SHRP II Request for Proposals

Safety Focus Area
Project Number: S01
Project Title: Development of Analysis Methods Using Recent Data
Date posted: September 11, 2006

SHRP II BACKGROUND

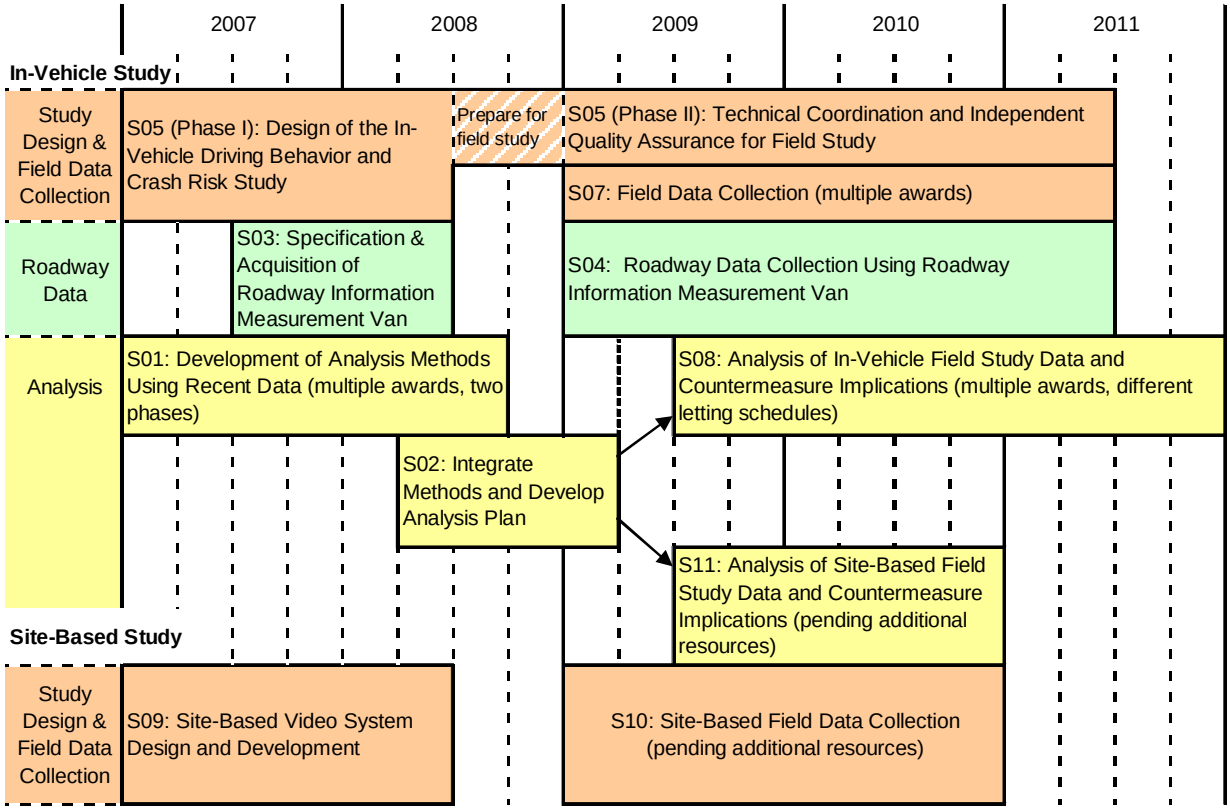
To address the challenges of moving people and goods efficiently and safely on the nation's highways, Congress has created the second Strategic Highway Research Program (SHRP II). SHRP II is a targeted, short-term research program carried out through competitively awarded contracts to qualified researchers in the academic, private, and public sectors. SHRP II addresses four strategic focus areas: the role of human behavior in highway safety (Safety); rapid highway renewal (Renewal); congestion reduction through improved travel time reliability (Reliability); and transportation planning that better integrates community, economic, and environmental considerations into new highway capacity (Capacity). Under current legislative provisions, SHRP II will receive approximately $150 million with a total program duration of 7 years. Additional information about SHRP II can be found on the program's web site at www.trb.org/shrpii.

OVERVIEW OF SAFETY FOCUS AREA

The SHRP II safety research plan includes two tracks: a large field study of driving behavior using volunteer drivers and a sophisticated instrumentation package installed in the volunteers' vehicles, and a video system to record the movements of all vehicles at specific road sites such as an intersection. The SHRP II field studies are intended to support a comprehensive safety assessment of how driver behavior and performance interact with roadway, environmental, vehicular, and human factors and the influence of these factors and their interactions on collision risk, especially lane departure and intersection collisions. The accompanying chart lays out the main projects anticipated. The chart provides a general idea of the flow of work. The exact number, content, and timing of contracts are subject to change.

The in-vehicle driver behavior and crash risk study is shown across the top of the chart, beginning with a Study Design (S05) that leads to data collection starting in 2009 (S07). Project S05, the Study Design, includes the development of a complete data collection system, a field trial of the system, and the management plan for the full study. The Study Design is supported by Project S03 to develop a digital measurement van to collect detailed and accurate roadway information in the study areas and this project, S01, to identify analytic methods to address the research questions. Multiple awards are anticipated under Project S01. A follow-on project, S02, will integrate the findings of the S01 projects to produce an analysis plan for the full study. The full driver study will be implemented at the beginning of the third year in 3 to 4 study areas with an overall

quality assurance and technical coordination contractor. Roadway data will be collected in the study areas under a separate project, S04. Multiple analysis projects (S08) are planned to address a wide range of research questions using the data collected.



SHRP II Safety Projects Timeline

A second track of research for the SHRP II Safety focus area involves site-based video instrumentation and is shown at the bottom of the chart. At this time, only the first project of this track, Project S09, Site-Based Video System Design and Development, is programmed. The purpose of this initial project is to improve the capabilities of existing systems. The Safety Research Plan continues this track with site-based field data collection starting in 2009 under Project S10 and the analysis of the field data in project S11. Execution of this track beyond Project S09 will depend on available funding and on the outcome of Project S09 to improve the capabilities of existing site-based video systems. The subject of this RFP is Project S01, Development of Analysis Methods Using Recent Data.

OBJECTIVE

The objective of this project is to identify/develop analytic methods for the SHRP II driving behavior and crash risk study and to carry out demonstrations of the methods using data from recent field studies for road departure and intersection safety issues. Key aspects of the analyses include the application of crash surrogate approaches (traffic conflicts, critical incidents, near-collisions, and other surrogate measures), development of exposure-based collision risk measures, and the formulation of analytic methods to quantify the relationship of human factors, driver behavior, vehicle, roadway and environmental factors to collision risk. The project includes: (1) identification of research questions, (2) review of data from recent studies, (3) development of an analysis plan that specifies risk measures to be used (including crash surrogates), response variables, control variables, and analysis methods, and (4) demonstration of the method using existing data from recent studies.

Several field studies using research vehicles with comprehensive instrumentation packages have been completed recently, such as the 100-Car Naturalistic Driving Study conducted by the Virginia Tech Transportation Institute and the Automatic Collision Avoidance System (ACAS) Field Operational Test conducted by the University of Michigan Transportation Research Institute (UMTRI) and General Motors. (See Attachment 2 for references.) Before embarking on the SHRP II field study, it will be instructive to use these existing data to develop and demonstrate the analysis planned for SHRP II. Only by implementing an analysis plan can the complexity and essential data requirements be fully realized. To that end, the suitability and availability of data from similar completed field studies will be reviewed to identify data that will support a reasonable trial of the planned analysis.

This project is divided into two phases:

> Phase I: Conceptual Development—12 months (See Special Note A)
> Phase II: Demonstration of Method with Recent Data—15 months (See Special Note A)

Proposals should address both phases. Multiple awards will be made if sufficient qualified proposals are received. The Phase I Report will include a detailed analysis plan for the Phase II demonstration application. Approval to conduct Phase II will depend on (1) satisfactory performance of Phase I, (2) availability of funds, and (3) availability of data to carry out the demonstration. It is possible that not all Phase I contracts will proceed to Phase II.

Phase I: Conceptual Development of Analytic Approach

Task I-1: Frame Specific Research Questions.

Formulate the list of candidate research questions to be addressed by an analysis of data from existing data sources in Task I-3. A starting point is a summary of research questions developed by SHRP II technical committees for the driving behavior field study that is included as Attachment 1. The questions should be representative of the

major SHRP II driving behavior field study goals. They must include (but not be limited to) questions involving road departure and intersection crashes. The questions should be stated precisely enough that they lead to specific data collection requirements and analysis techniques. The questions may include (but not be limited to) questions related to countermeasures, again representative of the overall major study goals.

The goal of this project is to produce analytic approaches that can be applied to the larger data sets that will be produced by the SHRP II field studies. Two central issues for the planned analysis of the driving behavior field study are the statistical relationship of surrogate measures of collisions (conflicts, critical incidents near-collisions, or roadside encroachment) with actual collisions, and the formulation of exposure-based risk measures using these surrogate measures. The specific research questions that follow build on these two central issues.

Specific research questions of interest to SHRP II relate to the interaction of driver behavior/performance with roadway design and operation to increase the risk of road departure and intersection crashes. Candidate factors include, but are not limited to:

- Driver factors: age and gender, speed, driver errors, inattention, distraction, fatigue, impairment, and perhaps driving characteristics such as aggressive or non-aggressive driving styles that might be characterized from measured driving performance such as speed on curves, deceleration levels on intersection approach, or gap acceptance.
- Roadway factors: edge-marking, rumble strips, lane width, shoulder type and width, curvature, grade, signing and sight distance.
- Intersection factors: signal versus signed, intersection configuration, signal timing, traffic volumes, and sight distance.
- Environmental factors: light condition, weather, and pavement quality condition.
- Vehicle factors: vehicle type (car, SUV, van), antilock braking systems, cruise control use, handling characteristics (including roll stability), and wheelbase.

Specific research questions would address the possible relationship of the factors listed above, either independently or in combination, with lane-keeping performance and road departure or with intersection safety. Proposals are not expected to address all the questions/issues posed, but rather should address a subset with a coherent scope. An example of such a subset might address road departure. Surrogate measures for road departure collisions should be identified, such as time-to-road departure based on current heading or actual road departures without collision. The surrogate measure(s) would be used to formulate an exposure-based risk measure to use as the response variable and a model would be formulated to relate an appropriate set of driver, roadway and other characteristics to the lane departure risk measure. Similar formulations would follow for various intersection collision types. Different surrogate measures of collision risk, response variables, and model formulations may be required for each. A separate issue to address would be an analysis to assess the relationship of the surrogate measures to actual collisions. These examples are illustrative only and are not intended to limit the creativity

of the proposal. Proposals may also address multiple questions, use multiple methods, and more than one database if they remain within the project scope.

Product: A set of research questions to be addressed by analyses of data from existing sources.

Task I-2: Review Recently Completed Field Studies
Identify one or more existing data sets that will support the research question(s) formulated in Task 1 and can be used for the demonstration of the analytic approach in Phase II. Offerors not familiar with recent studies that produced data similar to the planned SHRP II field studies should review the available information. Attachment 2 lists some of these studies and provides links to documentation.

The contractor should review data, or detailed descriptions of data, from one or more of the recently completed studies referenced, or other suitable data to:

- Assess the suitability of these data for addressing the research questions framed in Task I-1.
- Identify data elements that will address specific questions, or are otherwise needed for the analysis.
- Determine selection criteria (if any) to extract the necessary data.
- Assess limitations of the data that may impact the application analysis approach.

Because the goal of this project is to develop and demonstrate analytic methods for the SHRP II driving behavior field study, the contractor should choose databases that are similar to the data to be collected in the driving behavior field study and that are useful for addressing the research questions of Task I-1.

Product: A description of the candidate database selected for the demonstration application in Phase II. Describe the data requirements necessary to support the analytic approach, including variables that are needed, selection of data for analysis from the larger file, and limitations of the data that impact the application of the method.

Task I-3: Develop an Analysis Plan for the Phase II Demonstration
Prepare an analysis plan for the Phase II demonstration of the analytic approach to be presented in the Phase I final Report. The plan should identify an analytic method to be used to address questions framed in Task I-1 using the data selected in Task I-2.

The proposed analysis plan shall include the following:

- Research question(s) addressed
- Candidate collision surrogates
- Exposure-based risk measures
- Candidate explanatory variables
- A detailed description of the analysis method used, including assumptions

- Data requirements, including selection criteria, variables needed, file structure, etc.
- Formulation, or application, of the method. Explain how the results of the analysis address the research question
- Model assessment procedures and criteria
- Software used or developed
- Limitations of the method
- Limitations of the data
- Implications for the SHRP II field study data collection

It is anticipated that the limitations of existing field data available to this study will bound the research questions that may be effectively addressed and the statistical significance of any results. The emphasis of this project is on the development and demonstration of the analysis methods themselves, not on the specific results that may be achieved. Important issues include the relationship of surrogate measures of collision risk to actual collisions, the formulation of exposure-based risk measures for response variables and the demonstration of statistical methods to address illustrative research questions. This analysis plan is specific to the data available for this project. The results of this demonstration will subsequently be used in Project S02 to develop an analysis plan for the SHRP II field study data.

The small number of actual crashes may limit the ability of the study to assess the relationship with the surrogate model. To address this common problem, it might be possible to incorporate additional variables in the model to support extrapolation to a longer time period or larger set of road segments. For example, relating surrogate measures at an intersection to traffic volume might allow extrapolation of the measured surrogate information to earlier years or other similar intersections differing only in traffic volume. Another enhancement might incorporate additional factors that can occur in combination with the surrogate. Running a red light does not pose a high angle collision risk if there is no crossing traffic, but may still pose a risk of rear-end collision. Lane departure with a good shoulder and clear zone may result in high run off road events, but with few injuries. A model that incorporated "context" variables, such as crossing traffic volume, shoulder width, or guardrail presence and included collision type might show a better relationship with collision risk.

Product: A fully defined analysis plan suitable to carry out the demonstration planned for Phase II

Task I-4: Analysis Methods Workshop

Participate in an analysis methods workshop to be organized by the contractor for SHRP II Safety Project S05, Design for In-Vehicle Driving Behavior and Crash Risk Study. This two-day workshop will take place in Washington, D.C., in the summer of 2007; the exact dates will be coordinated with SHRP II staff. Contractors for this project (S01) will be expected to prepare material (papers, presentations, handouts) for the workshop; attend and participate in the workshop as presenters and discussants; and participate in the development of workshop products, which may involve revision of materials prepared

for the workshop and development of material summarizing the discussion and outcomes of the workshop.

The objective of the workshop is to exchange information on implications of the analysis methods under consideration for data elements to be collected, data storage, and data access provisions. Workshop participants will include the contractors from this project, the two study design contractors (from Project S05 and from Project S09, Site-Based Video Development and Design), SHRP II Safety Technical Coordination Committee members, SHRP II staff, and possibly other experts. Information from the analysis methods contractors under this project will be used by the study design contractors to specify the requirements for the data collection system to be used in the field study. Data requirements must be specified early in the study design process, which is why this workshop is called for early in the period of performance of all three projects.

Product: Papers, presentation and handouts describing the questions addressed, the analysis methods proposed, availability of required data, and implications for the SHRP II field study.

Task I-5: Data Acquisition and Exploratory Analysis

Acquire the data identified in the analysis plan (Task I-3), with the assistance of SHRP II, if needed, and carry out exploratory evaluations and preparations for analysis. For contractors who did not have the actual data sets when they performed the review of data in Task I-2 (and who therefore could only assess the data sets as they were described on paper), revisit that review and make any modifications necessary in terms of the adequacy of the data to address the questions chosen in Task I-2 using the analysis plan developed in Task I-3.

The proposal should state whether or not the proposer has access to one or more suitable data sets or if the proposer expects to be able to arrange to have access to such data. If so, the data set in question should be identified and described well enough for reviewers to determine if the data set is appropriate for this project. If the proposer will not have access to any of the data sets identified in Attachment 2, or a suitable alternative, this should also be stated, along with a statement of which of the data sets the proposer expects to use. This will allow SHRP II staff time to assist in arranging for access to the data. Current access to a data set is not a factor in awarding Phase I contracts and a proposer's not having current access to a suitable database is not an impediment to proposing on this project. The purpose of this project is to explore as wide an array as possible of analytical approaches for use on a relatively new type of data that holds great promise for safety research and potential improvements in safety. Every effort will be made to find a way to demonstrate promising analytical approaches.

Product: Acquisition and initial exploratory evaluation of the data for the Phase II demonstration

Task I-6: Phase I Final Report
Prepare a report documenting the activities and products from Tasks I-1, I-2, I-3, and I-5. The report shall include:

- The research questions framed in Task I-1, with an explanation of the rationale behind the selection of the particular questions and a discussion of how the selected questions address one or more of the critical issues listed under Tasks I-1 and how they related to the general research question of driver behavior in lane departure and intersection safety.
- The assessment of one or more existing data sets performed under Task I-2, including the rationale for choosing the particular data set(s); a discussion of the appropriateness of the data set to the questions selected in Task I-1; data requirements; and a discussion of the limitations or inadequacies of the data set for addressing certain questions. Suggestions for how to overcome the limitations or inadequacies are welcome.
- The analysis plan prepared under Task I-3, including a detailed description of the analysis method, data requirements, formulation or application of the method, assumptions, software used or developed, model evaluation, limitations, and implications for the SHRP II field study data collection and analysis plan.
- Results of the exploratory analyses carried out under task I-5. For contractors who initially evaluated a data set from its written description, include results of the re-evaluation carried out on the actual data set under Task I-5.

The report may include, if appropriate, any modifications, enhancement, or ideas that arose from the analysis methods workshop and that aided the contractor in developing the analysis plan.

DELIVERABLE: Phase I Report documenting the activities and products from Tasks I-1, I-2, I-3, and I-5; draft due at the end of month 9, final revised version due at the end of month 12.

Phase II Demonstration of Method with Recent Data

Contractors cannot proceed with Phase II unless and until approval is given by SHRP II. Approval will depend on (1) satisfactory performance of Phase I, including receipt of the final report from Tasks I-5 and approval of the analysis plan developed in Task I-3; (2) availability of funds; and (3) acquisition by the contractor of data to carry out the demonstration. In the event that contractors are not able to gain access to the data set selected for analysis, SHRP II staff will attempt to acquire existing data from the owners to enable the Phase II demonstration to be carried out; however, no guarantee can be made that these attempts will be successful. It is possible that not all Phase I contractors will be approved for Phase II.

Task II-1: Demonstrate Analytic Method
Carry out the analysis described in the Task I-3 Analysis Plan using the data acquired in Task I-5. Complete any additional evaluation and preparation of the data for analysis.

Evaluate the success of the method with regard to its ability to address the research questions and the adequacy of the data and methods used. The goal is to either successfully demonstrate the analytic method or identify necessary changes in data or methods for the approach to be successful in SHRP II. It is anticipated that recommendations can be made with regard to variables and formulations that provide the most effective analysis. The results from this activity will shape the design and analysis for the SHRP II field studies.

Product: A report detailing the findings of the demonstration. The work conducted, results, discussion of findings, discussions of problems and modifications to address the problems, evaluation of the models and results, limitation and implications for SHRP II will all be documented in the Phase II Final Report, Task II-3.

Task II-2: Analysis Demonstration Workshop

Participate in an analysis demonstration workshop to be organized by the contractor for SHRP II Safety Project S05, Study Design for In-Vehicle Driving Behavior and Crash Risk Study. This two-day workshop is expected to take place in Washington, D.C., in the summer of 2008; the exact dates will be coordinated with SHRP II staff. Contractors for this project (S01) will be expected to prepare material (papers, presentations, handouts) for the workshop; attend and participate in the workshop as presenters and discussants; and participate in the development of workshop products, which may involve revision of materials prepared for the workshop and development of material summarizing the discussion and outcomes of the workshop.

The objective of the workshop is to exchange information on implications of the demonstrations of analysis methods conducted under Phase II for the design of the field studies being conducted by the contractors for Projects S03, S05 and S09 and the development of an analysis plan for the SHRP II field study in Project S02. Workshop participants will include the contractors from Phase II of this project, the three study design contractors (from Projects S03, S05 and S09), SHRP II Safety Technical Coordination Committee members, SHRP II staff, and possibly other experts. Information from the analysis methods contractors under this project will be used primarily by the Project S02 contractor to integrate the results of the S01 projects to produce the analysis plan for the SHRP II field study and by the study design contractors to further refine the data requirements for the instrumentation packages to be used in the field study and to address issues related to data storage, data access provisions, data processing, and quality assurance and control. Contractors from this project (S01) should be prepared to address these issues as they relate to the methods they are demonstrating under Phase II.

Product: Papers, presentation and handouts derived from the report prepared at the completion of Task II-1

Task II-3: Phase II Report
Prepare a report documenting the analysis methods demonstration carried out in Task II-1 and all findings, results, and implications for future work. The report should include the following elements:

- Discussion of the evaluation of data as appropriate, especially regarding which aspects of the review conducted in Task I-2 on descriptions of the data were confirmed or had to be revised when actual data were assessed.
- A detailed description of how the demonstration of the analysis method was carried out.
- Description and discussion of the results of the analysis demonstration and model evaluation.
- Assessment of the success of the method in addressing the research questions and critical research issues chosen in Phase I.
- A discussion of implications for the full-scale risk study analysis plans (to be developed under a separate Project S02, Integration of Analysis Methods and Development of Analysis Plan for Field Study). This discussion may include, but is not limited to, the implications for what data should be collected, whether and how data should be reduced or coded for analysis, data storage, data access provisions, data processing, and reliability of data, quality assurance and quality control issues.

The report may include, if appropriate, any modifications, enhancement, or ideas that arose from the analysis demonstration workshop and that aided the contractor in carrying out or assessing the demonstration. The report should also include, where appropriate, materials derived from the Phase I report.

DELIVERABLE: Phase II Report documenting the analysis methods demonstration carried out in Task II-1 and all findings, results, and implications for future work; draft due at the end of month 12, final revised version due at the end of month 15.

SUMMARY OF DELIVERABLES:

- Papers, presentations, and/or summary materials prepared for the Analysis Methods Workshop in Task I-4—in the summer of 2007
- Draft Phase I report prepared in Task I-5—month 9 of Phase I
- Final Phase I report—month 12 of Phase I
- Papers, presentations, and/or summary materials prepared for the Analysis Demonstration Workshop in Task II-2—in the summer of 2008
- Draft Phase II report prepared in Task II-4—month 12 of Phase II
- Final Phase II Report—month 15 of Phase II

Meetings
Quarterly meetings at contractor's office with the SHRP II Program Officer starting with a kick-off meeting in the first month
Task I-4 Workshop in Washington DC—in the summer of 2007
Task II-2 Workshop in Washington DC—in the summer of 2008

Special Notes

Special Note A: The nominal period of performance is approximately 3 months shorter than the contract time stated for each phase because the Draft Final Reports must be submitted 90 days before the contract end date to accommodate the report review process (See *Information and Instructions for Preparing Proposals for SHRP II Research*). Thus, all work must be substantially complete 3 months before the contract end date. Sufficient funds should be allocated to that period to cover revisions and report production.

Special Note B: The funds available for Phase I and II represent an upper limit on project costs; proposals that exceed the funds available will be rejected. Proposals may be submitted for less than the funds available. Evaluation will consider both technical merit and cost efficiency within these caps.

Special Note C: The Research Plan, Item 4 of the proposal, shall be limited to no more than 35 pages.

Special Note D: Proposals will be evaluated by SHRP II staff and Expert Task Groups (ETGs) consisting of individuals collectively very knowledgeable in the problem area. Selection of an agency is made by the SHRP II Oversight Committee, based on the recommendation from SHRP II staff and the ETG. The following factors are considered: (1) the proposer's demonstrated understanding of the problem; (2) the merit of the proposed research approach and experimental design; (3) the experience, qualifications, and objectivity of the research team in the same or closely related problem area; (4) the proposer's plan for participation by disadvantaged business enterprises—small firms owned and controlled by minorities or women; and (5) the adequacy of facilities.

Funds Available:
Phase I: $100,000
Phase II: $200,000
Total, Phases I & II: $300,000

Contract Time:
Phase I: 12 calendar months from notice to proceed
Phase II: Begins 9 calendar months after Phase I begins and goes on for 15 calendar months from notice to proceed on Phase II
Phase I and II: 24 months

Responsible Staff Officer: Kenneth L Campbell, kcampbell@nas.edu, 202-536-5187

Authorization to Begin Work: January 2007, estimated

Proposal Due Date: October 26, 2006

Proposals (20 single-bound copies) are due not later than 4:30 p.m. on October 26, 2006

This is a firm deadline, and extensions simply are not granted. In order to be considered, all 20 copies of the agency's proposal accompanied by the executed, unmodified Liability Statement must be in our offices not later than the deadline shown, or they will be rejected.

Delivery Address:

PROPOSAL-SHRP II
ATTN: Neil F. Hawks
Director, Strategic Highway Research Program II
Transportation Research Board
500 Fifth Street, NW
Washington, DC 20001

Liability Statement

The signature of an authorized representative of the proposing agency is required on the unaltered statement in order for SHRP II to accept the agency's proposal for consideration. **Proposals submitted without this executed and unaltered statement by the proposal deadline *will be summarily rejected.*** An executed, unaltered statement indicates the agency's intent and ability to execute a contract that includes the provisions in the statement.

Here is a printable version of the Liability Statement (pdf). A free copy of the Adobe Acrobat PDF reader is available at http://www.adobe.com.

General Notes

1. According to the provisions of Title 49, Code of Federal Regulations, Part 21, which relates to nondiscrimination in federally assisted programs, all parties are hereby notified that the contract entered into pursuant to this announcement will be awarded without discrimination on the grounds of race, color, religion, sex, national origin, or disability.

2. The essential features required in a proposal for research are detailed in the brochure entitled **"Information and Instructions for Preparing Proposals for SHRP II Research." Proposals must be prepared according to this document, and attention is directed specifically to Section IV for mandatory requirements. Proposals that do not conform with these requirements will be rejected.**

3. The total funds available are made known in the project statement, and line items of the budget are examined to determine the reasonableness of the allocation of funds to the various tasks. If the proposed total cost exceeds the funds available, the proposal is rejected.

4. All proposals become the property of the Transportation Research Board. Final disposition will be made according to the policies thereof, including the right to reject all proposals.

IMPORTANT NOTICE

Potential proposers should understand clearly that the research project described herein is tentative. The final content of the program depends on the level of funding made available. Nevertheless, to be prepared to execute research contracts as soon as possible after sponsors' approvals, the Strategic Highway Research Program is assuming that the tentative program will become official in its entirety and is proceeding with requests for proposals and selections of research agencies.

Attachment 1: SHRP II Priority Research Questions

Overall question: Study the relationship of multiple factors or descriptors (human, vehicle, roadway and environmental) to the risk of collisions and casualties. This will involve observing, recording and studying data related to driver behaviors (e.g., lane keeping, speed choice, gap acceptance), driver descriptors (e.g., age, gender, driving experience, fatigue level, attention level), vehicle descriptors (e.g., vehicle type), roadway and traffic descriptors (e.g., curvature, speed limit, shoulder type and width, traffic density) and environmental descriptors (e.g., light level, weather). Basic questions will concern how driver behavior is affected by driver, vehicle, roadway and environmental descriptors and how changes in driver behaviors are related to crash risk under various vehicle, roadway and environmental conditions. While the study can involve many crash types and situations, attention will be given to crashes involving lane departures and crashes at intersections.

Specific questions, by major area:

1) Crash surrogates: define crash surrogates that occur more frequently than crashes, that exhibit behaviors or circumstances similar to those observed in crashes (face validity), and that are operationally observable in the data. Validate that these surrogates predict higher crash risk than "normal" driving. Candidates include "near-crashes" or incidents, lane departure, sudden braking or headway reduction, short headway at intersections, etc. If necessary, develop analytic methods for extrapolating from surrogates to crashes.

2) Exposure and relative risk: how often, and under what circumstances, do drivers do *X*. *X* could be many things such as speed more than 10 mph over the posted limit, violate lane edges, tailgate, leave less than 1 sec headway at an intersection, fail to wear safety belts, talk on their cell phone, look at their rearview mirrors, ... How does *X* affect the risk of crashes or other crash surrogates (relative risk: crash risk with / crash risk without)?

3) External roadway/environmental descriptors: how is driving behavior *X* and crash risk affected by external descriptors *A*, *B*? External descriptors include anything outside the vehicle, so include both permanent (all highway and environmental features: rumble strips, lane width and markings, curvature, road surface, roadside hardware, etc.) and transitory (weather, light conditions, traffic flow, adjacent vehicles, etc.) features. This area includes countermeasure evaluation of existing features (e.g., effect of rumble strips). Particular attention will be given to roadway descriptors related to lane-departure crashes (e.g., run-off-road crashes, head-on crashes) and crashes at intersections.

4) Vehicle descriptors: how is driving behavior *X* and crash risk affected by vehicle descriptors *C*, *D*? Vehicle descriptors include vehicle type, controls, handling

characteristics, etc. This area includes countermeasure evaluation of existing features (e.g., ACRS).

5) Human descriptors: how is driving behavior *X* and crash risk affected by driver descriptors *E*, *F*? Driver descriptors include both "permanent" descriptors (age, gender, driving experience, crash record) and transitory descriptors (fatigue, mental state, cell phones, other distractions, etc.).

In each of areas 3-5, explore the mechanisms by which the descriptors affect driving. As appropriate, study interactions of descriptors: for example, how does the effect of a distraction (cell phone) vary under different conditions (highway characteristics, vehicle ACRS, driver fatigue)?

6) Broad issues: as appropriate, use the information and results from the previous areas to shed light on today's and tomorrow's key traffic safety issues such as reducing crashes involving speeding or young drivers, high-speed congestion conditions, or increasing the safety belt use of part-time belt users.

Attachment 2: Information about Data from Recent Studies

The 100-Car Naturalistic Driving Study was recently completed by the Virginia Tech Transportation Institute (VTTI). This study is perhaps the closest in terms of data collected to the planned SHRP II driving behavior study. A sophisticated and unobtrusive instrumentation package was installed in the vehicles of about 100 volunteer drivers for a period of one year. The instrumentation recorded a wide array of numeric and video information sampled at 10 HZ whenever the vehicle was operating. Vehicles operated in the heavily urban Washington DC and Northern Virginia area. Drivers selected tended to be younger, high mileage drivers in order to accumulate more exposure. Data were collected on over 43,000 hours of driving covering about 2 million miles. Crashes, near-crashes and incidents were identified, where an incident required an evasive maneuver that was less severe than a near-crash. Reported events included:

15 police-reported crashes
67 non-reported crashes (some producing no damage)
761 near-crashes, and
8,295 incidents

In addition, a sample of about 20,000 non-events (6 second intervals with no crash, near-crash or incident) was analyzed to produce the same summary data as for the events above. The analysis included manual review of the driver face video to assess driver behavior such as inattention and fatigue.

Several reports address the 100-Car Naturalistic Study conducted by VTTI
An Overview of the 100-Car Naturalistic Study and Findings by VTTI
http://www-nrd.nhtsa.dot.gov/pdf/nrd-12/100Car_ESV05summary.pdf

The main report on the 100-car study. April 2006 (about 500p)
http://www-nrd.nhtsa.dot.gov/departments/nrd-13/driver-distraction/PDF/100CarMain.pdf

A subsequent analysis of the 100-car study also by Virginia Tech on driver inattention, April 06 (also about 500p)
http://www-nrd.nhtsa.dot.gov/departments/nrd-13/driver-distraction/PDF/DriverInattention.pdf

Another example is the Automotive Collision Avoidance System Field Operational Test conducted by UMTRI and General Motors. The technology evaluated consisted of a combination of adaptive cruise control (ACC) and forward collision warning (FCW). ACC combines speed control with headway management. Eleven identical vehicles were driven by a total of 96 drivers over a one-year period accumulating 137,000 miles. Over 300 data channels were sampled at 10 HZ with corresponding samples of the forward video and driver face video. Each driver had a car for 4 weeks, with the ACC and FCW disabled during the first week to establish a baseline. The report points out that the largest factor in the analysis was individual differences between drivers. The authors suggest

these differences reflected 1) the assertiveness of the driver, 2) mileage traveled, and 3) the mixture of road types and traffic conditions that established the "conflict potential" of the driving environment of each driver.

Main report on the Automotive Collision Avoidance System (ACAS) Field Operational Test by GM and UMTRI, Aug 05 (about 500p)
http://www-nrd.nhtsa.dot.gov/pdf/nrd-12/acas/809900All.pdf
(There is an additional 500p of appendices)

Volpe National Transportation system Center independent evaluation of the ACAS data, March 06 (about 500p)
http://www-nrd.nhtsa.dot.gov/pdf/nrd-12/HS910569.pdf

An earlier study by UMTRI is described at:
Intelligent Cruise Control Field Operational Test conducted by UMTRI
http://www-nrd.nhtsa.dot.gov/pdf/nrd-12/icc1998.pdf

Final reports are not available yet for the Road Departure Crash Warning Study (RDCWS)
Here is a link to a larger Microsoft PowerPoint file from UMTRI on RDCWS presented in April 06
http://www.itsa.org/itsa/files/pdf/RDCW_UM_v4.pdf

An alternative analytic approach is described in:
The Extreme Value Theory Approach to Safety Estimation by Songchitruksa and Tarko. *Accident Analysis and Prevention* 38 (2006) p811-822.