrians cross in front of them.



STEP 2

IDENTIFY ALTERNATIVE SOLUTIONS

Step 1 described how to determine the nature and extent of the pedestrian safety problem in your area. The next step is to do something about the problem. This is best done by considering a variety of possible solutions (i.e., countermeasures) and identifying those most likely to be effective.

In this step, countermeasures are identified by focusing on specific accident types and their specific behavioral event sequence. Countermeasures alter the behavioral event sequence of a potential pedestrian accident by changing the behavior of either the pedestrian or the driver or both. This can be done by changing the physical environment or changing the search, detection, evaluation, and decision process of pedestrians and/or drivers.

Traditionally there are three general types of safety countermeasures, called the three Es of safety: Engineering, Education, and Enforcement. Engineering countermeasures change the physical environment to produce a change in pedestrian or driver behavior. Educational countermeasures attempt to produce changes in behavior by changing the way pedestrians and drivers search, detect, evaluate, and decide. Enforcement countermeasures use laws and ordinances to produce "safer" behavior on the part of drivers and pedestrians. Obviously, there is a great deal of overlap between these three general types of countermeasures. For example, providing a pedestrian traffic signal is an engineering countermeasure. However, in order for it to be effective, pedestrians must understand how to use it (education) and realize that failure to use it may result in an accident or a citation (enforcement).

A wide variety of countermeasures are applicable to the pedestrian safety problem. The Appendix to this Guide contains detailed information on many of those countermeasures. Following is a brief description of the contents of the Appendix:

ENGINEERING COUNTERMEASURES

Barriers – Chain, fences, or similar devices used to separate pedestrians and vehicles.

Bus Stop Relocation – Moving the bus stop to the far side of an intersection.

Marked Crosswalks – Marking crosswalks at certain selected unsignalized intersections.

Grade Separation – Overpasses and underpasses that permit free-flowing, noninteractive flow of pedestrians and vehicles.

Facilities for the Handicapped and Older Adults – Pedestrian facilities that can aid those with physical disabilities.

Lighting – Street lighting and crosswalk lighting to improve the visibility of pedestrians.

One-Way Streets and Diagonal Parking – Changing traffic flow and parking to improve pedestrian safety.

Retroreflective Materials – Retroreflective materials to increase the visibility of pedestrians wearing them.

Safety Islands – Pedestrian refuge areas between opposing traffic lanes or within an intersection.

Sidewalks – Suitable walkways to improve the separation of pedestrian and vehicular traffic.

Signalization – Traffic signals and pedestrian signals to provide temporal spacing of vehicular and pedestrian traffic.

Signs and Markings – Signs and markings used to convey regulatory, warning or guiding messages to pedestrians or motorists.

Urban Pedestrian Environment (UPE) – Various methods used to separate vehicular and pedestrian traffic in heavily urbanized areas.

Vehicular Traffic Diversion Strategies – Methods used to eliminate or restrict through traffic in local neighborhoods.

EDUCATION COUNTERMEASURES

Programs for Preschool Children:

Parental Guidance – Setting a good example through proper behavior in traffic.

Safety Town – Teaching children traffic safety in a scaled-down village.

Traffic Safety Clubs – Clubs in which both parents and children learn basic traffic rules.

Television Programs – Topical programs using safety films and explanations by safety personnel.

Walking In Traffic Safety (WITS) – Parent-child program to teach preschool children about streets and cars.

Watchful Willie – A 4-lesson program for preschool teachers.

Programs for Elementary School Children:

Officer Friendly – Classroom or assembly programs given by police.

Education Within the Curriculum – Safety taught as a part of the classroom curriculum.

Green Pennant Program – Schools are given awards for remaining accident-free.

"Big Wheel"/Child Riding Toys – 60-second film for classroom or television use.

Willy Whistle Program – Behaviorally oriented program to teach children not to "dart-out."

Safe Street Crossing – In-class program to teach crossing safety.

Child Pedestrian Intersection Dash TV Spots – 60-second television spots teaching intersection safety.

"And Keep On Looking" Film – 15-minute film for grades 4 through 7.

Programs for High School Students:

Assemblies – Assemblies on pedestrian safety including films and speeches.

Driver Education – Inclusion of safe pedestrian practices as part of driver education curriculum.

Youth Traffic Court – Students discipline fellow students who violate safe walking, bicycling, or driving regulations.

Programs for the General Public:

Talks to Groups – Talks by police or safety officials to civic groups.

Community Action Programs – Use of existing groups to implement specific programs.

Use of the Mass Media – Use of radio, television, and print media to educate and inform.

Multiple Threat TV and Radio Spots – 30- and 60-second television and radio spots targeted for pedestrians and drivers.

Vehicle Turn/Merge TV and Radio Spots – 30- and 60-second television and radio spots targeted for pedestrians and drivers.

Adult Intersection Dash TV Spot – 30-second television spot on crossing signalized intersections.

Programs for Older Adults:

Safety Courses – Slide and tape show "Safety Steps for Pedestrians" developed by the American Association of Retired Persons.

Talks to Groups – Talks by police or safety officials to senior citizens' groups.

Community Contact Program – Use of existing senior citizens' groups to disseminate materials.

ENFORCEMENT/REGULATIONS/CHILD PROTECTION COUNTERMEASURES

Enforcement – Programs to encourage compliance with pedestrian and pedestrian/vehicle laws and ordinances.

Model Ice Cream Truck Ordinance – Regulations to reduce accidents to pedestrians going to or from vending trucks.

Model Bus Stop Ordinance – Regulations to change near-side bus stops to the far side of intersections.

Model Regulation for School Bus Pedestrians – Regulations to improve conspicuity of school buses.

Model Dismounted Motorist Safety Regulations – Model regulations to reduce pedestrian accidents involving a disabled vehicle.

Model Vehicle Hazard Warning Lights Regulation – Model law defining when to use 4-way flashers.

Model Freeway Walking Restrictions – Model law banning unnecessary pedestrian activity on freeways.

Model Regulation for Pedestrians on Highways – Model law defining safe pedestrian actions on highways.

Model Vehicle Overtaking Law – Model law to counter the multiple threat accident type.

Model Ordinance on Parking Near Intersections and Crosswalks – Model law to increase pedestrian visibility to drivers.

Safe Route to School Program – Identifies safe routes for children to use between home and school.

School Bus Routing Plan – Bus routes and bus stops planned to improve pedestrian safety.

School Bus Patrols – Student patrols trained to improve pedestrian safety at bus stops.

School Crossing Guards – Guards trained to instruct, direct, and control students at school crossings.

Play Streets – Residential streets temporarily closed to traffic to provide for safe recreation.

With so many possible countermeasures available, it is often difficult to decide which countermeasure (or countermeasures) is appropriate for a specific local pedestrian safety problem. Tables 3, 4, and 5 match specific accident types to possible countermeasures. Table 3 matches specific accident types to potential engineering treatments that are designed to affect specific unsafe behaviors. Table 4 relates the accident types to educational countermeasures. Many of the potential education countermeasures have been developed to affect very specific pedestrian behaviors. Other education countermeasures are more general but the content of the program can be tailored to target specific local pedestrian problems. Table 5 relates the accident types to enforcement countermeasures. The "enforcement" category includes the enforcement of existing laws as well as suggested model ordinances designed to improve pedestrian safety when enacted on the state or local level. Also included are various programs intended to increase the safety of children, i.e., school trip route planning and school crossing guard programs.

In using these tables, look over all the possible countermeasures and note any which may be helpful for a particular problem. There is usually no single cure for a specific safety problem. At this stage, it is important to keep an open mind and consider all possible solutions before making a choice. The next step will involve selecting the best alternative from among the full range of possible countermeasures.

Table 3. Pedestrian accident types and potential engineering countermeasures.

Accident Type \ Countermeasures	Engineering and Physical																					
	Barrier: Median	Barrier: Roadway/Sidewalk	Barrier: Street Closure	Bus Stop Relocation	Crosswalk: Intersection	Crosswalk: Midblock	Diagonal Parking-1 Way Street	Grade Separation	Facilities for Handicapped	Lighting: Crosswalk	Lighting: Street	One-Way Streets	Retroreflective Materials	Safety Islands	Sidwalk/Pathway	Signal: Ped. (Shared)	Signal: Ped. (Delayed)	Signal: Ped. (Separated)	Signal: Traffic	Signs and Markings	Urban Ped. Environment	Vehicular Traffic Diversion
Dart-out (First Half)	●	●				●	●														●	●
Dart-out (Second half)	●	●				●	●					●		●							●	●
Midblock Dash	●	●				●								●							●	●
Intersection Dash					●			●		●	●			●			●	●		●		
Turn-Merge Conflict								●									●	●				
Turning Vehicle								●									●	●				
Multiple Threat								●		●	●					●	●	●	●		●	
Bus Stop Related				●																	●	
School Bus Stop Related				●																		
Ice Cream Vendor																				●		
Trapped					●			●						●		●	●	●				
Backup																						
Walking on Roadway		●									●		●		●					●		
Result Vehicle-Vehicle Crash																				●		
Hitchhiking											●		●									
Working in Roadway																				●		
Disabled Vehicle Related																				●		
Nighttime Situation										●	●		●									
Handicapped Pedestrians									●													

*Dots designate countermeasures believed to positively affect the indicated behavior/accident types.

Table 4. Pedestrian accident types and potential educational countermeasures.

Countermeasures / Accident Type	Preschool					Elementary School								High Sch.			General Public						Older Adults		
	Parental Guidance	Safety Town/Safety Clubs	Television Programs	Walking In Traffic Safely	Watchful Willie	Officer Friendly	Education Within the Curriculum	Green Pennant Program	"Big Wheel" Spot	Willy Whistle Program	Safe Street Crossing	Child Intersection Dash TV Spot	"And Keep on Looking" Film	Assemblies	Drivers Education	Youth Traffic Court	Talks to Groups	Community Action Program	Use of the Mass Media	Multiple Threat Spot	Vehicle Turn-Merge Spot	Adult Intersection Dash Spot	Safety Courses	Talks to Groups	Community Contact Programs
Dart-out (First Half)					●					●															
Dart-out (Second Half)					●					●															
Midblock Dash																									
Intersection Dash												●	●									●			
Turn-Merge Conflict													●								●				
Turning Vehicle													●												
Multiple Threat													●							●					
Bus Stop Related						●																			
School Bus Stop Related						●																			
Ice Cream Vendor																									
Trapped																									
Backup	●																								
Walking on Roadway																									
Result Vehicle-Vehicle Crash																									
Hitchhiking																									
Working in Roadway																									
Disabled Vehicle Related																									
Nighttime Situation																									
Handicapped Pedestrians																									
Pedestrian Safety in General	●	●	●	●	●	●	●	●	●		●			●	●	●	●	●	●				●	●	●

Table 5. Pedestrian accident types and potential enforcement/regulations/ child protection countermeasures.

Countermeasures / Accident Type	Child Protection					Enforcement/Regulations									
	Safe Route to School Prog.	School Bus Routing Plan	School Bus Patrols	School Crossing Guards	Play Streets	Enforcement	Ice Cream Truck Ordinance	Bus Stop Ordinance	School Bus Regulations	Dismounted Motorist Regs.	Vehicle Hazard Lights Regs.	Freeway Walking Regs.	Regs. for Peds. on Highways	Vehicle Overtaking Law	Parking Near Intersections
Dart-out (First Half)					●										
Dart-out (Second Half)					●										
Midblock Dash					●										
Intersection Dash															●
Turn-Merge Conflict															
Turning Vehicle															
Multiple Threat														●	
Bus Stop Related								●							
School Bus Stop Related		●	●						●						
Ice Cream Vendor							●								
Trapped															
Backup															
Walking on Roadway													●		
Result Vehicle-Vehicle Crash															
Hitchhiking												●			
Working in Roadway															
Disabled Vehicle Related										●	●				
Nighttime Situation											●				
Handicapped Pedestrians															
Pedestrian Safety In General	●	●	●	●	●	●									

*Dots designate countermeasures believed to positively affect the indicated behavior/accident types.

STEP 3
SELECT THE BEST ALTERNATIVE

Step 1 of the Model Pedestrian Safety Program described procedures to identify problems in terms of behavioral and accident types. Step 2 listed countermeasures believed to be effective against particular safety problems. The next step is to select the countermeasure that will yield the highest benefit for the lowest cost. Procedures are needed to determine which of the various types of countermeasures may be most appropriate. Different procedures are used to select engineering, education, and enforcement countermeasures.

ENGINEERING COUNTERMEASURES

Likely cost variables that can be incurred during the installation and operation of pedestrian facilities include:

- Design costs
- Construction costs
- Maintenance and operating costs.

Potential benefits (or disbenefits) that can be received from pedestrian facility installation and operation include the reduction of:

- Accident frequency
- Accident severity
- Vehicle time delay
- Vehicle operating cost
- Pedestrian delay
- Economic loss to the areas
- Adverse social change
- Inconvenience to the public
- Ecological impact (including noise and air pollution, and aesthetic impact).

Background

Historically, benefit-cost analysis has met with considerable controversy. One problem pertains to the best units of measurement of the various benefits and costs. Benefit-cost analysis is most meaningful if the total costs and total benefits are described using the same units. That way, comparisons can be more readily seen. Most costs can be described in monetary values (e.g., construction costs, manpower requirements, gasoline costs of vehicle delay). However, there are additional "costs" that cannot be easily expressed in terms of dollars (e.g., time delays, environmental costs). The problem is even more severe in identifying benefits. Very few of the potential benefit variables are readily quantifiable.

To combat this problem, this step describes a variation of the commonly used benefit-cost analysis. It is different from traditional benefit-cost analyses in that monetary values are not directly used in the comparison. Instead, a "value rating" is assigned to each cost and benefit variable.

Value Rating System Method

The value rating system method was developed and demonstrated during a National Cooperative Highway Research Program (NCHRP) project. NCHRP Report 240, A Manual to Determine Benefits of Separating Pedestrians and Vehicles, contains the analyses undertaken as part of the project, the findings and recommendations of the researchers, and the technical user's guide. Although originally developed for evaluating such facilities as pedestrian overpasses and underpasses, the procedure can be readily modified to evaluate a variety of pedestrian facilities. A slide show with accompanying music, narration, and sound effects was prepared for those interested in evaluating pedestrian facilities but who will not be involved with the details of the method (i.e., elected officials, merchants, and the general public). A videotape that illustrates the actual method is available for those who will personally use the procedure. NCHRP Report 240 and both audiovisual products are available from NCHRP (see page 2).

The value rating system is a four-step process for evaluating the social, environmental, and economic benefits of proposals for facilities separating pedestrians and vehicles:

- Describe Alternatives. The first step in the process is to describe all of the alternative countermeasures identified as potential solutions.

- <u>Estimate Costs</u>. An integral component of identifying project alternatives is to estimate costs for the different countermeasures.
- <u>Prepare Project Summary Sheet</u>. A project summary sheet is prepared for each alternative being considered.
- <u>Assign Weights</u>. The purpose of this step is to develop weights that reflect the relative priorities of the different impacts on the pedestrian facility.

OTHER COUNTERMEASURES

Educational and enforcement countermeasures are often more difficult to evaluate than engineering countermeasures because costs are harder to quantify. For example, although a set of training materials may be available for free, there are costs involved in obtaining the materials, setting up the training, teacher time, etc. These costs are very difficult to quantify. Fortunately, most of the costs associated with educational and enforcement countermeasures are not "out-of-pocket" expenses, as is the case with many engineering countermeasures. They may not require a budget increase unless additional staff members are hired to do some of the additional work.

As with engineering countermeasures, the benefits associated with educational and enforcement countermeasures are also difficult to quantify. For example, a given ad campaign may have produced a statistically significant reduction in dart-out accidents during a research study in City A. Based on this information, it may not be appropriate to predict a similar accident reduction in City B. To do this, variables such as the length of the campaign, the number of ad exposures, the type of people exposed to the ad, etc. must also be known. Just as it is difficult to compare the costs and benefits of educational and enforcement countermeasures with each other, it is also difficult to compare these countermeasures with the various engineering countermeasures.

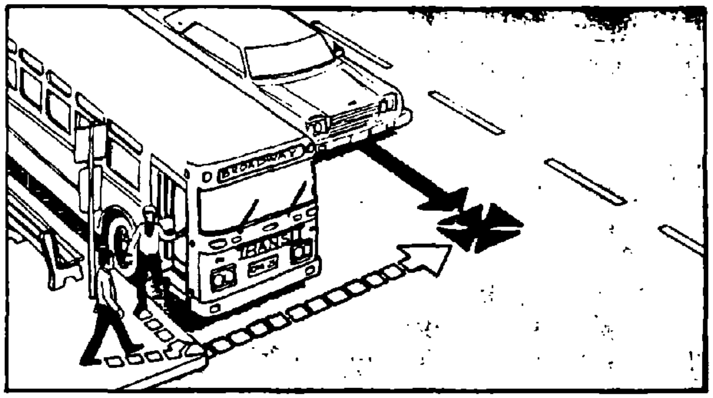
Depending on the nature and extent of the local pedestrian safety problem, there may not be many countermeasure options. If a number of countermeasures appear appropriate and the results of the value rating procedure are not definitive, there are three other considerations:

- Cost
- "Political" feasibility
- Community support.

These three factors are interrelated and must be considered in the implementation of all countermeasures. Often the least expensive solution to the problem is the one that is easiest to implement. A successful pedestrian safety program must be responsive to "political" reality. Without the support of the Town Council, Board of Education, local television and radio stations, and other local groups, the program is unlikely to succeed. The pedestrian safety program must also work to get the support of the community. The public, both drivers and pedestrians, must be willing to accept any changes to their daily lives that the countermeasures may bring.

SUMMARY

The value rating method is an important decision-making tool because it provides a technique to make countermeasure selections based on quantitative analysis. This is not to say that value rating should be the only basis for selecting an alternative. Political and public input, historical precedent, and your specific situation all must be considered. However, a quantitative analysis provides for rational and justifiable decisions.



STEP 4

IMPLEMENT SELECTED ALTERNATIVE

Once a countermeasure has been selected, the next step is to see that it gets implemented. The tasks of successful implementation are:

- Establish program goals and objectives
- Coordinate safety efforts
- Establish and maintain support
- Obtain financial resources
- Prioritize and schedule projects.

ESTABLISH PROGRAM GOALS AND OBJECTIVES

The goals and objectives of the local pedestrian program should be written in a policy statement to communicate the desired safety program to those who will implement it. Local priorities, goals, and objectives should be plainly stated in the form of specific performance statements -- descriptions of activities which must be performed, the costs involved, and the performance schedule. Program goals and objectives stated in performance terms are easier to track and monitor, and the program's effectiveness can be more readily evaluated (see Step 5).

The general objective of any pedestrian safety program should be to reduce the frequency and injury severity of pedestrian accidents. More specific goals, i.e., reducing dart-outs by school-age children, can be tailored to the specific needs of the community.

COORDINATE SAFETY EFFORTS

One of the major problem areas of pedestrian safety in general is that many agencies sharing the responsibility for pedestrian affairs. This can lead to duplication of effort or to inaction. Often involved are representatives from traffic engineering, police, planning and zoning, parks, public works, and the schools. Most successful safety programs have one individual or group responsible for coordinating the total pedestrian safety program. There must be an organization that directly represents pedestrian interests. Three possible answers to this problem are:

- Mayor's Task Force for Pedestrian Safety
- Bureau of Pedestrian Affairs
- Pedestrian Safety Coordinator.

Mayor's Pedestrian Safety Task Force

This is a group of citizens, business owners, city officials, and representatives of special interest pedestrian groups (e.g., older adults, children, walking/jogging clubs). The group's primary task is to act as a "buffer" between citizens directly affected by a safety program and the agency responsible for its implementation and operation.

Bureau of Pedestrian Affairs

This group is more professionally oriented and can be established as an agency on its own. It has the same duties as the Task Force, plus it is responsible for:

- Maintaining and publishing pedestrian accident statistics.
- Overseeing the installation of facilities.
- Initiating proposals for pedestrian-related improvements.

Pedestrian Safety Coordinator

This possibility focuses the duties of pedestrian safety on one individual. The Pedestrian Safety Coordinator's job can be one of the tasks of a Traffic Safety Coordinator, depending on the extent of the pedestrian and other safety problems. The duties of this individual include all those of the Task Force and the Bureau.

ESTABLISH AND MAINTAIN SUPPORT

No matter which type of organizational structure is selected, actively dealing with numerous people is an essential task of the safety coordination effort. One of the most important criteria for implementation of a program is its acceptance by the affected citizens. Without this acceptance, it is doubtful that any safety program could be effective.

Enthusiasm for the total pedestrian safety program generally must also come from the upper levels of the locality's political system. One way to generate such enthusiasm occurs when a good program becomes publicized. While this is difficult to initiate, there is a means already available to accomplish this -- the American Automobile Association's (AAA) Pedestrian Safety Inventory. The national AAA, through the local Automobile Clubs, annually surveys the pedestrian programs in over 2,000 American communities. Cities, counties, and states voluntarily fill out a two-page questionnaire describing their pedestrian safety efforts for the previous year. The AAA's responses to a locality indicate how that locality's program compared to other cities of a similar size. Awards are given to localities with outstanding safety programs and/or low accident occurrence. One of the side benefits of this program is that it helps a locality to become more aware of its total pedestrian safety efforts. On numerous occasions, poor showings by a community have caused local officials to initiate better pedestrian-oriented efforts.

OBTAIN FINANCIAL RESOURCES

Many options are available for funding individual pedestrian projects. These options will vary depending on the scope and target subjects of the project. Following is a list of some of the sources and funds that are or have been available for pedestrian-related projects. The appropriate organization should be contacted concerning the availability of funds.

Department of Transportation

Federal Highway Administration (FHWA) - Administered Through Each State Transportation Department

- Federal-aid Interstate Funds may be used for 90 percent of the cost of planning, construction, and improvement of pedestrian facilities within the interstate right-of-way. Interstate construction funds can only be used for replacement of existing facilities. Interstate 4R Funds may be used for new facilities.

- Federal-aid Primary, Secondary, and Urban funds may be used for up to 70 percent of the costs. These facilities can be provided off of the right-of-way but they must serve pedestrians who would otherwise use the Federal aid route.

- Highway Planning and Research (HPR) Funds cover up to 85 percent of the cost for planning and research activities on projects anywhere within a State. These projects are selected by the State transportation agency.

- Planning (PL) Funds are for planning and research activities in urban areas with a population of 50,000 or greater. The use of these funds is controlled by the metropolitan planning organizations within each state.

FHWA - Administered Through Governor's Highway Safety Representative

- Highway Safety (Sec. 402) Funds may be used for accident data collection and analysis, and planning and evaluation of pedestrian-related facilities. These funds may not be used for construction.

National Highway Traffic Safety Administration (NHTSA)

- Highway Safety (Sec. 402) Funds may be used for public information, public education, law enforcement, and similar program activities. These program activities must be part of the state highway safety plan. Contact your Governor's Highway Safety Representative. A listing of the addresses and phone numbers of the State Highway Safety Representatives begins on page 42.

Urban Mass Transportation Administration (UMTA)

- Demonstration grants, technical, and feasibility studies. Projects must be related to general urban development and include substantial transit improvement.

State Funds

- Matching funds for community development.
- Spot Safety Improvement Programs (Highway Department) to eliminate hazards at high accident locations.

Local Funding Sources

- Special assessments.
- School district assessment.
- Voluntary assessment.
- Gas or Special Sales Tax.
- Revenue bonds.
- Contributions.
- City Budget -- improvement and maintenance, general revenue, capital construction funds.

One of the necessary ingredients in obtaining funds is the ability to demonstrate a need (i.e., using the information in Step 1), or to show that previously used funds have created a safer pedestrian environment (i.e., using the information in Step 5).

PRIORITIZE AND SCHEDULE PROJECTS

To keep the problem from increasing in magnitude, the appropriate countermeasures should be implemented as soon as possible. Two elements play a role in applying solutions: Which pedestrian problems should be addressed first and where do pedestrian problems fit into the total transportation picture.

Prioritization

Although this manual addresses the pedestrian safety issue, other traffic problem areas cannot be ignored. The available funds must be split between pedestrian and nonpedestrian problem areas. A hazard prioritization process can be used to determine which problem areas should be addressed.

Hazard prioritization is a technique for evaluating the degree of hazard associated with a particular problem area. Each location is rated using three elements:

- Severity. The degree of the problem if left unattended (nuisance, marginal, critical, catastrophic).
- Probability. The likelihood of an accident if no solution is implemented (unlikely, probable, considerable, imminent).
- Cost. The cost of the implemented solution (prohibitive, extreme, significant, nominal).

Each problem area should be described using these three elements. A card such as the one below can be used to facilitate this technique.

HAZARD ANALYSIS CARD			
Prepared by ______		Date ______	
Hazard Description ______			
Departments:			
Severity	Probability	Cost	Action
O Nuisance	O Unlikely	O Prohibitive	O Defer
O Marginal	O Probable	O Extreme	O Analysis
O Critical	O Considerable	O Significant	O Immediate
O Catastrophic	O Imminent	O Nominal	Date ______

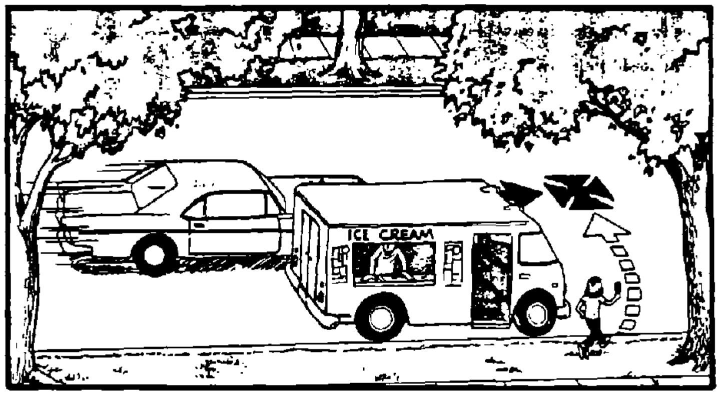
Problem areas are prioritized according to their severity, probability, and cost. Catastrophic-imminent-nominal problems should be addressed first because the greatest benefit for the least cost can be expected. Catastrophic-imminent-significant problems would be addressed next. After all catastrophic-imminent problems are considered, catastrophic-considerable-nominal problems should be turned to. The last problems to be addressed would be nuisance-unlikely-prohibitive.

This prioritization technique can establish a sequence for addressing pedestrian problems alone and for inserting these problem areas into the total transportation system management program.

Other techniques are available to help establish project priorities. One such method is project ranking. It can be based on either the benefit-to-cost ratio or the cost-effectiveness ratio. The Local Highway Safety Improvement Program (LHSIP) User's Guide explains project ranking and contains sample worksheets along with several case studies. A limited number of copies of this manual are available at no cost from the Federal Highway Administration, Research, Development and Technology, Publications and Report Center, HRD-11, 6300 Georgetown Pike, McLean, Virginia 22101.

Scheduling

For every project, the plan of action, from conception to operation, should be put on a time schedule. Time schedules allow managers to plan manpower and allocate funds. Schedules can also be used as a tool in spreading the costs of programs over a period of years. In addition, when the specific goals and objectives and a schedule for meeting them are established, they provide a tool for evaluating the safety program in general. The next step, Evaluation, discusses this use of project and program scheduling.



STEP 5

EVALUATE THE EFFECTIVENESS OF THE IMPLEMENTED ALTERNATIVE

Although the evaluation process is being discussed at the end of this User's Guide, it must be planned from the initial stages of the program. Two types of evaluation are needed: program evaluation and countermeasure evaluation. Program evaluation deals with the performance of the pedestrian safety program itself. The safety program should be evaluated in terms of the major program activities (planning, development, implementation, and operations). As the program evolves and changes, the measures of evaluation (e.g., cost, schedule) can be modified. Program evaluation should provide an awareness of the program status and its progress relative to its objectives. The following list presents potential program evaluation measures:

- Cost
  - Operating expenses (rent, supplies)
  - Labor
  - Evaluation (collection, accident records, data processing)
  - Equipment (data collection devices, furniture)

- Schedule
  - Creating program and evaluation plan
  - Identifying problem(s)
  - Identifying countermeasure(s)
  - Arranging funding
  - Designing facilities
  - Implementing countermeasure(s)
  - Collecting before and after data
  - Evaluating effectiveness
  - Maintaining countermeasure(s)

- Other Activities
  - Public involvement
  - Volunteer activities
  - Promotion
  - Personnel productivity.

Program evaluation is needed to determine:

- Whether or not the program is fulfilling its goals.
- How efficiently the program is accomplishing its goals.
- If the program is producing any results contrary to its goals.

Countermeasure evaluation attempts to determine the effectiveness of the various countermeasures implemented as part of the safety program. This information is used as the basis for expansion, redirection or modification of the safety program. Three steps should be followed in conducting a countermeasure evaluation:

- Develop evaluation plan
- Conduct evaluation
- Analyze and interpret data.

The remainder of this chapter addresses countermeasure evaluation.

DEVELOP EVALUATION PLAN

All pedestrian safety programs ultimately are intended to improve safety through the reduction of pedestrian accidents. However, because they occur relatively infrequently, accidents can be a poor measure of effectiveness. Also, since some countermeasures are designed to alter only certain pedestrian or driver behaviors, they will not affect all accident types and may not produce a measurable effect on the total number of accidents. The first step in developing the evaluation plan is to determine appropriate measures of effectiveness.

Select Measures of Effectiveness

Measures of effectiveness (MOEs) are observable behaviors or events that can be shown to change as the result of a countermeasure or treatment. Measures of effectiveness must be valid (they must measure what they are supposed to measure). They must be sensitive enough to discriminate between performance changes in the before and after conditions. Measures must also be collectable (in a technical sense with available manpower and resources) and they must be reliable (they must measure the same phenomenon each time they are used). Potential MOEs involving accidents, pedestrian behavior, and traffic operations are shown below.

POTENTIAL MOES

Accidents	Pedestrian Behaviors	Traffic Operations
Number of accidents	Pedestrian noncompliance (with signals, crosswalks)	Vehicle volumes
Number of accidents by causal type	Inadequate looking	Vehicle speed
		Turn counts
Number of accidents by location	Pedestrian hesitation/ backup	Pedestrian volume
Accident Rate	Pedestrian conflict with thru or turning vehicles	Pedestrian delay

Select Experimental Design

The experimental design is the method used to evaluate the data. Several experimental designs are used in highway safety evaluation. Many are used inappropriately, particularly when accidents are used as a criterion measure. Use of a control group or control site is mandatory with accident MOEs. When behavioral and operational measures are used, a before-after design with control group is highly desirable. In a before-after design, two measurements are taken, one before and one after the treatment is implemented. Effectiveness is defined as the difference in the two measurements over time. The before data must be collected prior to the installation of a countermeasure.

While this design is straightforward and easily applied, it does have its shortcomings. The before-after design is vulnerable to changes that occur during the time it takes to complete the study (e.g., in traffic volumes or composition). These changes can result in erroneous conclusions. It is essential that the effects of such variables be minimized as much as possible. The before-after design with control site(s) is similar to the before-after design except that two (or more) comparable sites are identified. Identical measurements are taken at both sites before the installation of the countermeasure. After the countermeasure is installed at one site, identical measurements are again taken at both sites.

This design overcomes the weaknesses of a simple before-after design. Before and after measurements at the test site are compared to changes at the control site. Variables that change over time will appear at both sites and thus be accounted for in the evaluation. The control group design requires that data collection be scheduled to control the influence of other variables. It is imperative that the only thing that changes over time is the treatment itself. Examples of the variables that need to be controlled include:

- Weather conditions
- Illumination level
- Traffic volume
- Traffic mix
- User familiarity/Unfamiliarity
- Pedestrian age and sex
- Pedestrian volume.

CONDUCT EVALUATION

The next step in developing an evaluation plan is to prepare a detailed data collection plan spelling out data needs, procedures, and schedules. Because comparable before and after data must be collected, the data collection must be planned before the countermeasure is installed.

Data Needs

The selected MOEs will determine the types of data needed. Having established a particular MOE of interest (e.g., pedestrian compliance), describe the exact type of data needed and the location(s) where it should be collected (e.g., crossing all legs of the intersection). To satisfy statistical requirements, it is necessary that a sufficient sample size be obtained. Suggested minimums for some typical measurements are shown below.

SUGGESTED MINIMUM SAMPLE SIZES

MOE	Minimum Sample Size
Speeds	100 (each vehicle type)
Pedestrian-vehicle conflicts	30 each type
Pedestrian survey	100 pedestrians
Pedestrian compliance	50 pedestrians

Procedures

Several techniques are available to collect nonaccident behavioral data including manual and photographic methods. Each of these has advantages and disadvantages.

The most direct method of assessing pedestrian and vehicle behavior is to count the frequency of occurrence of each defined behavior. The first step in behavioral analysis is to operationally define the events to be measured. This means specifying the observable elements necessary to define the event. The best operational definitions are simple enough to completely describe the behavior and be understood by all potential users. For example, an operational definition of Aborted Crossing might be: "Pedestrian returns to curb after having both feet in roadway." The definition should also reflect the method of data collection to be used. An example of an operational definition for Running might be: "Crossing an entire traffic lane in three or less frames of film." Such a concise statement of the elements used to define a behavior is invaluable for comparing the results of different studies, e.g., between localities in a state.

For a discussion of data collection techniques and procedures, see the FHWA research report: Urban Pedestrian Accident Countermeasures Experimental Evaluation. Sample data collection forms and detailed data collection procedures, including definitions of target behaviors, are provided in Appendix A of that document (Vol. I is PB-240 255; Appendix A is PB-240 257).

Schedules

The periods of data collection must be the same for each evaluation. That is, at one site, before and after data must be collected on the same day of the week, time of day, and season to avoid confounding variables (e.g., volume differences between day and night, or rush- and nonrush-hour traffic). It is also important to allow a sufficient acclimation period after the installation of the countermeasure to allow for any novelty effects. Usually a month is a sufficient acclimation period for most countermeasures.

ANALYZE AND INTERPRET DATA

Appropriate statistical analyses are required to determine if any differences between the before and after data are due to the treatment or to chance. In most cases, one of three types of data will be collected.

- Continuous. Data that have no distinct intervals between possible values are continuous. Examples include vehicle speed and lateral placement.
- Dichotomous or Count. Data that are identified by the occurrence or nonoccurrence of a behavior are dichotomous. Examples include pedestrian compliance or pedestrian-vehicle conflicts.
- Rare Event. Behaviors that occur very infrequently (e.g., accidents) are rare event data.

Testing for statistical significance is a mathematical procedure that quantitatively determines the likelihood that an observed change was elicited by the installation of the countermeasure or occurred purely by chance. It must be realized that testing for statistical significance is only a decision tool. It does not demonstrate the practical importance of the difference. For example, a new flashing signal may have a statistically significant effect on traffic speed. However, the cost of the signal versus the value of the speed reduction must still be addressed with benefit and cost data. There are many situations where the difference between the two sets of measures may be statistically significant but of no practical value.

The actual statistical analysis performed will depend on the type of data collected. Table 6 presents combinations of types of data, recommended statistical tests, and comments regarding the output or use of the test.

Table 6. Sample applications of statistical techniques.

Data Type	Recommended Tests	Comment
Continuous	t-test for difference in means F-test for difference in variances	Powerful because it uses mean and variance. Assumes data are normally distributed and samples are independent. Sample size of 30 or more required.
Continuous—more than two variables to be tested	Analysis of variance	Gives both significance of each variable and interaction between variables.
Dichotomous (percentage)	Z-test for proportions	Used for comparing two proportions.
Dichotomous or categorical data (numerical)	Chi-square (X^2) test	Used when comparing more than two numbers; e.g., 2x2 or larger contingency table. Particularly useful for testing cross-tabulated questionnaire data.
Rare event data	Poisson distribution Chi-square test	Used for testing the significance of accident reduction.

An Accident Research Manual was prepared for the Federal Highway Administration (FHWA) that can be used to carry out research related to highway accidents. Although the emphasis is on accident research, the manual contains an excellent discussion of experimental design, experimental confounds, exposures, and effectiveness evaluation. The manual describes when specific statistical tests are appropriate as well as how to perform a number of appropriate procedures. A limited number of copies of this manual are available at no cost from the Federal Highway Administration, Research, Development and Technology, Publications and Report Center, HRD-11, 6300 Georgetown Pike, McLean, Virginia 22101. Request Report No. FHWA/RD/80/016.

The Highway Safety Improvement Program (HSIP) User's Guide (FHWA Report No. FHWA-TS-81-218) also contains a description of statistical procedures and sample worksheets for conducting before/after evaluations.

EVALUATION RESOURCES

The process of experimental design and statistical analysis of behavioral or accident data is admittedly complicated. Often it will be helpful to obtain outside expertise. The following are several types of institutions/organizations/individuals who might be available within your locality.

Government Agencies

- Federal Highway Administration Regional Offices

- National Highway Traffic Safety Administration Regional Offices

  Regional officials are quite cognizant of the evaluation or statistical experts available within the region and will help guide you to adequate resources.

- Governor's Highway Safety Representative (see page 42)

  Although there may not be an evaluation expert on staff, they will tell you about existing resources.

Universities/Colleges

- Highway Research Centers and Traffic Safety Centers

  Several universities have transportation and/or highway centers experienced in either evaluation or accident analysis. Prominent examples are:

  Highway Safety Research Center, University of North Carolina
  Highway Safety Research Institute, University of Michigan
  Texas Transportation Institute, Texas A&M University
  Transportation Institute, Pennsylvania State University
  Highway Traffic Safety Center, Michigan State University
  Transportation Institute, Northwestern University
  Institute for Transportation and Traffic Engineering, University of California, Berkeley

Universities/Colleges (continued)

- Safety Departments

  Some universities have academic programs focusing on safety. The faculty usually will serve or can recommend individuals as consultants. The department may contract to perform evaluation services. Examples of these departments are:

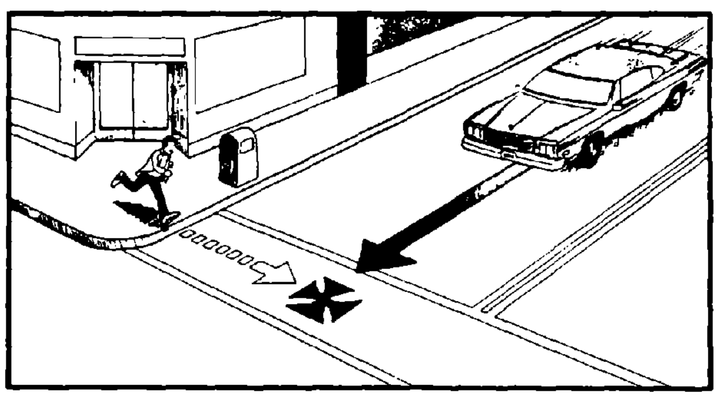
  Safety Department, Central Missouri State University
  Safety Center, University of Southern California

- Social Science Departments

  A school which offers training in human factors/engineering psychology/applied experimental psychology may have faculty who can aid in experimental design, data analysis, and behavioral performance measures. Individuals trained in quantitative psychology and with experience in applied research can assist in experimental design and statistical analysis.

- Consulting Firms or Individuals

  There are a number of companies with corporate and staff experience in evaluation or accident analysis. These organizations are best found by looking at current literature in the highway safety field. A similar statement applies equally to individual consultants. However you will most often find out about individuals by talking with regional officials or others intimately involved in highway safety.



STEP 6

MAINTAIN THE PEDESTRIAN SAFETY PROGRAM

The first five steps of the Model Pedestrian Safety Program have been presented:

- Step 1: Determine the Extent of the Pedestrian Safety Problem
- Step 2: Identify Alternative Solutions
- Step 3: Select the Best Alternative
- Step 4: Implement the Selected Alternative
- Step 5: Evaluate the Effectiveness of the Implemented Alternative.

These five steps do not end your safety program. A successful pedestrian safety program is a never-ending loop. Step 6 is not so much a definitive step as a feedback to Step 1. Although one or more problems may have been corrected with one cycle through the steps, other problem areas will continually flare-up. Only through continual watch will these be identified on a timely basis. Early detection can mean prompt reaction, keeping the problem at a minimal level.

There are few procedural differences between Steps 5 and 1. Although the discussion deals primarily with statistical aspects, the data used in the evaluative process in Step 5 are the same data used in Step 1 to identify the problem -- accident and behavioral analyses. This is useful because new problems might be detected during the process of evaluating the effects of a previously implemented facility. Also, the process of making a safer situation for pedestrians may have adverse effects on other traffic. Part of the evaluation-problem identification process is to check out possible unfavorable effects resulting from earlier implementations.

The complete safety program begins with a return to Step 1 and recycles through again and again. It must be realized, however, that this User's Guide cannot provide one of the prime elements of every effective safety program -- enthusiasm and commitment. These guidelines provide the what and the how. You must provide the initiative, the involvement, and the long-term interest to get the resources necessary to improve pedestrian safety.

RESOURCES

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GOVERNOR'S HIGHWAY SAFETY REPRESENTATIVES

AL Dept. of Economic & Community Affairs
Room 101, State Capitol
Montgomery, AL 36130
Phone: 205-284-6532

Department of Public Safety
Pouch N
Juneau, AK 99811
Phone: 907-465-4322

AZ Department of Transportation
3010 North Second Street
Phoenix, AZ 85006
Phone: 602-255-3216

AR Highway Safety Program
1 Capitol Mall, Suite 4B-215
Little Rock, AR 72201
Phone: 501-371-1101

Office of Traffic Safety
7000 Franklin Blvd., Suite 330
Sacramento, CA 95823
Phone: 916-445-0527

Division of Highway Safety
4201 East Arkansas Avenue
Denver, CO 80222
Phone: 303-757-9381

Office of Highway Safety
24 Wolcott Hill Road
Wethersfield, CT 06109
Phone: 203-566-4248

DE Office of Highway Safety
Thomas Collins Bldg, Suite 363
540 South duPont Highway
Dover, DE 19901
Phone: 302-736-4475

Department of Public Works
2000 - 14th St., N.W., 6th Floor
Washington, D.C. 20009
Phone: 202-939-8000

Department of Community Affairs
2571 Executive Center Circle, E.
Tallahassee, FL 32301-8244
Phone: 904-488-8466

Office of Highway Safety
959 East Confederate Avenue, S.E.
Atlanta, GA 30301
Phone: 404-656-6996

Department of Transportation
869 Punchbowl Street
Honolulu, HI 96813
Phone: 808-548-4655

ID Department of Transportation
3311 West State Street
Boise, ID 83707
Phone: 208-334-3887

Division of Traffic Safety
2300 South Dirksen Parkway
Springfield, IL 62764
Phone: 217-782-4972

Governor's Rep. for Highway Safety
State Capitol, Room 210
Indianapolis, IN 46204
Phone: 317-232-4578

Department of Public Safety
Wallace State Office Building
Des Moines, IA 50319
Phone: 515-281-5524

KS Department of Transportation
State Office Building, 7th Floor
Topeka, KS 66612
Phone: 913-296-3461

Kentucky State Police Headquarters
919 Versailles Road
Frankfort, KY 40601
Phone: 502-695-6300

Department of Public Safety
P.O. Box 66336, Capitol Station
Baton Rouge, LA 70896
Phone: 504-925-6991

ME Department of Public Safety
36 Hospital Street
Augusta, ME 04330
Phone: 207-289-2581

MD Department of Transportation
P.O. Box 8755
Baltimore-Washington International Airport, MD 21240-0755
Phone: 301-859-7397

Governor's Highway Safety Bureau
100 Cambridge Street, Room 2104
Boston, MA 02202
Phone: 617-727-5073

Office of Highway Safety Planning
300 South Washington Sq., Suite 300
Lansing, MI 48913
Phone: 517-373-8011

Department of Public Safety
211 Transportation Building
St. Paul, MN 55155
Phone: 612-296-6642

Governor's Highway Safety Program
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Jackson, MS 39203-3088
Phone: 601-949-2198

Division of Highway Safety
Truman State Office Building
Jefferson City, MO 65102-0749
Phone: 314-751-4161

GOVERNOR'S HIGHWAY SAFETY REPRESENTATIVES (Continued)

Highway Traffic Safety
303 North Roberts
Helena, MT 59620
Phone: 406-444-3412

Department of Motor Vehicles
301 Centennial Mall South
Lincoln, NE 68509
Phone: 402-471-2281

Department of Motor Vehicles
555 Wright Way, Room 258
Carson City, NV 89711
Phone: 702-885-5375

NH Highway Safety Agency
117 Manchester Street
Concord, NH 03301
Phone: 603-271-2131

Division of Motor Vehicles
25 South Montgomery Street
Trenton, NJ 08666
Phone: 609-292-4570

Sec. of NM Transportation Dept.
P.E.R.A. Building, Room 220
Santa Fe, NM 87503-1028
Phone: 505-827-4653

Swan Street Building
Empire State Plaza
Albany, NY 12228
Phone: 518-474-0841

Highway Safety Program
215 East Lane Street
Raleigh, NC 27601
Phone: 919-733-3083

State Highway Department
600 East Boulevard Avenue
Bismarck, ND 58505-0178
Phone: 701-224-2581

OH Department of Highway Safety
240 Parsons Avenue
Columbus, OH 43205
Phone: 614-466-3383

OK Highway Safety Office
200 N.E. 21st St., ODOT Building
Oklahoma City, OK 73105
Phone: 405-521-0019

OR Traffic Safety Commission
State Library Building, 4th Floor
Salem, OR 97310
Phone: 503-378-3669

PA Department of Transportation
1200 Transportation & Safety Bldg.
Harrisburg, PA 17120
Phone: 717-787-3928

State Office Building
Smith Street
Providence, RI 02903
Phone: 401-277-2481

Office of Highway Safety Programs
1205 Pendleton Street
Columbia, SC 29201
Phone: 803-734-0421

Office of the Governor
State Capitol Building
Pierre, SD 57501
Phone: 605-773-3546

TN Department of Transportation
505 Deaderick Street, Suite 700
Nashville, TN 37219
Phone: 615-741-2848

State Department of Highways
11th and Brazos
Austin, TX 78701
Phone: 512-475-3525

UT Department of Public Safety
4501 South 2700 West
Salt Lake City, UT 84119
Phone: 801-965-4461

Vermont Agency of Transportation
133 State Street
Montpelier, VT 05602
Phone: 802-828-2657

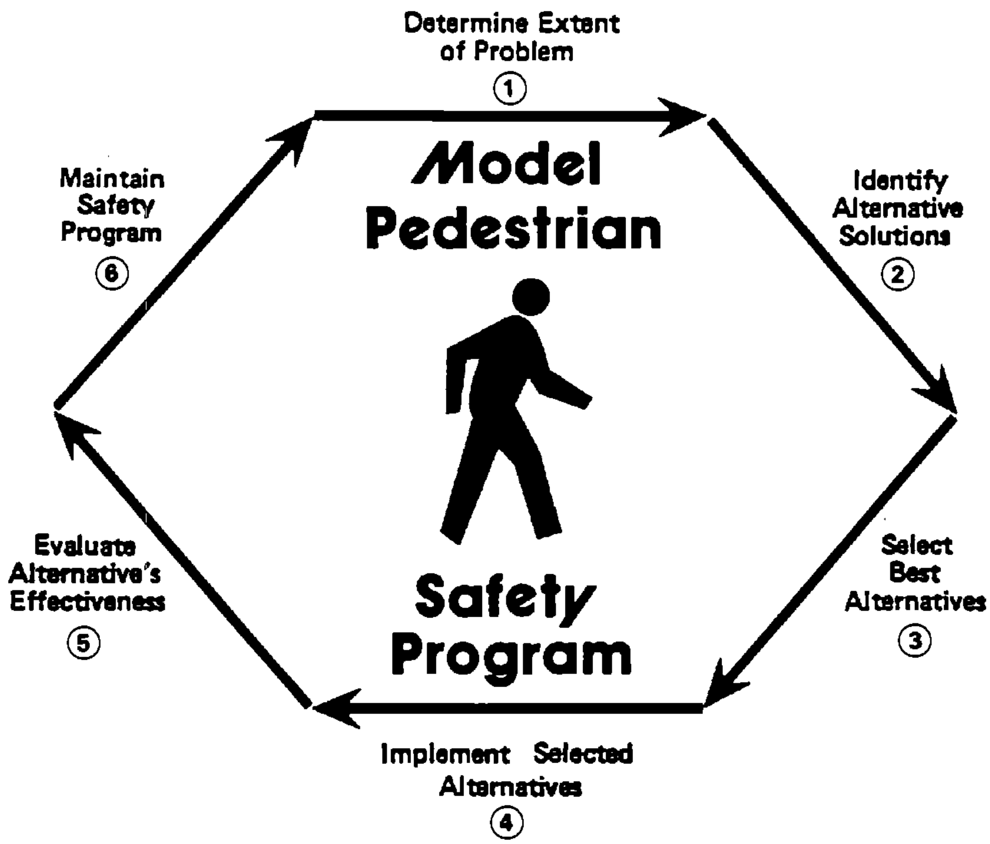
Division of Motor Vehicles
2300 West Broad Street
Richmond, VA 23269
Phone: 804-257-6602

Washington Traffic Safety Commission
1000 South Cherry Street, MS/PD-11
Olympia, WA 98504
Phone: 206-753-6197

Criminal Justice & Highway Safety Office
5790-A MacCorkle Avenue, S.E.
Charleston, WV 25304
Phone: 304-348-8814

WI Department of Transportation
4802 Sheboygan Avenue
Madison, WI 53702
Phone: 608-266-1113

Highway Safety Branch
P.O. Box 1708
Cheyenne, WY 82002-9019
Phone: 307-777-7296


Determine Extent of Problem
1
Model Pedestrian
Identify Alternative Solutions
2
Select Best Alternatives
3
Implement Selected Alternatives
4
Evaluate Alternative's Effectiveness
5
Maintain Safety Program
6
Safety Program