Traffic Safety Issues of the Future:
A Long Range Research Agenda

In collaboration with:

Federal Highway Administration
National Highway Traffic Safety Administration

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Acknowledgement

Contents

1. Introduction

To stimulate multi-disciplinary and multi-organizational thinking on traffic safety research issues, the AAA Foundation for Traffic Safety (AAAFTS), in cooperation with the Federal Highway Administration (FHWA) and the National Highway Traffic Safety Administration (NHTSA), sponsored a planning workshop at AAAFTS in Washington, DC on October 11-12, 2005. Over forty invited traffic safety researchers and practitioners attended (see Appendix E). The workshop's objectives were to identify and prioritize national long-term traffic safety research needs, with special emphasis on identifying gaps in existing research plans.

The workshop began with an overview of big-picture safety and mobility issues and trends by transportation generalist and futurist Alan Pisarski (the full agenda is included in Appendix D). Then three experts summarized their views of research needs and gaps in their areas of expertise: Doug Harwood for highway and environment, David Shinar for human factors, and Donna Nelson for vehicles. All four presentations are available on the AAAFTS website: http://www.aaafoundation.org/projects/index.cfm?button=FutureWorkshop.

Workshop participants were then divided into three interdisciplinary groups. Each group developed and prioritized a long-range, macro-level list of potential research areas ranging across all traffic safety areas. Workshop staff separated the priority recommendations by discipline: highway and environment, human factors, vehicles, and cross-cutting issues relevant to all three disciplines.

On the workshop's second day, participants worked in three breakout tracks by discipline. Participants first refined and re-prioritized their discipline's research area recommendations from the first day based on their experience and expertise. They also provided detail on the cross-cutting recommendations as appropriate. Their final research area recommendations are presented in the Research Priorities section of this report. The recommendations are presented in the following order:
1. Transcending issues that involve all three traffic safety disciplines.
2. Multi-disciplinary issues, for which more than one of the three disciplinary tracks provided recommendations.
3. Issues specific to each of the three disciplinary tracks: highway and infrastructure, human factors, and vehicles.

Finally, each group developed specific research project statements for their highest research priorities. These are found in the report's first three appendices. After the workshop, all participants reviewed a draft report and provided additional detail and clarification to these project descriptions. During this review process, participants added a few project descriptions that were not completed at the workshop itself due to time constraints.

Project sponsors and participants recognize that this report is not a complete discussion and that additional work is necessary to translate it into a form that can be implemented. For example, all of the cost estimates provided should be considered preliminary, because additional scoping of the proposed projects would be necessary to more accurately assess the budgets for each.

This report is intended to supplement current research projects and plans, not replace them. Its goal is to describe key research priorities that may not be addressed by existing projects and plans. Nonetheless, sponsors and participants believe that this report's research priorities and project descriptions provide an excellent starting point for all organizations interested in sponsoring or conducting traffic safety research. Sponsors and participants hope that the report will stimulate cooperative activities to plan and conduct the research that is necessary to improve traffic safety in the United States. The AAA Foundation for Traffic Safety intends to use the findings from this project in planning its future research agenda.

2. Background

Traffic safety progress in the United States has slowed considerably over the past dozen years. From 1992 to 2004, the traffic fatality rate dropped 17%, from 1.75 per 100 million vehicle miles of travel to 1.46, and traffic injuries dropped 9%. But total traffic fatalities increased by 9%. In contrast, over the previous dozen years from 1980 to 1992, the fatality rate dropped 48% and total traffic fatalities dropped 17%. In 2004, traffic crashes killed 42,636 persons, or 116 every day, almost 5 every hour, 1 every 12 minutes throughout the year. Traffic crashes injured 2,788,000 persons: 7,617 every day, 317 every hour, more than 5 every minute. The stated goal of the U.S. Department of Transportation is to reduce the rate of motor vehicle traffic fatalities to 1.0 per 100 million vehicle miles of travel by 2008. As of the date of the workshop, it appears unlikely that this goal will be achieved, and even if it were to be achieved, motor vehicle traffic crashes would still be killing roughly 30,000 people annually in the United States.

One key to reducing this toll is research, not just short-term research on specific countermeasures but also long-term, big-picture, cross-disciplinary research to investigate innovative traffic safety strategies. This research stretches across the agencies and organizations that deal with traffic safety. It involves all of them, but belongs to none.

In that context, it is important to note that the Transportation Research Board's Safety Working Group of the Strategic Partnership effort, in coordination with AASHTO, FHWA, NHTSA and others, hosted a National Safety Agenda Workshop in January of 2000. From that initial workshop, a series of other meetings and workshops were held that not only developed proposals for future research, but suggested a new institutional system to identify, plan, and manage traffic safety research in the country to ensure greater coordination and collaboration among all parties. Presently, that effort is continuing through a new TRB project titled, "Research Priorities and Coordination in Highway Infrastructure and Operations Safety." All of the future research plans identified through this TRB effort were explicitly considered and integrated into the planning for this workshop.

2.1. Societal forces and trends

Alan Pisarski's opening talk outlined several broad forces and trends that will affect transportation and traffic safety over the coming decades. Transportation use and modes influence and are influenced by the population's age distribution, income, education, and overall societal structure. As one obvious example, transportation depends on where people live and work. In 2000, 60% of the US population lived in the 50 "big metro" areas with over 1 million in

population, but the greatest growth is and will continue to be in the rural and suburban "donut" areas surrounding cities of all sizes. In the next 10 years, the US will have:

- another 30 million people, another 30 million vehicles, and another $3 trillion in GDP;
- changing work patterns with more women in the workforce, more "retirees" in part-time jobs, and more variable work and commuting schedules;
- continued concerns with congestion;
- more older drivers driving more miles; and
- more on-board technological devices in new vehicles, requiring both new knowledge and skills from their drivers and integration with older vehicles still on the road.

Private automobiles will continue to provide most trips for most people. For additional trends and issues, see Pisarski's full presentation on the AAAFTS website, http://www.aaafoundation.org/projects/index.cfm?button=FutureWorkshop.

The research to improve or even maintain traffic safety in light of these forces and trends requires broad, imaginative, cross-disciplinary, and long-term thinking. The workshop sought to stimulate this thinking and capture the results in a form that could be used by all interested organizations. It focused on long-term research: information that would be useful in about five years and with most specific projects having a three to five year timeframe. It sought to supplement and complement—not replace—existing research plans.

3. Research priorities

Workshop participants identified an extensive list of priority research issues in the first day's interdisciplinary groups and refined and re-prioritized these issues in the second days' track breakout groups. In each session, participants voted on priorities using the "10-4" decision tool in which each participant had 10 votes and could use as many as 4 votes on a single issue. All issues are listed in this section, in three categories. First, four broad issues transcend or are relevant to each of the three disciplinary tracks of highway and environment, human factors, and vehicles. At least two tracks provided specific research areas for each of these issues. Next, the issue of aging road users is critical to both the human factor and vehicle tracks. Finally, a number of issues were relevant to or addressed by only one of the tracks.

The first three appendices list each track's research areas determined on the second day, in the priority order determined by the track. Project descriptions for most high-priority research areas follow the priority lists in each appendix.

3.1. Transcending issues

Workshop participants identified four broad research areas that transcend or are relevant to all of the three traditional traffic safety disciplines of highway and environment, human factors, and vehicles. These four areas follow, with the specific research topics under each that were identified by the three tracks. Project descriptions for each topic marked with an asterisk (*) are found in the Appendices. Project descriptions were not prepared for the lower-priority topics marked with an (o).

Creating a safety culture. Everyone says that transportation safety is important, and almost nobody advocates policies that would reduce safety. But the public is not disturbed that over 40,000 men, women, and children die each year in traffic crashes and many more are seriously injured. Many do not support effective laws or enforcement and adjudication strategies such as reduced speed limits and red light cameras. When budget funds are allocated or laws and policies considered, transportation safety often is not a high priority among the public or decision makers at national, state, or local levels. Safety is often considered reactively, only after a safety problem is identified and quick solutions are demanded. Safety should be considered proactively, when transportation systems and components are designed and implemented. Research is needed into methods to create and enhance a safety culture.

- Highway and environment track:
  * Enhancing a safety culture at the local and state levels
  o Quantify impacts of safety at state, regional, and local level (economic, congestion, air quality, lives)
  o Report on safety improvements
  o Personalize safety
- Human factors track:
  * Create and validate a Safety Culture Index (SCI) for traffic safety
  * Acceptance, implementation, and diffusion of innovation
- Vehicle track:
  o Create a "market" for safety and safety technologies through public education and awareness programs

Crash causation. The more that is known about the causes of crashes, the more this knowledge can help develop and implement crash avoidance countermeasures. While much has been learned in recent decades, many questions remain, especially regarding human factors issues for which good data are difficult to obtain. Two tracks identified specific crash causation research issues. Vehicle track discussions focused more on crash avoidance and on mitigating the severity of those crashes that do occur.

- Highway and environment track:
  o Geometric design
  o Emerging issues
  o Location (GIS)
  o Pavement (friction) condition
  o Provide researchers with location of crashes
- Human factors track:
  * Distinguish causes by crash severity
  o Distinguish causes by driver demographics
  o Study near-crashes
  o Techniques for collecting on-scene crash data and evaluating data reliability and validity [see also the Data section, following]

Data. Good data are essential for good research. Good data are needed to track trends, define problems, study potential countermeasures, and evaluate countermeasure effectiveness. All three

tracks identified data needs of different types: crash data, exposure data, inventory data, and performance data.

- Highway and environment track:
  * Improve roadway-related inventory and operations data
  * Improve crash location data
  o Improve exposure data, including VMT by vehicle classification [see Human Factors topic below]
  o Data on unreported crashes
  o Link data bases
- Human factors track:
  * Develop exposure metrics
  * Roadway inventory - development of a comprehensive database
  * Nationally representative instrumented vehicle study
- Vehicle track:
  * On-board vehicle data: Identify data collection systems and recommend standards
  o Learn how to effectively utilize new safety-related information that will be generated by on-board vehicle systems

Countermeasure identification and evaluation. Countermeasures all too often are selected without a good understanding of the safety problem they are meant to address and without due consideration of alternative methods to address it. Once countermeasures are implemented, they frequently are not evaluated well, or at all. All three tracks identified specific research areas under this topic.

- Highway and environment track:
  * Conduct specific countermeasure evaluations
  o Improve evaluation methodology [see Human Factors evaluation projects]
  o Prioritize countermeasures that should be evaluated based on facility, driver, and vehicle changes [see Human Factors project on minimum standards]
  o Scoping study to identify new countermeasures
  o Develop new countermeasures
  o Bringing together practitioners and inventors
- Human factors track:
  * Identify and validate surrogate measures for traffic safety evaluations
  * Develop methods for identifying problems and selecting countermeasures
  * Identify minimum standards for acceptable and valid evaluations
  * Develop procedures for determining countermeasure lifecycle
  * Cost/benefit determination of countermeasures
- Vehicle track:
  o Technology evaluation
  o Technology to provide feedback on driver performance and assist in evaluating the effectiveness of behavioral countermeasures

3.2. Multi-disciplinary issue

Aging road users. The aging of the US population will have substantial impacts on traffic safety. Transportation and mobility are critical to both physical and mental health, yet aging

brings inevitable changes to physical and mental abilities. New technologies may help compensate, but also require new skills and habits.

- Human factors track:
  - * Older adult mobility: developing exposure data
  - * Self-assessment tools for older drivers
  - * Evaluation of remediation and rehabilitation programs for older drivers
  - * Transportation options for older adults
  - o Measurement of functional abilities related to driving (physical, cognitive, social)
  - o Gradual de-licensing of older drivers (reverse GDL)
  - o Driver-vehicle interface for older drivers [see last Vehicle suggested project]
- Vehicle track:
  - * Simulator study of older driver performance and adaptability
  - o Vehicle systems, technologies, and design to enhance older driver safety and mobility [see last Human Factors suggested project]

3.3. Additional highway and infrastructure track issues

Relationship of congestion and safety
- * Safety effects of congestion treatments
- o Problem identification study on safety effects of congestion, high and low speed
- o Effects of safety treatments on congestion, including secondary impacts (other six planning factors)
- o Develop safety index related to congestion, especially related to future VMT
- o Evaluate secondary impacts (other six planning factors) from safety

Run off road crashes
- * Evaluate road departure countermeasures and identify promising new countermeasures
- * Treatments to reduce tree-related crashes
- * Safety design for parallel drainage ditches
- o Roadside hardware warrants
- o Crash causation, especially rural [included under crash causation topic below]

Analysis tools for highway agencies and researchers
- * Safety analysis tools for the metropolitan planning level
- o Provide guidance on analyzing data from small samples
- o Tools to analyze the safety implications of planning decisions re allocation of VMT by functional class
- o Tools to analyze crash causation and other data
- o Tools to identify and validate surrogate safety measures
- o Improve evaluation methodology [covered by Human Factors projects in evaluation]
- o Guidance on asking the right question

Self-explaining roads
- * Evaluate safety of self-explaining roads
- o Analyze relationship of road (design) classification to vehicle speeds and operations
- o Synthesize existing work on self-explaining roads

Safety design and operations
- o Safety implications of changing vehicle fleet and mix
- o Scoping study [appears to fit under previous project]

Crash causation
- o Geometric design
- o Emerging issues
- o Location (GIS)
- o Pavement (friction) condition
- o Provide researchers with location of crashes

3.4. Additional human factors track issues

Young drivers
- * Develop theory-based driver education and training
- * Evaluate innovative driver education and training programs
- * Evaluate advanced on-road license tests
- * Intervention strategies for high-risk teen drivers
- * Determinants of risky driving behavior
- o Analytic techniques for assessing effects of GDL components
- o Age v. experience effects
- o Evaluate programs to increase teen safety belt use

Driver attention and distraction
- * In-vehicle gaze control
- * Measuring driver information overload
- o Relative risk of different distractions
- o Metrics for driver attention and distraction
- o Technological methods for directing driver attention
- o Impact of in-vehicle technologies and other distractions

Changing driver behavior through education and enforcement

Cognitive models

Impaired driving [see Vehicle suggested project under Alcohol-impaired Driving]

Occupant protection [see last Vehicle suggested project under Crashworthiness]

These final two issues - impaired driving and occupant protection - are crucial to improving highway safety. They were ranked low because of the extensive research already available. Progress can be made through implementation of programs based on existing research, and progress can be measured through short-term evaluations, but longer-term research is less critical than for the higher-ranked issues.

3.5. Additional vehicle track issues

On-board safety monitoring
   * Demonstration of driver behavior change by on-board safety monitoring

Vehicle-to-vehicle and vehicle-to-environment/infrastructure communications
   * Determine how vehicle-to-vehicle and vehicle-to-environment/infrastructure communication can be used to optimize traffic flow, reduce congestion, and improve safety (includes automated collision warning - crash notification systems)

Changes in vehicle fleet
   * Effects of vehicle size and type changes on safety and congestion (very small vehicles, SUVs, trucks)
   * Effects of vehicle design changes on safety (new fuels systems, materials)
   * Development of vehicle-based safety technologies

Crashworthiness
   * Occupant entrapment post-crash
   * Vehicle safety ratings
   * Far-side occupant protection
   o Lower extremity protection
   o Rollover and roof crush
   o Safety belts designed for pregnant women
   o Crash protection for older occupants
   o Vehicle compatibility issues

Public understand of vehicle safety and advanced technology systems
   * Educating drivers to use new safety technologies
   o Develop standardized test protocols to assess safety benefits or risks of vehicle design features and potential safety systems

Alcohol-impaired driving
   * Assess the feasibility and efficacy of in-vehicle non-invasive alcohol monitors and interlocks

In-vehicle system design to minimize distraction

Post-crash management
   * Rapid notification of crash, transmission of crash details to emergency responders
   * Policies, procedures, and tools for emergency responders to deal with hybrid and alternative-fuels vehicles

Collision warning [included in Vehicle-to-vehicle topic above]

Pre-emptive adaptive crashworthiness

APPENDICES

Appendix A: Highway and infrastructure research priorities and projects

All the priority research areas identified by the highway and infrastructure track are listed below, in approximate priority order, using the prioritization process described in the text. Specific research topics are listed for each of the research areas. Project descriptions for the highest-priority topics are found on the pages indicated in parenthesis after their titles.

Relationship of congestion and safety
  * Safety effects of congestion treatments (12)
  o Problem identification study on safety effects of congestion, high and low speed
  o Effects of safety treatments on congestion, including secondary impacts (other six planning factors)
  o Develop safety index related to congestion, especially related to future VMT
  o Evaluate secondary impacts (other six planning factors) from safety

Run off road crashes
  * Evaluate road departure countermeasures and identify promising new countermeasures (14)
  * Treatments to reduce tree-related crashes (16)
  * Safety design for parallel drainage ditches (18)
  o Roadside hardware warrants
  o Crash causation, especially rural [included under crash causation topic below]

Better data
  * Improve roadway-related inventory and operations data (20)
  * Improve crash location data (22)
  o Improve exposure data, including VMT by vehicle classification
  o Current performance of inventory elements [probably fits under first project]
  o Condition and performance report [probably fits under first project]
  o Historical changes of facility and inventory elements [probably fits under first project]
  o Unreported crashes
  o Link data bases

Creating a safety culture
  * Enhancing a safety culture at the local and state levels (24)
  o Quantify impacts of safety at state, regional, and local level (economic, congestion, air quality, lives)
  o Report on safety improvements
  o Personalize safety

Analysis tools for highway agencies and researchers[†]
 * Safety analysis tools for the metropolitan planning level (25)
 o Provide guidance on analyzing data from small samples
 o Tools to analyze the safety implications of planning decisions re allocation of VMT by functional class
 o Tools to analyze crash causation and other data
 o Tools to identify and validate surrogate safety measures
 o Improve evaluation methodology [covered by Human Factors projects in evaluation]
 o Guidance on asking the right question

Self-explaining roads
 * Evaluate safety of self-explaining roads (27)
 o Analyze relationship of road (design) classification to vehicle speeds and operations
 o Synthesize existing work on self-explaining roads

Countermeasure identification and evaluation
 * Conduct specific countermeasure evaluations (28)
 o Improve evaluation methodology [see Human Factors evaluation projects]
 o Prioritize countermeasures that should be evaluated based on facility, driver, and vehicle changes [see Human Factors project #3 on minimum standards]
 o Scoping study to identify new countermeasures
 o Develop new countermeasures
 o Bringing together practitioners and inventors

Safety design and operations
 o Safety implications of changing vehicle fleet and mix
 o Scoping study [appears to fit under previous project]

Crash causation
 o Geometric design
 o Emerging issues
 o Location (GIS)
 o Pavement (friction) condition
 o Provide researchers with location of crashes

[†] Participants in this track also noted several ongoing efforts related to the development of analysis tools for highway agencies and researchers. These included the development of *SafetyAnalyst*, *the Interactive Highway Safety Design Model* (IHSDM), the *Highway Safety Manual*, and also ongoing pilot projects of the *U.S. Road Assessment Program* (usRAP). It was noted that longer-term research might be needed in some or all of these areas; however, they were not discussed further during the workshop due to the workshop's emphasis on identifying research gaps as opposed to ongoing work.

Track: Highway and infrastructure

Research area: Relationship of congestion and safety

Proposed Project: Safety effects of congestion treatments

Background: The relationship between congestion and safety is poorly understood. It seems unusual that, with some much of the highway system, especially in urban areas, operating at high levels of congestion during significant portions of the day, the safety implications of this congestion have not been quantified. Does congestion lead to higher crash rates, because there are so many vehicle-vehicle interactions, or to lower crash rates, because speeds are often slower during congested periods. At the very least, we need a fundamental understanding of the safety differences between periods with no congestion; with substantial but undersaturated congestion, which might be referred to as high-speed congestion; and with oversaturated stop-and-go congestion, which might be referred to as low-speed congestion. We also need a better understanding of the future changes in safety that are likely to occur over the years as VMT grows. A broad range of facility types should be addressed. And, in addition, the safety effects of specific congestion-reduction treatments should be quantified.

Objectives:
- Determine how congestion treatments effect safety
- Examine all types of roadways, including intersections, interchanges, road segments
- Provide guidance to highway agencies

Methods:
- Perform before-after evaluations, using empirical Bayes other methods, to evaluate safety effects of such treatments as HOV/HOT lanes, ramp metering/main line meter/side road consequences, part-time shoulder use, transit effects, truck lanes, bypass lanes, intersection approach widening, innovative interchange design, innovative intersection design, ITS strategies, TCDs
- Determine current level of safety problems at various congestion treatments to justify research and potential changes in treatments
- Perform cross-sectional analyses to determine safety performance for groups of similar facilities during several times of the day when differing levels of congestion are present

Likelihood of Success: High

Potential Impact of Successful Project: Provide highway agencies with guidance on the safety impacts on various congestion treatments and allow for improved decision-making and prioritization of treatments. Provide a better basic understanding of the relationship between congestion and safety.

Timeframe: 5 years

Cost Estimate: $ 5-10 M

Cross-cutting Issues:
- Human factors
- Data
- Countermeasure identification and evaluation
- Vehicle types

Track: Highway and infrastructure

Research area: Run off the road crashes

Proposed Project: Evaluate road departure countermeasures and identify new countermeasures

Background: Better estimates of the safety effectiveness of road departure countermeasures are needed, including both roadside design and roadside hardware improvements. Specific countermeasure safety effectiveness estimates should be developed and safety data should be used to improve existing cost-effectiveness analysis tools, such as the Roadside Safety Analysis Program (RSAP). Fundamental research is needed on the effectiveness of roadside design improvements for safety including design alternatives for trees in hazardous locations and the shape of roadway ditches, for which separate statements have been developed. New countermeasures should be developed and tested.

Objectives:
1. Develop a methodology for prioritizing which existing roadway departure countermeasures to evaluate. (Phase I–A)
2. Develop a methodology for identifying promising areas that could be addressed by new countermeasures. (Phase I-B)
3. Conduct the needed evaluations based on the priorities established in Phase I-A.
4. Identify the gaps using methodology from Phase IB and propose new countermeasures. (Phase II-B)

Methods:
1. Identify existing countermeasures to prioritize for evaluation.
2. Prioritize them based on key criteria such as:
    a. the magnitude of the problem each countermeasure will address
    b. the potential safety impact of each countermeasure
    c. data availability
    d. cost of each countermeasure
3. Design an evaluation program of selected countermeasures
4. Conduct the evaluations using state-of-the art statistical methods.
5. Identify emerging safety issues to help in the development of new roadway departure countermeasures.
6. Identify new countermeasures and develop a plan for their evaluation.

Likelihood of Success: Medium

Potential Impact of Successful Project: The impact could be quite significant given run-off-the-road crashes make up "x" number of fatalities and injuries.

Timeframe:
Evaluation of existing countermeasures – 5 to 10 years
Development of new countermeasures – 5 to 10 years

Cost Estimate:
        Evaluation of existing countermeasures – $4 to $6 million
        Development of new countermeasures – $2 million

Cross-cutting Issues:

Track: Infrastructure

Research area: Run off the road crashes

Proposed Project: Develop and evaluate treatments to reduce tree-related crash injuries

Background: Impacts with trees along roadsides are a significant safety issue, particularly on rural two-lane roads. FARS data from 2004 on single-vehicle crashes on non-Interstate roads indicates that over 3600 fatal crashes involve a tree in the "most harmful event." Additional tree-related crashes occur even on Interstate roads, with over 500 fatal tree-related fatal crashes occurring on rural and urban Interstates in 2004. The issue is also a significant environmental, aesthetic and roadway-user issue in that people like trees, want them planted for beautification reasons, and do not like seeing them removed. *NCHRP Series 500, Volume 3: A Guide for Addressing Collisions with Trees in Hazardous Locations* describes the issue in detail and provides a series of low-cost treatments. However, even for the treatments that are described as "proven," specific Accident Modification Factors (AMFs) are either not presented, not specific to trees, or based on only one state's experience. It may also be possible to expand the strategies provided there with more detail. For example, the initial strategy involving the development of "planting guidelines to prevent placing trees in hazardous locations" could possible be expanded by research aimed at identifying region-specific tree species that will meet the public's beautification demands but not grow trunks so large that they become hazardous for the prevailing travel speeds on a given facility type (e.g., high-speed rural roads vs. lower speed suburban arterials). In addition, there is limited research supporting the position that trees in medians, which provide shade and other aesthetic value, may also reduce speeds and thus possibly reduce crashes and crash severity. This research needs to be validated or replicated, and guidelines developed which "balance" the safety effects of a possible speed reduction with the safety disbenefits of increased tree impacts.

Objectives:
1. Supplement the existing tree-related treatments with new additions.
2. Evaluate both existing and new strategies in crash-based before/after evaluations.
3. Further research the issue of speed-reduction capabilities of trees in medians and along roadsides of suburban arterials
4. Modify NCHRP and other guidance based on the research findings.

Methods:
1. Examine the currently proposed tree-related strategies and developed additional treatments (e.g., "crash-friendly" tree species).
2. In the identification of species, use computer simulation (e.g., dynamic finite element modeling) to define the descriptors of such "crash-friendly" trees (e.g., tree density, maximum trunk diameter, number of trunks per square meter, etc.). Provide this material to arborists who can then define species for different parts of the US.
3. Conduct before/after evaluations of treatments found in NCHRP Series 500, Volume 3 and any additional treatments identified in step 1 above. These should include evaluations of:
   a. Tree planting guidelines implemented recently in some jurisdiction

  b. Tree shielding through use of guardrail
  c. Tree removal (reexamine and validate/supplement Pennsylvania AMF)
  d. Tree delineation (e.g., see Pennsylvania experience in Volume 3 Guide)
4. If successful, develop guidelines for tree planting, maintenance, removal, shielding and delineating and submit to AASHTO for approval and dissemination

<u>Likelihood of Success</u>: The likelihood of defining species should be high. The likelihood of sound evaluations of tree-related treatments is judged to be medium to high and will depend on finding suitable samples of treatment locations with historic crash, inventory and traffic data.

<u>Potential Impact of Successful Project</u>: The impact could be quite significant. Based on 2004 FARS data, over 3,500 tree-related fatal crashes occur annually in the US – approximately 29% of all fatal single-vehicle crashes.

<u>Timeframe</u>:
  Supplementing existing treatments – 0.5 years
  Computer simulation and species definition – 1 year
  Crash-based evaluation of treatment strategies – 3 years (assuming treatments in place by 2004)

<u>Cost Estimate</u>:
  Documentation and simulation – $100,000 - $200,000
  Crash-based evaluations – $300,000 per evaluation

<u>Cross-cutting Issues</u>:
- Countermeasure identification and evaluation

<u>Track</u>: Infrastructure

<u>Research area</u>: Run off the road crashes

<u>Proposed Project</u>: Develop a safety design for parallel drainage ditches

<u>Background</u>: Roadside ditches are an often-struck feature in run-off-road crashes, particularly on rural two-lane roads. The vehicle is either stopped by the ditch (sometimes overturning) or continues past the ditch (or vaults over it) and strikes whatever is behind it. While there has been some research on better design for large drainage ditches (i.e., essentially research on fore- and backslope design), there has been little or none on the smaller "normal" ditches seen on most rural two-lane and multi-lane roads. The ditch design is basically established by drainage needs with little thought given to safety.

<u>Objectives</u>:
1. Attempt to develop a safer ditch design for these small, parallel ditches, one that would do a better job of "capturing" the errant vehicle and stopping it at acceptable deceleration rates.
2. Develop designs that would "protect" the predicted future passenger vehicle population (e.g., include pickup trucks and SUVs). Note that at this point, it is not envisioned that this project would include large trucks.
3. Develop alternative designs if needed for different soils and drainage needs in different parts of the US (e.g., tires interact differently with sandy soils vs. clay soils).

<u>Methods</u>:
1. Document the current "standard" designs used and the distribution of drainage requirements
2. Using computer simulation (e.g., dynamic finite element modeling), develop and explore alternative designs for different vehicle classes
3. Crash test the most promising designs
4. If successful, develop guidelines for safer ditch designs and submit to AASHTO for approval and dissemination

<u>Likelihood of Success</u>: Medium to High (will depend to a large extent on the ability to simulate different soil types and the interaction with tires).

<u>Potential Impact of Successful Project</u>: The impact could be quite significant. Based on 2004 FARS data, of the 15,800 single-vehicle fatal crashes on non-interstate rural roads, approximately 80% could *possibly* involve roadside ditches. The majority of the "most harmful events" in these crashes are rollovers (57%) and impacts with trees (29%) and utility poles (6%).

<u>Timeframe</u>:
       Documentation and simulation – 1 year
       Crash testing and final designs – 1 year

<u>Cost Estimate</u>:

Documentation and simulation – $200,000 - $300,000
Crash testing and final designs $300,000

Cross-cutting Issues:
- Countermeasure identification and evaluation
- Vehicle types

Track: Highway and infrastructure

Research area: Better data

Proposed Project: Improve roadway-related inventory and operations data

Background:

Objectives:
1) Define the list of "critical" non-crash data elements that states and municipalities should collect and maintain; describe each critical variable.
2) Develop performance measures for the collection and storage of these elements,
3) Identify technologies that may be used in acquiring these data elements.
4) Develop an inventory of non-traditional safety data sources that may be accessed to acquire these data elements.

Background: See research statement submitted to NCHRP for additional detail.

Methods:
1. Compile a comprehensive list of potential "critical" non-crash data elements.
2. Develop and apply a methodology to rank the potential elements by "level of criticality" based on such factors as current and anticipated future safety program needs within state and local DOTs, data needs for current and anticipated research analysis tools, and use of the data in other safety research.
3. Develop definitions for each of the data elements included in the Task 2 list, including both "minimum" and "recommended" data description or data codes.
4. Convene a workshop of practitioners to review and discuss the critical element list and definitions. Include individuals from appropriate AASHTO committees.
5. Revise the list and definitions on the basis of feedback.
6. Develop performance measures for data collection and storage.
7. Survey state and municipal agencies to determine potential sources for these data. Include asset management systems and other non-traditional data sources.
8. Identify technologies that may be used to acquire the data elements. Begin with the NCHRP Synthesis 36-03, *Technologies for Improving Safety Data*, report.
9. Submit draft final report; revise final report based on comments.

Likelihood of Success: High

Potential Impact of Successful Project: These data are critical to planning and implementation of safety programs in all state and local DOTs as well as to safety research and countermeasure evaluation.

Timeframe: 30 months

Cost Estimate: $350,000

<u>Cross-cutting Issues</u>: These data will allow better safety research on crash and injury "risk" as a function of roadway design features. With appropriate exposure data they could also be used to study crash and injury for specific driver or vehicle types.

Track: Highway and infrastructure

Research area: Better data

Proposed Project: Improve crash location data

Background: Sound safety analyses depend on good crash data, and locating crashes is one of the most important yet challenging aspects of providing these data. Many would agree that much is left to be desired with regard to the quality, consistency and comprehensiveness of crash location data on many of the nation's highways. While lack of resources is often accepted as the most challenging barrier, many technical and institutional issues remain as impediments to improvement. These issues would seem to warrant further research or at least synthesis of best practice to benefit those jurisdictions where gaps in data or questions of quality remain.

Collection, processing, quality control and assimilation of crash location is expensive. Many models exist for the process. Several methods are used in various states and range from automatic collection of geographic coordinates using GPS or smart maps in the field (e.g., TraCS Location Tool) to manual transcription of literal crash descriptions from paper crash forms into route-milepoint or other linear referencing methods in a central location. With millions of crashes annually in the US, the time spent determining crash location will always require significant resources. The principal research question remains: "Which is the most efficient and effective method or set of methods?" This depends to a large extent on the following factors:

- crash location and analysis needs in the state
- availability of computing resources in the field and office
- training (cost and priority)
- the need for consistency in procedure and scope across jurisdictions
- need for timely crash data
- crash reporting thresholds and consistency
- availability, consistency quality and timeliness of attributed cartography (base map) and linear referencing *system* (not method) available in the state

 Editing and post-processing of crash location are also significant issues. For example, crashes located with GPS alone may not overlay existing cartography or may be referenced to the wrong road or highway element. Further, GPS coordinates collected near the crash scene represent the technology's best estimate of the location of the GPS receiver, not necessarily the crash location. Crash location itself may be defined as where the crash started or where it ended up – and this is complicated by the involvement of multiple vehicles or traffic congestion at the scene. Smart maps may be better suited to address some of these concerns, but come with their own set of training and resource challenges. And if crashes are not digitally located in the field, there is generally a greater chance for error the farther down the line crash locations are obtained.

Even with the acceptance and use of advanced technologies such as GPS and smart maps, and increasing resources available for locating crashes, it is likely that hybrid automated and manual methods will remain for many years to come.

Objectives: Research is suggested to examine the implications of inconsistency in crash location methods on analysis and to synthesize information on best practice so that solutions may be recommended and consensus developed regarding the improvement of crash location data.

Methods: The major challenge in this work is that, while there are existing technologies that can provide better crash locations, many agencies do not have the funds and other resources to take advantage of these technologies. However, there is no consensus about which technologies are best. The research will focus on developing such a consensus and on assessing whether lower cost technologies can be developed that would achieve more widespread use. The research will identify and describe all crash location technologies in current use and work with agencies using each technology to document best practices. A workshop, focus group, or expert panel may be needed to provide guidance for the assessment.

Likelihood of Success: High with respect to reaching consensus on best practices; Moderate with respect to developing lower cost practices.

Potential Impact of Successful Project: The project has the potential to improve the accuracy of crash location data throughout the U.S. More accurate crash location data is a key to effective programming of site-specific safety improvements.

Timeframe: 2 years

Cost Estimate: $500,000

Cross-cutting Issues:
    Multijurisdictional considerations
    New technologies

Track: Highway and infrastructure

Research area: Creating a safety culture

Proposed Project: Enhancing a safety culture at the local and state levels

Background: It is presumed, although not proven, that safety can be improved most successfully in highway agencies at both the state and local levels that have a strong safety culture. The safety community can readily identify highway agencies with strong safety cultures, but there has been little research about how to introduce a strong safety culture in an agency that does not have one. Part of improving the safety culture of an agency may involve quantifying the impacts of safety at state, regional, and local levels relative to other issues that stakeholders value including congestion reduction, air quality, economic growth, and quality of life.

Objectives: Identify successful practices employed at the state and local levels to get legislators, agency personnel, and other decisionmakers and policymakers to embrace highway and traffic safety

Methods:
- Identify state and local persons and groups who have done this
- Identify and document "best practices"
- Prepare full case studies, including on-site visits, for the categories below:
  - Local government elected officials
  - Local government staff
  - State legislators
  - State agency staff (multi-level and multi-disciplinary)
  - State DOT management
- Identify other potential approaches in areas such as public relations, marketing, etc. that might be adaptable in modifying public officials' perception of safety
- Prepare and publish synthesis

Likelihood of Success: Fairly high, as we believe there are identifiable "success stories"

Potential Impact of Successful Project: Big. Possible long-term change in culture and practice.

Timeframe: 12 months

Cost Estimate: $75,000 - $100,000

Cross-cutting Issues: This potentially could impact all areas of highway safety.

Track: Highway and infrastructure

Research area: Analysis tools

Proposed Project: Safety analysis tools for the metropolitan planning level

Background: The recent years have seen a heavy focus of the metropolitan planning process, as prompted by Congressional mandates, on air quality issues. More recently the Congress has begun to mandate shifts in focus again on areas of past activity such as economic development and safety. Metropolitan Planning Organizations (MPOs) are not well prepared to undertake these new requirements.

Research needs to be undertaken to assess the needs of MPOs for assistance in developing their capabilities to make project evaluations in the safety area. A package of tools to be employed by the MPOs would be very desirable. It should permit:

- o   Identification of key safety projects and programs; infrastructural and other
- o   Identify and assess project and program costs
- o   Identify and assess project and program benefits
- o   Identify key data issues and needs

A key concern is to produce that body of material and support that will permit MPOs to make benefit/cost based decisions comparing safety projects side by side with air quality, congestion and other MPO mandated interest areas.

Large MPOs those serving metropolitan areas of over five million population, about twelve in all representing a third of the nation, are probably well-served with staff, but will still need training and support. Those with over one million in population, about 40, will be less effectively served and will need broader support. Those with population under a million, several hundred in number, will have limited staffs and will need the greatest support and assistance. One avenue of assistance will be through the states, especially for those metropolitan areas with populations under one million.

Objectives: The objective of the proposed research is to determine the needs of MPOs for developing their capabilities to identify the needs for projects and to assess the likely costs and benefits of projects in the safety area.

Methods: The research should work with MPOs to define their needs in the safety analysis area and to recommend an approach to meeting those needs. The research might be continued with the development of training materials or analytical tools for use by MPOs. Alternatively existing tools such as FHWA's *SafetyAnalyst* software tools for safety management of specific highway sites and FHWA's Interactive Highway Safety Design Model (IHSDM) might be adapted for application to roads at the metropolitan level.

Likelihood of Success: High

Potential Impact of Successful Project: The project could improve the consideration given to safety in project-level decisionmaking at the metropolitan level.

Timeframe: 18 months

Cost Estimate: $200,000 for needs assessment; $200,000 to 500,000 for development of training materials and tools based on the results of the needs assessment

Cross-cutting Issues:
Multijurisdictional coordination
Multimodal considerations

Track: Highway and infrastructure

Research area: Self-explaining roads

Proposed Project: Evaluate safety of self-explaining roads

Background: European highway agencies have been very active in developing the concept of self-explaining, self-enforcing roads. Such roads are designed to encourage operating speeds that are consistent with the speeds intended by the designer. NCHRP Project 15-25 is considering alternatives for modifying the design speed concept as applied in AASHTO policy to the design of roads in the U.S. One of the alternatives under consideration would incorporate aspects of the European concept of self-explaining, self-enforcing roads, which may incorporate geometric elements such as narrower lanes, narrower shoulders, or sharper curves to encourage low speeds. Before this concept can be fully accepted for application in the U.S., highway agencies will want assurance that such roads can be operated safety.

Objectives: Conduct a safety evaluation to assess the safety performance of self-explaining roads in the U.S.

Methods: Perform a before-after evaluation of demonstration projects built by U.S. highway agencies to implement the self-enforcing roads concept. The evaluation could use the Empirical Bayes method or another relevant method. The project should include a synthesis of international experience with self-explaining roads and related U.S. experience.

Likelihood of Success: Moderate

Potential Impact of Successful Project: A successful project could lead to wider implementation of self-enforcing roads and would demonstrate the ability of highway agencies to design for lower speeds on highways where that is appropriate. Even a project that found negative safety effects for self-enforcing roads would provide valuable information for the design process.

Timeframe: 4 years

Cost Estimate: $500,000 (not including the construction cost of the demonstration projects which would be paid by the highway agencies that own them)

Cross-cutting Issues:
Speed control
Driver speed choices
Design speed criteria

Track: Highway and infrastructure

Issue: Countermeasure identification and evaluation

Proposed Project: Conduct specific countermeasure evaluations

Background: One of the greatest needs in infrastructure safety management is to have better measures of the safety effectiveness of specific countermeasures, including geometric design and traffic control improvements. It is not possible to make rational decisions about whether and where specific countermeasures should be installed unless reliable, quantitative estimates of the safety effects of those countermeasures are available. Two major initiatives for countermeasure evaluation, with substantial resources, have been planned. FHWA has begun a pooled-fund effort to evaluate countermeasures from the Phase I guides in the NCHRP Report 500 series. The planned funding level for this effort is $4.5 million. The plans for the safety component of the Future Strategic Highway Research Program (F-SHRP) include funding of $15 million for countermeasure evaluation. However, both of these planned efforts are in danger of being reduced in scope or eliminated because of research budget cuts in the recent SAFETEA-LU legislation.

Objectives: Assure that the countermeasure evaluations planned in the FHWA pooled-fund study and in F-SHRP are conducted.

Methods: The countermeasure evaluation should, to the maximum possible extent, be conducted as before-after evaluations using the Empirical Bayes method or other related methods.

An important part of the research should be to prioritize the countermeasures for evaluation based on their anticipated effectiveness and other factors; while anticipated effectiveness may be based on judgment, and is not necessarily scientifically based, a professional assessment of the potential for each countermeasure may be the best approach to setting priorities. The results of the evaluations should be used in planning safety improvement programs and in anticipating the effects of future facility, driver, and vehicle changes on safety.

Likelihood of Success: High, if sufficient funds are available to evaluate a substantial number of countermeasures.

Potential Impact of Successful Project: This project, or series of projects, has the potential to greatly improve the ability of highway agencies to select the most appropriate improvement types for specific locations and to better anticipate the level of benefits that should be expected from specific projects.

Timeframe: 5 years

Cost Estimate: $19.5 million (already planned but in danger of being reduced or eliminated)

Cross-cutting Issues:

Appendix B: Human factors research priorities and projects

All the priority research areas identified by the human factors track are listed below, in approximate priority order, using the prioritization process described in the text. Specific research topics are listed for the highest priority research areas. Project descriptions for the highest-priority topics are found on the pages indicated in parenthesis after their titles.

Countermeasure identification and evaluation
* Identify and validate surrogate measures for traffic safety evaluations (31)
* Develop methods for identifying problems and selecting countermeasures (32)
* Identify minimum standards for acceptable and valid evaluations (33)
* Develop procedures for determining countermeasure lifecycle (34)
* Cost/benefit determination of countermeasures (35)

Data, including exposure and road inventory
* Develop exposure metrics (36)
* Roadway Inventory - development of a comprehensive database (37)
* Nationally representative instrumented vehicle study (38)

Creating a safety culture
* Create and validate a Safety Culture Index (SCI) for traffic safety (39)
* Acceptance, implementation, and diffusion of innovation (40)
o Research into the social psychology of driving

Young drivers
* Develop theory-based driver education and training (41)
* Evaluate innovative driver education and training programs (42)
* Evaluate advanced on-road license tests (43)
* Intervention strategies for high-risk teen drivers (44)
* Determinants of risky driving behavior (45)
o Analytic techniques for assessing effects of GDL components
o Age v. experience effects
o Evaluate programs to increase teen safety belt use

Aging road users
* Older adult mobility: developing exposure data (47)
* Self-assessment for older drivers (48)
* Evaluation of remediation and rehabilitation programs for older drivers (49)
* Transportation options for older adults (50)
o Measurement of functional abilities related to driving (physical, cognitive, social)
o Gradual de-licensing of older drivers (reverse GDL)
o Driver-vehicle interface for older drivers [see last Vehicle suggested project under Aging Driver Population]

Driver attention and distraction
   * In-vehicle gaze control (51)
   * Measuring driver information overload (52)
   o Relative risk of different distractions
   o Metrics for driver attention and distraction
   o Technological methods for directing driver attention
   o Impact of in-vehicle technologies and other distractions

Crash causation
   * Distinguish causes by crash severity (53)
   o Distinguish causes by driver demographics
   o Study near-crashes
   o Techniques for collecting on-scene crash data and evaluating data reliability and validity

Self-explaining roads; designing roads for drivers [see Highway projects under this topic]

Changing driver behavior through education and enforcement

Cognitive models

Impaired driving [see Vehicle suggested project under Alcohol-impaired Driving]

Occupant protection [see last Vehicle suggested project under Crashworthiness]

<u>Track</u>: Human factors

<u>Research area</u>: Countermeasure identification and evaluation

<u>Proposed Project</u>: Identify and validate surrogate measures for traffic safety evaluations (not limited to impaired driving and occupant protection)

<u>Background</u>: Crash rates are affected by too many factors to be easily used. Some measures have gained recognition as valid countermeasures such as observations of DWI, belt use, and speeding. There is a need to better define these (i.e., what rates are most appropriate for each) and try to identify additional measures.

<u>Objectives</u>:
- Identify candidate measures (e.g. seat belt use)
- Validate measures

<u>Methods</u>:
- Literature review and synthesis (including international literature)
- Use expert panel to identify additional surrogates not identified in literature
- Do small-scale testing of surrogates

<u>Likelihood of Success</u>: High

<u>Potential Impact of Successful Project</u>:
- Will contribute to knowledge about effectiveness of countermeasures
- Will increase quality and availability of evaluations

<u>Timeframe</u>: 2 years

<u>Cost Estimate</u>: $200,000 - $500,000 for 4-6 surrogate measure evaluations plus literature review

<u>Cross-cutting Research areas</u>: This is a cross-cutting topic that is relevant to both vehicle and environmental research areas.

Track: Human factors

Research area: Countermeasure identification and evaluation

Proposed Project: Develop methods for identifying problems and selecting countermeasures

Background: Problem identification is often an art more than a science. It is therefore worth exploring the potential for a more structured process for problem identification, such as crash data analysis, consumer complaints, predicting problems as a consequence of changes in the social, legal, infra-structure, or vehicle environment.

Objectives: Develop methods regionally and nationally for identifying problems and selecting countermeasures

Methods:
- Develop methodology to identify problems and assess capabilities for implementing countermeasures
- Validate through program assessments and expert opinions

Likelihood of Success: Variables across states

Potential Impact of Successful Project: Improvements in countermeasure selection in some (many?) states

Timeframe: 2-3 years

Cost Estimate: $200,000 - $500,000

Cross-cutting Research areas:

<u>Track</u>: Human factors

<u>Research area</u>: Countermeasure identification and evaluation

<u>Proposed Project</u>: Identify minimum standards for acceptable and valid evaluations

<u>Background</u>: Evaluation research is a term that is often very loosely defined. Consequently, many reviews that attempt to synthesize the research literature note that inadequacy of many studies, to the point of making them worthless. This project is designed to identify key components that should be included in every evaluation study to assure its validity.

<u>Objectives</u>: Determine evaluation design and measures that will lead to acceptable and valid program evaluation

<u>Methods</u>:
- Conduct literature review of evaluation designs and measures
- Coordinate with surrogates research project
- Develop criteria for a Cochrane review of evaluation design and measures
- Take results and turn into minimum standards for evaluation

<u>Likelihood of Success</u>: Very high

<u>Potential Impact of Successful Project</u>: Uncertain

<u>Timeframe</u>: 1 year

<u>Cost Estimate</u>: $100,000

<u>Cross-cutting Research areas</u>:

Track: Human factors

Research area: Countermeasure identification and evaluation

Proposed Project: Develop procedures for determining countermeasure lifecycle

Background: It is obvious that 100% compliance will never be achieved with any countermeasure (e.g. belt use). Furthermore, the higher the starting rate of the countermeasure, the more difficult it is to affect a significant positive change. This project will try to define maximum levels that are practical to strive for and the cost/benefit associated with increase in compliance relative to different starting benchmarks.

Objectives:
1. Develop procedures to determine the point at which countermeasure/project has achieved maximum result
2. Determine incremental cost/benefit of continuation of program
3. Determine what is needed to successfully maintain countermeasure

Methods:
- Do case studies of real countermeasures
- Develop evaluation methodology based on case studies
- Develop guidance based on methodology

Likelihood of Success: Potentially very high

Potential Impact of Successful Project: Uncertain

Timeframe: 2-3 years

Cost Estimate: $200,000 - $300,000

Cross-cutting Research areas:

Track: Human factors

Research area: Countermeasure identification and evaluation

Proposed Project: Cost-benefit determination of countermeasures

Background: Given the reality that funding is not inexhaustible, it would be very nice to have methods to determine the costs of various countermeasures relative to their expected benefits.

Objectives: Develop valid and acceptable methods to determine overall costs and benefits of countermeasures and groups of countermeasures

Methods:
- Identify accepted elements of costs (direct costs, political capital, time and convenience, acceptability)
- Identify accepted elements of benefits (raise awareness, save time and convenience, satisfy political need, save lives and reduce crashes)
- Develop an analytical model for determining cost-benefit

Likelihood of Success: High

Potential Impact of Successful Project:
- Advances field of knowledge
- Model will help decision-making

Timeframe: 2-3 years

Cost Estimate: $200,000 - $300,000

Cross-cutting Research areas:

Track: Human factors

Research area: Data

Title: Develop exposure metrics

Background: There is an urgent need to have better exposure data against which various behaviors and types of crashes can be evaluated. Current exposure data are quite gross and consequently insufficient to measure the current state of highway safety and progress due to the applications of various countermeasures.

Objectives:
- Identify exposure data needs for specific situations such as pedestrians (measuring walking, how to make representative), bicyclists, alcohol and drug, and technology use
- Develop more general exposure metrics for specific needs such as speed, following distance, and turn signal use (measures of current driving)
- Investigate methods to obtain nationally representative data
- Develop cost/benefit metrics for situations
  - Example: speed vs. crash risk (with additional factors considered)
  - What quality of data are necessary; what are the trade-offs
- Investigate use of new technology to generate exposure data, both vehicle-based (fleets, naturalistic driving studies) and site based.

Methods:
- Identify most critical problem areas
- Identify needed denominators
- Consider methods
- Technology assessment, proof of concept
  - Example: Hi-tech Pedometers for walking stratified across population segments
- Conduct cost-benefit assessment

Likelihood of Success: high

Impact: Allows prioritization of problems for countermeasure needs, allows tracking of important trends

Timeframe: 3-5 year project

Cost estimate: Pedestrians/bicyclists/motorcycles/personal transportation devices: $5-10M

Cross Cutting Research areas: Roadway, Specific vehicles

Track: Human Factors

Research area: Data

Title: Roadway inventory - development of a comprehensive database

Background: To appreciate the crash risk in different environments, it is necessary to have an inventory of the frequencies and locations of various environments, such as mileage of curved roads, different service levels, ramps, work zones, illuminated roads, etc.

Objectives: Develop a comprehensive database of road characteristics that affect safety

Methods: Developing/utilizing technologies to cost-effectively develop roadway inventory

Likelihood of Success: Good; but dependent upon availability of resources and advances that occur for other purposes (e.g., State dot Asset Management)

Potential Impact: Allows creation of specific exposure metrics related to all aspects of the road environment; "black spot analysis"

Timeframe: 5-10 year project

Cost estimate: $25M +

Cross Cutting: Roadway, Human factors

Track: Human Factors

Research area: Data

Title: Nationally representative instrumented vehicle study

Background: The significant advances in instrumentation allow online monitoring of multiple aspects of the vehicle behavior, the roadway characteristics, and the driver behavior. Thus, for the first time, many of the factors contributing to crashes can be assessed objectively without relying of subjective and biased testimony.

Objectives:
- Detailed understanding of pre-crash/near crash circumstances
- Understanding of exposure metrics to estimate crash risk

Methods: Large vehicle fleet, drivers own vehicles, national, multi-site sampling; similar to F-SHRP plan

Likelihood of Success: Very high

Impact: Allows detailed analysis of factors that contribute to crashes, allows assessment of successful crash avoidance behaviors and techniques, allows development of exposure metrics, allows prioritization of problems for countermeasure needs, allows tracking of important trends

Timeframe: 5-8 year project

Cost estimate: $25M - $40M

Cross Cutting: Roadway, Specific vehicles

Track: Human factors

Research area: Creating a safety culture

Proposed Project: Create and validate a Safety Culture Index (SCI) for traffic safety

Background: Level of awareness of, concern for, and behavior consistent with safety in transport is a function of the prevailing policy and acceptance of countermeasures at different levels of an organization or informal groups.

Objectives:
- Define the components of SCI
- Relation of the components and the index to impact and process measures of safety
- Retain all components that are valid and practical (easy) to measure in most contexts
- Assess SCI for different organizations (national level to local, companies to individuals), road users (demographics).

Methods:
- Lit review of current measures of safety (e.g. use of occupant restraints, speeding behavior, violations, crashes, drinking driving).
- Focus groups of safety professionals to discuss measures emerging from the lit review
- Small scale correlational studies of entities with high and low SCI and their relation to bottom-line impact measures (e.g. crashes), with adjustments to exposure.
- Statistical analysis to improve the model
- Cross validation on new set of organizations
- Evaluation of safety climate changes on impact bottom-line criteria.

Likelihood of success: High

Potential impact: Acceptance of the metric can be a great motivational tool to enhance importance of traffic safety and at the same time provide people/organizations with goal setting on how to improve it.

Time frame: This multi-stage project is projected to extend over 4-5 years.

Cost estimate: $1m

Cross-cutting Research areas: countermeasure identification, exposure measures for various components of the SCI, social psychology techniques of attitude change.

Track: Human factors

Research area: Creating a safety culture

Proposed Project: Acceptance, implementation, and diffusion of innovation

Background: Level of awareness of, concern for, and behavior consistent with safety in transport, is a function of the policy and acceptance of countermeasures at different levels of the organization.

Objectives:
- Define emerging technologies and measures of benefit
- Assess implementation strategies in terms of their potential and cost
- Identify pathways for various high risk groups, and different users populations (end users, policy makers, vehicle manufacturers

Methods:
- Review successful and unsuccessful implantation campaigns in the area of injury prevention and attempt to distil critical components for success, possibly through statistical analyses techniques. Try to breakdown by relevant users.
- Determine appropriateness for different products
- Gain more insights into successful techniques through in-depth interview with managers of past successful implementations to develop detailed strategies.
- Assess and develop strategies for creating face validity.
- Determine criteria for success for implementation
- Test/validate the strategy on at least two different innovations.

Likelihood of success: High

Potential impact: Provides market entry mechanism and tool of assessment of implementation.

Time frame: 2 years.

Cost estimate: $500,000 + cost of validation

Cross-cutting Research areas: Social psychology of attitude change, driver vehicle interface, depending the product it would relate to specific driver impairment/limitation Research areas.

Track: Human factors

Research area: Young drivers

Proposed Project: Develop theory-based driver education and training

Background: Traditional driver education programs have not proven effective in reducing young driver crashes. To a large extent, this might be related to a lack of theory-based approaches to the content and delivery of driver education.

Objectives: This project will identify the theoretical underpinnings necessary to develop a driver education/training with crash reduction potential.

Methods: Review available information on the theoretical basis of existing driver education curricula. Identify relevant behavioral/educational theories, the key crash contributory/causal factors that should be addressed in the curriculum, as well as learning principles with relevance to driver education. . Use these theories and principles to develop the content and delivery mechanism of a program for learner drivers, that includes both professional instruction and parental involvement.

Likelihood of Success: High

Potential Impact of Successful Project: High, but new program would need to be implemented on a pilot basis and evaluated to determine the safety effect.

Timeframe: 2 to 3 years

Cost Estimate: $500,000

Cross-cutting Research areas: The curriculum has to consider new, in-vehicle technologies and aftermarket products as well as highway design that influence the crash involvement of young drivers.

Track: Human factors

Research area: Young drivers

Proposed Project: Evaluate innovative driver education and training programs

Background: New innovative approaches to driver education programs have emerged in recent years. Although these programs hold promise, evaluation of their safety impact is lacking.

Objectives: This project will identify and evaluate several promising, new driver education/training programs (at least two programs).

Methods: A panel of road safety and educational experts will identify innovative programs. The panel will provide guidance in regards to the methodology that will be used to evaluate these programs. The methodology will then be used to conduct the evaluation.

Likelihood of Success: High

Potential Impact of Successful Project: The evaluation will reveal the extent to which the programs are effective, and therefore, the safety impact cannot be determined at this point.

Timeframe: 2-3 years

Cost Estimate: $500,000-$750,000

Cross-cutting Research areas: Only to the extent that the innovative programs being evaluated address Research areas related to the vehicle or infrastructure.

Track: Human factors

Research area: Young drivers

Proposed Project: Evaluate advanced on-road license tests

Background: Historically, basic road tests for beginning drivers have been a mainstay of safety programs. More recently, with the advent of graduated licensing, some jurisdictions have improved or modified their license testing systems with the use of advanced on-road exit tests that must be passed to move from the intermediate stage to a full license. The extent to which these new tests contribute to the safety effect of graduated licensing is not known.

Objectives: This project will evaluate the safety effect of new testing procedures such as an advanced on-road exit test.

Methods: Identify and obtain cooperation of jurisdictions with advanced on-road exit tests (e.g., British Columbia, Ontario) as well as a control jurisdiction(s) that do not have such testing procedures. The study would involve an analysis of collision and driver record information (.e.g., convictions) using pre-post comparisons. As well, the crash/conviction experience of intermediate drivers who have passed the test on their first attempt would be compared to those who have failed the test or have passed it but after several attempts. The ability of the test to predict collision involvement would also be examined.

Likelihood of Success: High

Potential Impact of Successful Project: If the test is effective, and jurisdictions implement an advanced on-road exit testing, the impact is potentially high.

Timeframe: 1.5-2 years

Cost Estimate: $100,000-$150,000

Cross-cutting Research areas: None

Track: Human factors

Research area: Young drivers

Proposed Project: Intervention Strategies for high-risk teen drivers

Background: Research has shown that young drivers who crash have a higher incidence of traffic violations. However, few jurisdictions take driver improvement actions that are tailored to young drivers and these actions are seldom triggered by the first occurrence of a violation of a collision.

Objectives: Current driver improvement actions/interventions for young drivers in North America and elsewhere will be reviewed as basis to identify/develop a potentially effective intervention strategy. The strategy will be implemented and evaluated to determine its safety effectiveness.

Methods: Review of the relevant literature and survey of jurisdictional practices to identify current practices, and the extent to which these have been proven effective. Based on this work, the project will involve the development of an intervention strategy, implementation of the strategy on a pilot basis, and evaluation of the strategy.

Likelihood of Success: High

Potential Impact of Successful Project: Potentially high if an effective program is developed and implemented widely.

Timeframe: 3-5 years

Cost Estimate: $100,000-$750,000

Cross-cutting Research areas:

Track: Human Factors

Research area: Young drivers

Title: Determinants of risky driving behavior

Background: Overall, young drivers have far higher crash involvement rates than mature drivers. Much of this is due to riskier driving behaviors, such as speeding, close car following, gap acceptance, multi-tasking, distraction, non-belt use, and so forth. Yet risky driving does not characterize all, perhaps not even most, young driver trips. In order to develop effective countermeasures, it will be important to understand the causal factors that promote risky trips by young drivers, and conversely, those factors that reduce risk taking. This research should be distinguished from past research that has contrasted young drivers with older drivers. Rather, the need is to focus on young driver trips and to determine what discriminates the probability of risky vs. non-risky practices.

Objectives:
- Identify and quantify the effects of factors related to risky and non-risky young driver trips. Include trip factors, driver factors, passengers, social factors, environmental, enforcement, driving history, training, etc.
- Determine the causal basis of these effects
- Integrate the findings into a comprehensive descriptive framework or model of risk promotion and risk inhibition.
- Develop countermeasures to reduce risky driving by young drivers, based on the understanding of risk factors and dynamics.

Methods:
- Review existing literature on driver risk taking in general and young driver behavior in particular
- Conduct empirical research on trip and driver correlates and causes of risky actions by young drivers. Multiple, complementary techniques may used, from possibilities such as naturalistic driving, simulator and instrumented vehicle research, observational studies, crash analyses, surveys/interviews, focus groups, insurance or violation records, etc.
- Develop integrated framework or model for predicting likelihood of various risky practices as a function of trip/young driver attributes
- Validate framework/model
- Develop recommended countermeasures based on contributing causes
- Implement and evaluate countermeasures

Likelihood of Success: high

Potential Impact of project:
- Effective countermeasures for risky youthful driving
- Reduced young driver/occupant crashes, injuries, and deaths

Timeframe: 4 years

- Year 1: literature analysis (6 mo) and empirical research (6 mo)
- Year 2: empirical research
- Year 3: develop and validate model, design countermeasures
- Year 4: implement countermeasures

Cost Estimate: $2M

Cross-cutting Research areas:
- Countermeasure identification
- Safety culture
- Driver education/licensing

Track: Human factors

Issue: Aging Road Users

Proposed Project: Older Adult Mobility: Developing Exposure Data

Background: The older driver population is expected to peak at around 2020. These large numbers present both a societal challenge as well as a research challenge. Modern medicine has allowed us to live a longer productive life, and traffic safety researchers must now find ways to allow older people to retain their mobility through driving and other options without sacrificing their – and others' - safety . To do so, we need valid measures of risk exposure -- something that does not exist today, especially for older pedestrians.

Objectives:
- To determine and validate existing measures of exposure for drivers and pedestrians
- To develop and validate new measures of exposure for drivers and pedestrians
- To include measures of exposure which describe destination, distance, time of day, trip purpose, person factors

Methods: NHTS
1. Enlarge the sample of older adults in NHTS
2. Increase the frequency of data collection.
3. Expand questions on NHTS

New Measures
- Identify, develop, and validate proxies for exposure
- Validate new measures against NHTS and other exposure data

Likelihood of Success: High

Potential Impact of Successful Project:
- Ability to calculate rates of crashes, injuries and deaths
- Ability to identify and target high-risk groups, locations, times for targeting effective countermeasures

Timeframe: Next NHTS, 3 to 5 years

Cost Estimate: Unknown

Cross-cutting Issues: Enhanced ability to measure which highway and vehicle countermeasures are effective.

Track: Human factors

Issue: Aging Road Users

Proposed Project: Self-Assessment for Older Drivers

Background: One dilemma shared by many older drivers is to acknowledge changing cognitive/visual/motor capabilities, and seek professional help when appropriate. Turning to their physicians or other professionals – even if they can help - carries at least the perceived risk of losing one's license. One approach that is less frightening but can be a first step to addressing any driving problems is self-assessment. Computerized driving self-assessment tools allow aging drivers to understand specific driving-related deficits, so they can begin considering remediation, self-regulation of driving, or other alternatives, without the risk of losing the license.

Objectives: To understand how different self-assessment tools predict changes in knowledge, attitudes, and behavior, including crashes. These behaviors would include seeking further evaluation or remediation, reducing driving, changes in use of alternative transportation, self-regulation, route choices, and other factors.

Methods:
   A. Inventory of self-assessment tools and evaluations
   B. Identify best tools (criteria could include usability, availability)
   C. Validate self-assessment tools with respect to internal consistency and validity (if not already done)
   D. Take tools that have internal validity and validate them against driver behavior, as described above

Likelihood of Success: High-medium

Potential Impact of Successful Project: Wide acceptance of need to self-assess driving ability, as a part of general health and independence. Initiate planning about transportation and future housing options.

Timeframe: 2 to 5 years

Cost Estimate: $500,000 to $750,000.

Cross-cutting Issues: Potentially useful for people with medical conditions or functional limitations.

Track: Human factors

Issue: Aging Road Users

Proposed Project: Evaluation of Remediation/Rehabilitation Programs for Older Drivers

Background: There are a few remediation programs currently available on the market, but none have received the research scrutiny that is desirable. This is critical, because they may not be effective, and claims that they work can lead to a false sense of security.

Objectives: To identify and evaluate existing older driver remediation/rehabilitation programs for older drivers to identify what works and how components can be improved

Methods:
    A. Inventory of older driver remediation/rehabilitation programs and evaluations
    B. Identify best older driver remediation/rehabilitation programs and components of programs, including those that change knowledge, attitudes, and behavior
    C. Identify linkages between behavior and crashes, injuries, and deaths

Likelihood of Success: Medium

Potential Impact of Successful Project: DMVs, health care providers, and others would be able to refer older drivers to programs with established evidence of effectiveness. Ability to discriminate between older drivers who can be trained to be safe drivers and those who should stop driving.

Timeframe: 2-5 years

Cost Estimate: $500K - $1M

Cross-cutting Issues:
Research related to in-vehicle modifications/technology to allow older drivers to continue driving safely

Track: Human factors

Issue: Aging Road Users

Proposed Project: Transportation Options for Older Adults

Background: Acknowledging that some older persons cannot drive as safely as before puts a burden on society to provide alternative means of mobility. The transition to other forms of transportation can be difficult for people who are accustomed to driving where they want to go, when they want to go. It may also be necessary to make more than one transition over time, for example, from driver to public transportation user, from public transportation user to paratransit client.

Objectives: Identify and evaluate transportation options to driving and methods to increase older adults' acceptance of transitioning to other transportation options

Methods:
   A. Inventory of transportation options including supplemental transportation programs, vehicle alternatives, mode alternatives.
   B. Develop, implement, and evaluate a program to increase older adults acceptance of transitioning to other transportation options (criteria could include availability, accessibility, acceptability, affordability, adaptability)

Likelihood of Success: Medium-High

Potential Impact of Successful Project: Older adults would use alternative transportation options that match their mobility needs and functional ability.

Timeframe: 5-7 years

Cost Estimate: $1-2 million

Track: Human Factors

Research area: Driver attention and distraction

Title: In-vehicle gaze control

Background: Episodes of glancing away from the roadway frequently precede crashes or incidents. We need to better understand what factors cause drivers to look away from the road, what contributes to the duration of glances away from the road, and how drivers make decisions to look away from the road.

Objectives:
- Identify contributing factors to eye-off-road episodes
- Create a model of driver gaze control, that predicts when drivers will direct gaze away from the roadway
- Develop countermeasures, which may be vehicle, roadway, communications, or driver based

Methods:
- Review existing eye control models and research
- Naturalistic driving, simulator and instrumented vehicle research
- Develop models
- Field validate models on-road

Likelihood of Success: high

Potential Impact of project:
- Crash reduction
- Improved driver-vehicle interfaces
- Improved roadway design/operation

Timeframe: 4 years
- Year 1: develop analytic models
- Year 2: empirical data collection
- Year 3: refine models, collect additional data
- Year 4: validate on road

Cost Estimate: $4M

Cross-cutting Research areas:
- Cognitive models
- Aging drivers
- Young drivers
- countermeasures

Track: Human Factors

Research area: Driver attention and distraction

Title: Measuring driver information overload

Background: People have a limited ability to process information. When the rate of incoming information exceeds this ability, drivers make errors. The plethora of information assaulting the driver, from within and without the vehicle, exceeds human capacity.

Objectives:
- Create a metric for out-of-vehicle information load based upon vehicle speed, roadway design, operational factors, decision points, as well as formal information displays
- Create a metric for in-vehicle information load, including load imposed by non-visual events
- Estimate total driver workload
- Create red-line limits for excessive rates of information load
- Develop models and design guidelines for preventing information overload

Methods:
- Review existing attention models and information overload research
- Simulator and instrumented vehicle research
- Develop models
- Field validate models on-road

Likelihood of Success: high

Potential Impact of project:
Improved in-vehicle and roadway display guidelines, with resulting crash reduction and improved operations

Timeframe: 5 years
- Year 1: develop analytic models
- Year 2, 3: empirical data collection
- Year 4: refine models, collect additional data
- Year 5: validate on road

Cost Estimate: $5M

Cross-cutting Research areas:

- Cognitive models
- Aging drivers
- countermeasures

Track: Human Factors

Research area: Crash causation

Title: Distinguishing crash causes by crash severity

Background: Crash causation has long been a topic of study but recent advances in methodology now make it possible to capture data of a sort not possible before. In particular, instrumented vehicle/naturalistic driving techniques can capture details of crashes and close calls in real time, including pre-crash driver actions, vehicle dynamics, and external events. There are also possibilities for capturing naturally-occurring crashes, based on the common location of now low-cost fixed-location video cameras. These methods provide the field with an important new resource and the opportunity to study crash evolution in detail. However, in the NHTSA/VTTI 100-car study, essentially all of the recorded crashes were low-severity and any future studies will get overwhelmingly low severity cases. We do not know to what extent low severity crashes and/or near misses are representative of the crashes of greatest interest (high severity). Caution must be used in generalizing results and in fact, there is a risk of making inaccurate assumptions about the causal factors of severe crashes. Some traffic safety theorists long have warned about the risks of extrapolating findings from close calls or minor crashes. This issue now becomes more acute with the new methods.

Objectives:
- Develop a set of severe crash causal and behavioral resources
- Compare severe crashes and non-severe crashes and close call events for a range of crash types and scenarios
- Determine the validity and limitations of using naturalistic driving or traffic observations and measurements for understanding severe crash causation
- Develop techniques for acquiring severe crash dynamics/driver behavior or for appropriately using/adjusting non-severe or close-call data
- Note: this work statement does not include a task of actually implementing a "naturalistic" severe crash study since the method and scope will depend so greatly on the preceding findings

Methods:
- Critically review methods, findings, limitations of existing crash study techniques, including naturalistic driving/field operational tests, other instrumented vehicle methods, observational methods, crash investigation techniques
- Evaluate research and theory on the relation of severe, non-severe, and close-call events. Summarize the key problems, issues, theory.
- Identify existing and potential sources for real-time dynamic capture of severe crash events.
- Develop a detailed plan for collection of a sample of severe crash data sufficient to test hypotheses regarding relationships to non-severe and close call events for key crash types.
- Next step would be to collect sample and conduct analyses. This is not included within the time and cost estimates for this work statement because alternatives might vary

greatly in time and cost and may ultimately overlap with other proposed work statements (naturalistic driving study, on-scene crash data validity)

Likelihood of Success: moderately high

Potential Impact of project:
- Severe crash reduction
- Improved driver-vehicle interfaces
- Improved roadway design/operation

Timeframe: 2 years

Cost Estimate: $500K

Cross-cutting Research areas:
- Surrogate measures
- Representative instrumented vehicle study
- Countermeasure identification and evaluation

Appendix C: Vehicle research priorities and projects

All the priority research areas identified by the vehicle track are listed below, in approximate priority order, using the prioritization process described in the text. Specific research topics are listed for the highest-priority research areas. Project descriptions for the highest-priority topics are found on the pages indicated in parenthesis after their titles.

On-board safety monitoring
   * Demonstration of driver behavior change by on-board safety monitoring (57)

Vehicle-to-vehicle and vehicle-to-environment/infrastructure communications
   * Determine how vehicle-to-vehicle and vehicle-to-environment/infrastructure communication can be used to optimize traffic flow, reduce congestion, and improve safety (includes automated collision warning - crash notification systems) (58)

On-board vehicle data
   * Identify data collection systems, recommend standards (59)
   o Learn how to effectively utilize new safety-related information that will be generated by on-board vehicle systems

Changes in vehicle fleet
   * Effects of vehicle size and type changes on safety and congestion (very small vehicles, trucks) (60)
   * Effects of vehicle design changes on safety (new fuels systems, materials) (60)
   * Development of vehicle-based safety technologies (60)

Crashworthiness
   * Occupant entrapment post-crash (61)
   * Vehicle safety ratings (61)
   * Far-side occupant protection (61)
   o Lower extremity protection
   o Rollover and roof crush
   o Safety belts designed for pregnant women
   o Crash protection for older occupants
   o Vehicle compatibility issues

Aging driver population
   * Simulator studies of older driver performance and adaptability (62)
   o Vehicle systems, technologies, and design to enhance older driver safety and mobility [see last Human Factors suggested project under Aging Road Users]

Public understand of vehicle safety and advanced technology systems
   * Educating drivers to use new safety technologies (63)
   o Develop standardized test protocols to assess safety benefits or risks of vehicle design features and potential safety systems

Alcohol-impaired driving
  * Assess the feasibility and efficacy of in-vehicle non-invasive alcohol monitors and interlocks (64)

In-vehicle system design to minimize distraction

Post-crash management
  * Rapid notification of crash, transmission of crash details to emergency responders (65)
  * Policies, procedures, and tools for emergency responders to deal with hybrid and alternative-fuels vehicles (65)

Collision warning [included in Vehicle-to-vehicle topic above]

Technology evaluation

Pre-emptive adaptive crashworthiness

Creating a safety culture: create a "market" for safety and safety technologies through public education and awareness programs

Track: Vehicle

Research area: Driver on-board safety monitoring

Proposed Project: Demonstration of driver behavior change by OBSM

Background:

Objectives:
Broad: Demonstrate driver behavior change and associated safety benefits.
Specific:
- Identify best driver performance/behavior measures
- Identify available sensors
- Identify or develop data analysis algorithms
- Identify or develop best driver interface
- Identify or develop management interface (if applicable)
- Identify or develop approaches to Driver-Management interaction

Methods:
- review literature
- identify or develop optimal total system (i.e., considering all aspects above)
- gather volunteers to study OBSM in vehicle
- experimentally evaluate driver behavior chnge
- report findings, including experimental results and guide to implement based on findings.

Likelihood of Success: High

Potential Impact of Successful Project: Very high. New male drivers and commercial drivers are two possible target groups (though different from each other). Adult non-commercial drivers are another possible target, though in this case, there is no management structure -- the question relates more to individual motivation to improve.

Timeframe: 2 – 4 years

Cost Estimate: $1 – 3 million

Cross-cutting Research areas: many human factor Research areas

<u>Track</u>: Vehicle

<u>Research area</u>: Vehicle-to-vehicle and vehicle-to-environment/infrastructure communication

<u>Proposed Project</u>: Determine how vehicle-to-vehicle and vehicle-to-environment/infrastructure communications can be used to optimize traffic flow, and reduce congestion, and improve safety

<u>Background</u>:

<u>Objectives</u>: Identify and document the various ongoing initiatives that integrate various technologies to enhance Vehicle-to-vehicle and vehicle-to-environment/infrastructure communication, showing how this technology will benefit the consumer in terms of reducing driving times, avoiding congestion, compensating for driver distraction, and other safety benefits. Suggest standardization for the future.

<u>Methods</u>:
- Identify the different government agencies and manufacturers working on VII.
- Make site visits to sites doing the research and development.
- Write up findings on similarities and differences in communication approaches.
- Identify areas where standardization is needed.

<u>Likelihood of Success</u>: High for initial recommendations.

<u>Potential Impact of Successful Project</u>: High impact on transportation in the future

<u>Timeframe</u>: 18 months

<u>Cost Estimate</u>: approximately $350,000

<u>Cross-cutting Research areas</u>: Design of highways

Track: Vehicle

Research area: On-board vehicle data

Proposed Project: Identify on-board vehicle data collection systems, recommend standards

Background:

Objectives:
- Determining the type and nature of data that is or is likely to be collected.
- Determining who has ownership, who should have access, and when, and how can data be used.
- How can legitimate users access the data?

Methods:
- Create an inventory of existing and future data collection.
- Undertake a study of potential owners and users of data and legitimate users of data.
- Establish standards for user interfaces, data formats, and types of data collected.

Likelihood of Success: Significant obstacle will be agreement among stakeholders. Privacy is significant Research area.

Potential Impact of Successful Project: High. Should produce more and better data regarding all aspects of vehicle use and crash performance. Potential to affect policy Research areas.

Timeframe: First phase is 1 year; need is immediate with rapid growth of advanced technology.

Cost Estimate: $250,000

Cross-cutting Research areas: Human factors, event data recorders, technology effectiveness.

Track: Vehicle

Research area: Changes in vehicle fleet

Discussion: Over the coming decade, several factors are likely to affect safety-related characteristics of the vehicle fleet on the road in the United States. Participants discussed three distinct aspects related to changes in the vehicle fleet. 1) Changes in the size and weight mix of vehicles on the roadway due to factors such as changes in CAFE and changing consumer preferences. 2) Changes in vehicle materials and the anticipated introduction of alternative fuels. 3) Effects if the instruction and market penetration of vehicles equipped with advanced safety-related technologies ranging from electronic stability controls to cooperative collision avoidance systems.

Vehicle size and weight. Research related to vehicle size, weight, and performance capabilities is closely associated with research programs focused on crash worthiness factors associated vehicle compatibility. NHTSA's proposed research plan for 2005-2009 identifies the need to ensure that alternative fuels vehicles (ATV) provide a level of safety similar to that of traditional vehicles on the road in the United States. Research programs will need to identify and address the safety performance of ATV with respect to vehicle size and weight (compatibility with other vehicles and the roadside), as well as Research areas specifically related to the use and storage of new fuels.

New materials and alternative fuel systems. In response to CAFE and other influences, the mix of construction materials used in automobiles is changing (increasing use of plastics, etc.). Research is needed to explore the impact of these changes on post crash incident management, including fire hazards. The increasing popularity of hybrid (gasoline-electric) vehicles and the anticipated introduction of alternative fuels (including hydrogen) introduce new safety concerns for the vehicle fleet. Research is needed to explore the impact of these fuels on post crash fire severity and appropriate mitigation measures.

Vehicle-based Safety Technologies. The introduction of active, vehicle-based safety systems provides substantial opportunity for improving road safety. A presentation provided by Alan Pisarski at the opening of the workshop, however indicates that by international standards, the age of the vehicle fleet in the US is relatively old and that with the emphasis on producing longer-life vehicles, the average age is likely to increase. The end result is that realization of safety benefits from new technological advances may be limited by the rate at which older vehicles are retired. Research may be needed to determine the need or feasibility of developing "after-market" versions of some active safety systems.

Track: Vehicle

Research area: Crashworthiness

Proposed Project: Three crashworthiness needs

Background:

Objectives:
1. Identify major obstructions in exiting vehicles after a crash
2. A new and better way to rate the safest vehicles
3. Identify effective restraints to protect occupants on the non-struck side in a lateral crash

Methods:
1. Study real-world crash data files to identify obstructions to exiting vehicles
2. Study real-world crash data files and laboratory crash tests to suggest new, improved vehicle ratings for consumer information
3. Study real-world crash data files and laboratory crash tests to determine restraint to reduce risk to far-side occupants

Likelihood of Success: High, for all three studies

Potential Impact of Successful Project:
1. High if the number of trapped occupants turns out to be high.
2. High impact on consumer information.
3. High because of a high number of serious and greater injuries to far-side occupants.

Timeframe:
1. 12 months
2. 24 months
3. 24 months

Cost Estimate:
1. $150,000
2. $750,000
3. $1,250,000

Cross-cutting Research areas:
- Post-crash trauma
- Consumer information

<u>Track</u>: Vehicle

<u>Research area</u>: Aging driver population

<u>Proposed Project</u>: Simulator studies of older driver performance and adaptability

<u>Background</u>: We need a better understanding of age-related factors that affect driving ability and the safe operation of vehicles.

<u>Objectives</u>: The proposed project includes a series of simulator studies focused on older drivers. Studies are needed to evaluate older driver reaction times in controlled situations and establish minimum reaction thresholds and vision standards for drivers licensing. Work is also needed to evaluate the ability of older drivers to safely operate vehicles equipped with complex systems that require driver input/interaction, and to understand how driving ability and driver adaptability to technology changes over time

<u>Methods</u>:
- Develop a simulator study to evaluate older driver performance in vehicles equipped with packages of on-board equipment involving various levels of complexity.
- Conduct a synthesis study which would include a literature review and focus group to identify the information needed to identify factors that affect older driver performance.
- Design a study to establish a minimum vision standard for older drivers that considers the age of the driver, diminished vision and safe operation of the vehicle. Begin with a feasibility study, then a pilot test, then a full study.

<u>Likelihood of Success</u>:

<u>Potential Impact of Successful Project</u>:

<u>Timeframe</u>:

<u>Cost Estimate</u>:

<u>Cross-cutting Research areas</u>: Human factors

Track: Vehicle

Research area: Public understanding of vehicle safety and advanced technology systems.

Proposed Project: Educating drivers to use new safety technologies

Background: New vehicles are being equipped with increasingly sophisticated new systems. Drivers (and passengers) may need training to help them understand the capabilities and proper use of new in-vehicle systems, and information on how systems need to be maintained over time. Improper use of safety-related systems can mitigate their benefits and can pose a safety hazard. Recent examples where driver knowledge of proper use is important include airbags, ABS, and child safety seats.

Objectives: Assure benefits of advanced in-vehicle technologies through driver education and training (avoid ABS-type problems). Ensure that:
- Drivers/passengers can receive full benefit from new safety systems
- Safety hazards resulting from improper use of any in-vehicle systems are avoided.
- Safety of vehicles is maintained over the life of vehicles.

Methods: For various education and training methods (e.g., DVD documentation, voice activated owner manual), evaluate five items:
- Identify the new knowledge, skills, and abilities needed to safely operate and receive full safety benefits from specific new in-vehicle systems.
- Evaluate the potential effectiveness of training delivery formats and media for various purposes and target audiences.
- Consider the need for additional training resources/programs for drivers (purchasers) of vehicles equipped with new safety systems.
- Encourage adoption of new safety technologies through general public education/awareness programs.
- Identify potential effectiveness of specific training methods and media for various purposes and target groups.

Likelihood of Success: High

Potential Impact of Successful Project: High

Timeframe: 24 months – 36-months

Cost Estimate: $750,000

Cross-cutting Research areas: Driver behavior

<u>Track</u>: Vehicle

<u>Research area</u>: Alcohol-impaired driving

<u>Proposed Project</u>: Assess the feasibility and efficacy of in-vehicle non-invasive alcohol monitors and interlocks

<u>Background</u>: Current alcohol interlocks require drivers to provide breath samples prior to starting a vehicle. While this approach may be successful under special circumstances, it is not practical for widespread (general) use. Development of a non-invasive monitoring system practical for general use could reduce the number of alcohol-impaired drivers on the roadway.

<u>Objectives</u>:
- Determine the technical feasibility of an in-vehicle non-invasive BAC monitor and interlock
- Assess the potential safety benefits associated with the widespread introduction of such a system, including cost-benefit.

<u>Methods</u>:
- Proof-of-concept research and development and construction of an in-vehicle demonstration prototype
- Statistical analysis to estimate costs and benefits

<u>Likelihood of Success</u>: N/A

<u>Potential Impact of Successful Project</u>: Reduction of alcohol-involved crashes, injuries, and fatalities

<u>Timeframe</u>: 12 months

<u>Cost Estimate</u>:
1. $500,000 to $1,000,000
2. $250,000

<u>Cross-cutting Research areas</u>: None

Track: Vehicle

Research area: Post-crash Management

Discussion: Vehicle track participants discussed the potential need for additional research related to safety during the "post-crash" phase (incident identification and response). While participants recognized that many past and on-going research programs address post-crash management, additional research may be needed in three general areas: 1) reducing the time between crash occurrence and initiation of response activities (e.g. when notification of a crash is received); 2) providing detailed, crash-related information to responders and emergency medical facilities as early as possible following the occurrence of a crash; and 3) understanding and providing the processes, procedures and tools responders need to safely and quickly respond to crashes involving hybrid and alternative-fuels vehicles.

Crash Notification. Participants discussed the contributions that new and emerging technologies may have in providing very rapid notification that crashes have occurred (automated collision notification) and in providing detailed information about the crash that could be used to tailor emergency medical responses to crashes could pay off by increasing occupant survivability and mitigating injuries resulting from crashes.

The first generation of collision notification systems, such as General Motor's On-Star, are available to the public as an option on specific manufacturer's models. These systems provide notification based on air-bag deployment or are notification initiated by a driver or passenger. More advanced concepts in support of automated crash notification are also being included in safety use cases and architectures proposed for the Vehicle Infrastructure Integration (VII) program. These concepts build on a suite of sensors that can provide information about the dynamics of the crash, vehicle occupants, and vehicle condition that in turn, can be used to assess likely requirements for emergency medical response, selection of treatment facilities, and more. Future research needs will include studies to identify and evaluate technologies, as well as research that will help us understand how to coordinate and share information with the medical community, and to effectively use available data to improve safety and mitigate injuries resulting from crashes.

Hybrid and Alternative-fuels Vehicles. Hybrid gasoline-electric vehicles are beginning to gain popularity in the US. In the next few years, hydrogen-powered vehicles are also likely to be introduced. As with any new technology, initially, very little data are available concerning the safe performance of these vehicles in the general transportation environment. Research will be needed on the safety performance of new vehicles, including vehicle compatibility. As early experience with hybrid vehicles as shown, research is also needed to identify and develop policies, procedures, and tools that incident responders need to quickly and safety extricate passengers from vehicles involved in crashes.

Appendix D: Workshop Agenda

Tuesday, October 11

8:30 AM - 9:00 AM	Breakfast
9:00 AM - 9:15 AM	Welcome / Opening remarks (Peter Kissinger, AAAFTS, and others)
9:15 AM - 9:25 AM	Objectives; Introductions of track leaders (Jim Hedlund)
9:25 AM - 10:25 AM	Plenary: Presentations by Alan Pisarski and Doug Harwood
10:25 AM - 10:40 AM	Break
10:40 AM - 11:30 AM	Plenary: Presentations by David Shinar and Donna Nelson
11:30 AM - 12:00 PM	Plenary Discussion
12:00 PM - 1:00 PM	Lunch
1:00 PM - 4:00 PM	Group breakouts: Mixed groups, each group discusses human, vehicle, and highway issues
4:00 PM - 4:15 PM	Break
4:15 PM - 5:30 PM	Plenary: Group reports and general discussion
6:30 PM	Group Dinner at Bobby Van's

Wednesday, October 12

8:30 AM - 9:00 AM	Breakfast
9:00 AM - 9:10 AM	Brief overview of Day 1
9:10 AM - 10:30 AM	Breakout groups vote to prioritize topics, begin synthesis and development of projects
10:30 AM - 10:45 AM	Break
10:45 AM - 12:00 PM	Continue synthesis and development of projects
12:00 PM - 1:00 PM	Lunch
1:00 PM - 2:45 PM	Continue synthesis / development of agenda; add details and vote
2:45 PM - 3:00 PM	Break
3:00 PM - 3:30 PM	Summary, Closing Remarks
3:30 PM	Adjourn

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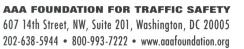Federal Highway Administration
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