Long-Term Stewardship of Safety Data from the Second Strategic Highway Research Program (SHRP 2) Letter Report: October 14, 2013

DETAILS

AUTHORS

Committee on the Long-Term Stewardship of Safety Data from the Second Strategic Highway Research Program

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October 14, 2013

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SUBJECT: Second Report from the Committee on the Long-Term Stewardship of Safety Data
            from the Second Strategic Highway Research Program

Dear Mr. Mendez, Mr. Strickland, and Mr. Wright:

In response to a request from the U.S. Department of Transportation (US DOT), the
National Research Council (NRC) formed a committee to examine the long-term stewardship
requirements for the second Strategic Highway Research Program (SHRP 2) driving-safety data
and to provide advice on strategies to meet those requirements. (See Appendix A for the
committee's statement of task and Appendix B for biosketches of the committee members.)

The committee issued its first letter report on May 3, 2013.[1] As discussed in that report,
SHRP 2,[2] including the collection of Naturalistic Driving Study (NDS) data[3] and the development
of the Roadway Information Database (RID),[4] is scheduled to end in March 2015, and decisions
are being made about the disposition of the completed driving-safety data set. The committee
indicated in its first letter report that there has been far too little experience with using driving-
safety data at the scale and complexity of the SHRP 2 data. As a result, there are many
uncertainties about the availability and use of the data set that make firm decisions about long-term
institutional and financial arrangements concerning the data ill-advised at this time. The committee
therefore recommended a phased approach to the long-term administration of the driving-safety
data. The first phase (referred to as Phase 1) would be a period of experimentation with the

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[1] The committee's first letter report is available at http://www.trb.org/SafetyHumanFactors/Blurbs/168924.aspx

[2] http://www.trb.org/StrategicHighwayResearchProgram2SHRP2/General.aspx.

[3] http://forums.shrp2nds.us

[4] http://www.ctre.iastate.edu/shrp2-s04a/

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administration of the driving-safety data and its actual use for research purposes. As explained in the committee's first letter report, Phase 1 would be expected to last about 5 years to allow sufficient time to develop and test strategies for making the data set available, facilitate its productive use, evaluate efforts to ensure confidentiality, and identify long-term and sustainable funding strategies for subsequent phases.

At the committee's most recent meeting, held July 31 through August 1, 2013, the Federal Highway Administration's (FHWA's) Associate Administrator for Safety indicated that US DOT agreed with the recommendations the committee provided in its first letter report and that the agency intends to pursue Phase 1 after SHRP 2 ends.[5] US DOT is seeking to execute an agreement with the National Academy of Sciences (NAS) to establish the Phase 1 governance board (or oversight committee) and administer Phase 1 activities. The governance board (expected to be composed of stakeholders and other interested individuals with relevant expertise, as listed in the committee's first report) would be responsible during Phase 1 for making critical policy decisions about overall operation and for setting policies for data access and use, information privacy and confidentiality, security, pricing, types of product offerings, and performance evaluation. The governance board would also oversee Phase 1 pilot studies of operating strategies and design a transition plan to subsequent phases of long-term productive use of the driving-safety data.

The committee noted that the existing SHRP 2 oversight committee could serve as a model for how the board might function. Like the SHRP 2 oversight committee, the governance board would have the ability to ask the National Research Council's Transportation Research Board (TRB) to appoint ad hoc technical committees to provide expert advice on specific topics to the board.

The committee recommended that the governance board be convened as early as possible in 2014 while SHRP 2 is still in operation. It could prepare a plan for transitioning to Phase 1 and for obtaining key empirical information about the operation and uses of the combined NDS and RID data set. In addition, convening the board before this committee has been disbanded would avoid a gap in the capacity to provide advice for planning Phase 1.

In this report, the committee provides a set of principles intended to maximize the use of the data and to ensure that their use is appropriate (e.g., that privacy is protected) and sustained for a long time. In addition, the committee provides recommendations concerning priority issues for the governance board to consider and specific activities for obtaining key empirical information in Phase 1. This report builds on the committee's first report and its discussion of Phase 1 planning, as well as on reports of recent experiences of users of the NDS data as presented at the committee's recent meeting (see Appendix C). This report has been reviewed in draft form in accordance with procedures approved by the NRC Report Review Committee (see Appendix D for a list of reviewers).

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[5] Presentation to committee by Tony Furst, Associate Administrator for Safety, FHWA, US DOT, July 31, 2013.

PRINCIPLES

Principle 1: Facilitate the use of the data by a variety of researchers. Greatest benefits will be derived from the driving-safety data if they are used by the widest possible array of researchers. Minimizing barriers to data access and making the data easier to use will promote their widespread use, which is expected to lead to benefits of increased safety, including crashes avoided and lives saved.

The committee expects that the volume of useful results coming from analyzing the data set will be proportional to the number and variety of users who have access to the data. Researchers are likely to come from a wide variety of different organizations, including federal and state agencies, original equipment manufacturers (OEMs) (e.g., motor vehicle manufacturers), academic and nonacademic research institutes, and nongovernmental organizations. Therefore, the researchers can be expected to have a wide range of analytic capabilities, financial resources, and data needs for studying the driving-safety data set. Potential impediments to broad use of the data set include the cost of accessing it, the lack of researcher experience with the data, and the limited availability of analytic tools. Researchers who have not had experience working with data sets as large and complex as this one will need expert assistance to get the most out of it.

A wide variety of researchers would be able to work with the data if they are readily accessible and available at moderate cost in formats that would not require excessive training in data handling. Accessibility and availability of many forms of data (e.g., raw data; cleaned and coded data; refined data; and derived, specialized data sets) need to be considered in planning for management and dissemination of the data. Access issues, particularly confidentiality requirements, will vary for different types of data (e.g., data with and without personally identifying information (PII)).

Reduced data sets, with PII removed or transformed, could be designed to meet the needs of some users. Such data sets can be made available through the Internet or other mechanisms that do not require high levels of security or computing power. However, some researchers will need access to data containing PII. Because access to data with PII poses additional privacy and confidentiality concerns, a higher level of security will be necessary to protect such applications.

Making some of the complex data products available to advanced users at reduced cost and developing a library of software tools would foster the growth of a user base. It will be valuable to encourage third-party data-tool development, through, for example, incentives such as prize competitions (possibly sponsored by private entities).

Data management, analysis, and visualization tools are evolving rapidly, and significant changes in capabilities and application potentials can be expected over the useful life of the driving-safety data set. In Phase 1 and beyond, to maximize the value of the data set, it will be important for the governance board to adopt a flexible approach to data policies and management that will ensure the effective use of new methods and tools.

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Principle 2: Offer multiple access opportunities. These will promote wider use of the driving-safety data.

At the present time, one operator is providing a single point of access to the NDS data for researchers. RID data are being developed separately. The committee considered two potentially beneficial approaches to facilitating the wider use of driving-safety data during Phase 1:

1. Multiple operators, each with a copy of the entire driving-safety data set, and
2. A single (prime) operator holding the sole copy of the data set, along with multiple, geographically dispersed operators at other facilities that would have remote access to—but not possession of— the data set itself.

Either of those options would have several potential benefits compared with having a single operator and a single point of data access:

- Increased capacity to provide efficient and economical data access and technical support to researchers,
- Diversification of services provided to meet the varied needs and circumstances of researchers,
- Reduced travel burden on those researchers, who would need face-to-face access to expert guidance or to the PII data, and
- Encouragement of innovation in support services, access, and delivery modalities.

The second option appears to be more practicable than the first one for Phase 1 because it would not involve the costs of establishing an appropriate infrastructure to house and operate the data at multiple sites and of transferring a copy or copies of the entire large and complex data set to multiple operators. The committee notes that the Phase 1 experience may elucidate the benefits of creating multiple full or partial copies of the data set in several locations.

Researchers will need to get Institutional Review Board (IRB) approval before they access the data. Some local IRBs may not be familiar with data of this type, so it will be more difficult– and take longer–for them to review proposed uses of the driving-safety data. Also, foreign researchers, operating under different legal requirements, may be involved in using the data either independently or in collaboration with domestic researchers. To facilitate and promote consistency in IRB reviews, it may be desirable to train or at least brief the diverse IRBs expected to review projects that use the data. A forthcoming report about the NRC study on Proposed Revisions to the Common Rule for the Protection of Human Subjects in Research in the Behavioral and Social Sciences may provide some insights into how users could interact with the IRB process more expeditiously.[6]

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[6] In its forthcoming report, the committee will address proposed changes to the current regulations for protecting research participants under Title 45, Part 46, in the Code of Federal Regulations ("the Common Rule"). The committee's report is expected to be released in December 2013 with recommendations concerning the changes that were proposed by the HHS Office of Human Research Protections (OHRP). One of OHRP's proposed changes pertains to streamlining IRB review of multisite studies under a central IRB to increase efficiencies. A related workshop report is available at http://www.nap.edu/catalog.php?record_id=18383.

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Principle 3: Protect privacy and ensure data integrity. Protecting privacy and ensuring data integrity are vital for all aspects of data use.

Procedures will need to be established for protecting privacy (which includes ensuring confidentiality) and ensuring integrity of the data while providing remote access to the data by researchers.[7] Because the NDS data contain a large amount of PII, a number of privacy issues, particularly the risk of violating the commitment to keep individual driver data confidential as promised to volunteers in the consent agreements, need to be addressed in Phase 1. It will be important to guard against the risks of disclosure that may arise when driving-safety data without PII are linked to roadway data or data from other sources and the possibility of the application of widely used re-identification techniques.

In addition, during Phase I, protocols will need to be developed and evaluated to protect the integrity of the driving-safety data to guard against unauthorized modification.[8] The application and effectiveness of data management strategies to ensure continuing integrity and security of the data will be important performance aspects of driving-safety data operation as researchers are provided appropriate access to data.

Principle 4: Document early strategies and use best practices. Near-term strategies, decisions, and approaches concerning the driving-safety data can have implications over the long term.

The driving-safety data will likely be managed, distributed, and analyzed through different physical infrastructures over the long time span of expected data use. To help ensure stability and extensibility, clear documentation of those evolving data structures is needed. Application of best data-management practices[9] by the operator will allow data users in the future to know exactly how the reduced and specialized data sets were developed.

Continuity planning for phases beyond Phase 1 will be essential to the long-term sustainability of the database. Important Phase 1 activities will include:

- Designing a transition plan to subsequent phases,
- Evaluating performance of the management and dissemination processes,
- Developing a process for appointing a governance board after Phase 1, and
- Considering relationships between the new board and the data owner in future phases.

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[7] Security and Privacy Controls for Federal Information Systems And Organizations, NIST Special Publication 800-53, Revision 4, Joint Task Force Transformation Initiative, Computer Security Division, Information Technology Laboratory, National Institute of Standards and Technology. Available at http://dx.doi.org/10.6028/NIST.SP.800-53r4.

[8] The Glossary of Key Information Security Terms provided in National Institute of Standards and Technology Computer Security Division "Interagency or Internal Report 7298, Revision 2" (May 2013, R. Kissel, ed.) defines "data integrity" as "the property that data has not been altered in an unauthorized manner. Data integrity covers data in storage, during processing, and while in transit" (Source: SP 800) and as "the property that data has not been changed, destroyed, or lost in an unauthorized or accidental manner." (SOURCE: CNSSI 4009).

[9] See, for example, http://www.oracle.com/technetwork/articles/entarch/oea-best-practices-data-gov-400760.pdf

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Principle 5: Enhance researcher collaboration. Frequent interactions among independent researchers and the governance board regarding use of the driving-safety data will promote collaboration, foster synergies, improve learning, and contribute to plans for future phases of safety-data implementation.

The governance board will have the opportunity to facilitate the continual exchange of information among diverse researchers, including information about how the data are being used in the American Association of State Highway and Transportation Officials' (AASHTO's) "concept to countermeasure" program, the National Highway Traffic Safety Administration's (NHTSA's) speeding study, and the Toyota Collaborative Safety Research Center's creation of a driver distraction database.

FHWA is currently conducting a feasibility study of its plan to establish a data enclave[10] at the Turner-Fairbank Highway Research Center that will support the use of highway-safety data, including data from SHRP 2.[11] If this plan moves ahead, it will present an opportunity for FHWA to share learning and approaches for accessing the data and ensuring the confidentiality of drivers involved in the SHRP 2 study. The committee looks forward to hearing more details about FHWA's project at its next meeting. There may be important interactions between that project and the Phase 1 planning for multiple access points to the data.

Principle 6: Use a sustainable financial model. Such a model is needed to ensure long-term availability of the data.

Preliminary estimates of the cost of making the safety data available to researchers (including housing, managing, providing access and ensuring confidentiality) were provided to the committee.[12] It will be important to develop refined cost estimates based on the actual costs of producing data products and providing researcher access during Phase 1. It will also be important to assess users' willingness and ability to pay for data access and support services, knowing that willingness to pay for the data may change over time. The Phase 1 experience with marketing and pricing data from this unusual data set will provide a factual basis for setting fees. Obtaining such experience is essential because there is a need to balance operating cost recovery with ease of data access. The committee is not aware of any large database made available to the broad community of researchers that has been able to recover all costs directly from individual end-users over multiple years. As the committee indicated in its first report, consideration of private sources of funding, including public-private partnerships, will be required for developing long-term, sustainable funding. This would be in addition to identifying strategies for marketing the data to potential users.[13]

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[10] A data enclave is a secure environment through which confidential data can be accessed remotely.

[11] Presentation to committee by Tony Furst, Associate Administrator for Safety, FHWA, US DOT, July 31, 2013.

[12] In a presentation to the committee on July 31, 2013, Jon Hankey, Senior Associate Director, Virginia Tech Transportation Institute, said, "There are a number of fixed costs that require a minimal amount of resources; even with cost share and user fees, this will be $4–5 million per year." Volpe National Transportation Systems Center of the US DOT Research and Innovative Technology Administration, Cambridge, Massachusetts, estimated annual ongoing infrastructure costs to be more than $3 million (see page 60 of Volpe's Jan 2013 draft report *Options for Long-Term Stewardship and Ownership of the SHRP 2 Safety Data*).

[13] For additional discussion, see *Sustainable Economics for a Digital Planet: Ensuring Long-Term Access to Digital Information*, by the Blue Ribbon Task Force on Sustainable Preservation and Access. http://brtf.sdsc.edu/

RECOMMENDATIONS

US DOT is seeking to execute an agreement with NAS to establish the governance board and to administer Phase 1 activities. In addition, agreements will need to be established with one or more operators. In making the following recommendations, the committee does not presuppose the terms of any agreements that will be established for Phase 1. Nevertheless, the committee recommends these priority actions by the governance board:

1. Pursue the option of using one prime operator that maintains the entire data set (containing NDS and RID data) and other operators that provide multiple access points to the data set. To meet the range of data-access, support-services, and price needs of diverse users, different locations and types of operators should be selected. The resulting experience should inform plans to move management of the database beyond Phase 1.

2. To the extent that multiple operators are to be involved in Phase 1, ensure that the agreement with the prime operator (which will hold a copy of the entire data set in Phase 1) specifically permits and facilitates multiple access points maintained by other operators, with which the prime operator will actively cooperate.

3. Explore possibilities for lessening potential IRB-related research delays, including offering consistent IRB training for cases where approvals from multiple IRBs may be required and developing an information package describing the driving-safety data designed for the researchers' use in their submission to their IRB.

4. Develop a compendium of privacy-protection and data-integrity approaches and assess their effectiveness in the context of the NDS and RID data sets as well as the planned linkages between them. Consider the applicability of those approaches to the use of the data by foreign researchers either individually or through collaboration with domestic researchers.

5. Develop operating policies for data use and qualification criteria for users.

6. Develop approaches for determining ownership of and access to derivative data products and the distribution of those products among data-access points.

7. Explore approaches for building capacity in the research community both for using the safety data and for providing user support services and access tools. For example, workshops and training courses could focus on particular types of data or applications of the data, and "train-the-trainer" programs could be used to develop knowledgeable people who can provide various types of one-on-one support, as well as one-to-many training, at multiple locations.

8. Foster an interactive and collaborative user community. The governance board should plan to serve as a clearinghouse by facilitating the continual exchange of information among diverse researchers who are using the driving-safety data in Phase 1, and it should consider how this function can grow in effectiveness after Phase 1.

9. To facilitate ease of use by researchers and enable data to be replicated or moved, use best practices in managing large and secure data sets. Establish requirements for detailed

and accurate documentation of data sets, database structures, and other data files. During Phase 1, encourage the development of a diverse portfolio of software capabilities and tools for data manipulation and analysis through incentives such as development grants and competitions.

10. Define the process for developing a business plan for long-term, sustainable funding, including exploring potential funding sources in addition to US DOT such as other federal agencies that might contribute as public-sector funding partners (e.g., the National Institutes of Health, the Centers for Disease Control and Prevention, and the National Science Foundation) and potential private sources (e.g., original equipment manufacturers, the insurance industry, and public interest groups).
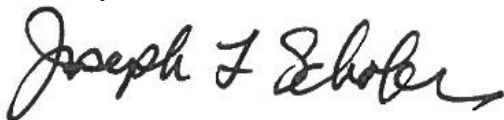
CONCLUSION

The committee expects that Phase 1 will provide important experiences with the uses of the data that will inform the development of long-term policies and management strategies for data use, protection, costs, and pricing. Given current uncertainties and resource limitations, it may not be feasible to fully answer all priority questions concerning these policy and management issues during Phase 1 according to a predetermined schedule. Furthermore, analysis methods, software, and hardware for data coding, analysis, dissemination, and security are evolving rapidly, so both capabilities and user needs may be quite different 5 years from now. It will be important for the governance board to take an adaptive and iterative approach to experimentation and decision making. Management and decision making will need to be flexible and opportunistic as outcomes from previous actions and other events become better understood.

By the end of Phase 1, the governance board will need to have assessed the efficacy of this model for data delivery, security, and funding. Key assessment considerations will include the following:

- User perspectives on accessing the driving-safety data and responses to the pricing for the access,
- Effectiveness of measures to preserve privacy and data integrity,
- Costs and cost recovery or cost-sharing approaches per unit of service provided,
- Research products produced (e.g., derivative data sets and publications), and their use and impacts, and
- Performance-evaluation metrics for the data-delivery process.

Sincerely,

Joseph L. Schofer
Chair, Committee on the Long-Term Stewardship of Safety Data from the Second Strategic Highway Research Program

Attachments

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Appendix A

Statement of Task

An ad hoc committee will examine the long-term stewardship requirements for the second Strategic Highway Research Program (SHRP 2) safety databases and will provide policy and technical advice, in the form of written reports, to the Congress and the U.S. Department of Transportation (US DOT) on recommended strategies for meeting these requirements. The committee will focus its recommendations on plans and future actions by the US DOT and other organizations that will be involved in the long-term stewardship of the SHRP 2 safety database. The committee is expected to provide recommendations concerning the following: resource requirements, including specific federal budget requirements, to administer the program; administrative and oversight structures, including institutional arrangements and legal requirements to carry out the tasks involved in long-term stewardship of the data; database management and security; and user access and support. The study is intended to support the overall purpose of the SHRP 2 safety data—to provide maximum access to the data for researchers over the next 30 to 40 years, while ensuring conformity to the data use conditions contained in the participant consent forms.

The project is sponsored by the U.S. Department of Transportation.

Appendix B

**Biographical Information on the
Committee on the Long-Term Stewardship of Safety Data from
the Second Strategic Highway Research Program**

Joseph L. Schofer is professor of civil and environmental engineering and associate dean of the Robert R. McCormick School of Engineering and Applied Science at Northwestern University. He is also director of Northwestern's Infrastructure Technology Institute, which focuses on monitoring and protecting surface transportation infrastructure. He chaired the Department of Civil and Environmental Engineering from 1997 to 2002 and was director of research and interim director of the Transportation Center for various periods until 2008. Dr. Schofer's research interests focus on planning and management of transportation systems, particularly the provision and use of data and information for effective decision making and evaluation of systems, plans, and projects. His current research includes studies of the sustainability of transportation systems, decision support for infrastructure preservation and rehabilitation, privatization of transportation facilities, and transportation policy. Dr. Schofer has been significantly engaged in transportation data issues through the technical activities of the Transportation Research Board, including the Data and Information Systems Section of the Policy and Organization Group; the Special Task Force on Data for Decisions and Performance Measures; and the Task Force on Understanding New Directions for the National Household Travel Survey. He is also currently a member of the SHRP 2 Technical Coordinating Committee for Capacity Research. Dr. Schofer chaired the National Research Council (NRC) Committee on Equity Implications of Evolving Transportation Finance Mechanisms. He also chaired the NRC Committee to Review the Bureau of Transportation Statistics' Survey Programs. He is a member of other advisory organizations, including the Congestion Pricing Technical Group for the Chicago Civic Consulting Alliance, and the Transportation Committee of the Chicago Metropolitan Agency for Planning. He earned a B.E. degree from Yale University and M.S. and Ph.D. degrees from Northwestern University, all in civil engineering.

John F. Adam is the highway division director and chief engineer for the Iowa Department of Transportation. He was appointed interim director in January 2010 and was permanently appointed in September 2010. In this position, Mr. Adam is responsible for all aspects of highway infrastructure, including right-of-way management, project development from design through construction and contract administration, and operation and maintenance of the system, including winter maintenance operations. Before holding the position of highway division director and chief engineer, he spent 8 years as the statewide operations bureau director, where he was responsible for the functional areas of maintenance, materials, contracts, construction, local systems, and specifications. Mr. Adam is an active member of the American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on Highways, and the AASHTO Standing Committee on Highway Traffic Safety. He is a member of the Industry Advisory Council for the Construction Engineering Program at Iowa State University. He also serves on the executive board for the National Concrete Pavement Technology Center. Mr. Adam served as a member of the Iowa Highway Research Board for 10 years, and served as board chair for a portion of that period. He holds a B.S. degree in construction engineering from Iowa State University. He is a licensed civil engineer in the State of Iowa.

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Troy E. Costales has more than 20 years of experience in transportation safety. He has served as the transportation safety division administrator at the Oregon Department of Transportation and governor's highway safety representative since 1997. Mr. Costales also serves as a member of the executive management team for the Oregon Department of Transportation. Before joining the Transportation Safety Division in 1997, he supervised the statewide crash data system. He has served for seven terms as a member of the board for the Governors Highway Safety Association (GHSA) and as chair of GHSA from December 2011 through August 2012, and he led the member services committee. Mr. Costales served as a member of the American Association of State Highway and Transportation Officials (AASHTO)–Standing Committee on Highway Traffic Safety; and as a team member for the revisions to the NHTSA impaired driving program management course. He is currently serving as a member of the Transportation Safety Management Committee and the National Cooperative Highway Research Program Panel 17-18 for the Transportation Research Board. Mr. Costales is also currently serving as a member of the AASHTO Strategic Highway Safety Plan initiative, and he is on the Technical Advisory Panel of the International Association of Chiefs of Police–Drug Evaluation and Classification Program. Mr. Costales received a B.S. degree in management from George Fox University.

Forrest M. Council is a senior research scientist at the University of North Carolina Highway Safety Research Center (HSRC), where he served as director from 1993 to 1999. He is also a senior research consultant to VHB, a transportation engineering firm in Vienna, Virginia. In his 40 years at HSRC, Dr. Council directed more than 20 projects and authored more than 150 articles and reports. His research has ranged from studies of motor vehicle injury for specific populations (children, beginning drivers, seat-belted occupants) to projects aimed at identifying and strengthening research methodologies in the roadway safety field. He has directed the planning, development, and implementation of FHWA's Highway Safety Information System, a database that contains crash, roadway inventory, and traffic volume data for nine states. Dr. Council chaired the National Research Council's Committee for Review of the Federal Motor Carrier Safety Administration's Large Truck Crash Causation Study and served on the Research and Technology Coordinating Committee and the Committee for Guidance on Setting and Enforcing Speed Limits. He has also served on several Transportation Research Board standing committees and National Cooperative Highway Research Program project panels. Dr. Council is chair of the SHRP 2 Safety Technical Coordinating Committee for Safety Research. He earned B.S., M.S., and Ph.D. degrees from North Carolina State University, all in civil engineering.

James P. Foley is a senior principal human factors engineer at the Toyota Technical Center in Ann Arbor, Michigan. At the center, he is a team leader for human factors research in the Collaborative Safety Research Center. He has more than 30 years of experience in automotive human factors, traffic safety, and intelligent transportation system (ITS) technologies. Previously, he worked at Noblis, where he provided support and human factors expertise to the U.S. Department of Transportation and worked closely with the National Highway Traffic Safety Administration and the ITS program office. Dr. Foley is active in both SAE Safety and Human Factors and ISO WG8 committees. He is a member of the TRB Technical Expert Task Group on Data Access for the Naturalistic Driving Study. He received a Ph.D. degree in industrial engineering from Purdue University.

Michael J. Franklin is a professor of computer science at the University of California, Berkeley, specializing in large-scale data management applications and infrastructure. He works primarily in database and operating systems and networking technology areas. Dr. Franklin is director of the Algorithms, Machines and People Lab (AMPLab), an industry- and government-supported collaboration of students, postdocs, and faculty who specialize in data management, cloud computing, statistical machine learning, and other topics necessary for making sense of vast amounts of varied and unruly data. He is a founder of Truviso, a high-performance analytics software company in Foster City, California, that has been acquired by Cisco. Dr. Franklin is a member of the NRC Committee on the Analysis of Massive Data. He received a Ph.D. degree in computer science from the University of Wisconsin at Madison.

Nicholas J. Garber is the Henry L. Kinnier Professor Emeritus of Civil Engineering in the Department of Civil and Environmental Engineering at the University of Virginia. He has authored more than 120 refereed publications and reports and has co-authored two textbooks. He is a registered professional engineer in the Commonwealth of Virginia and a chartered engineer of the United Kingdom. He is also a Distinguished Member of the American Society of Civil Engineers (ASCE) and a Fellow of the Institute of Civil Engineers of the United Kingdom. He is a member of ASCE's Committee on Highway Safety and Traffic Operations and a former member of the editorial board of ASCE's Journal of Transportation Engineering. He has served as the principal investigator for many research projects sponsored by federal, state, and private agencies. His research areas include traffic operations and highway safety, with particular emphasis on intelligent transportation systems, speed management on high-speed roads, work zones, and large truck safety. Dr. Garber has served on the following committees of the Transportation Research Board: the Executive Committee, the Oversight Committee for the Second Strategic Highway Research Program, and the Committee on Research Priorities and Coordination in Highway Infrastructure and Operations Safety. Dr. Garber served as chair of the Transportation Research Board Committee on Traffic Safety in Maintenance and Construction Operations. Before joining the University of Virginia faculty, he taught at the University of Sierra Leone and the State University of New York at Buffalo and worked as an engineer in London and Sierra Leone. Dr. Garber received a Ph.D. degree in civil engineering from Carnegie Mellon University. He was elected to the National Academy of Engineering in 2004.

Rochel Gelman is professor of psychology and cognitive science in the Department of Psychology and Center for Cognitive Science at Rutgers, the State University of New Jersey. She has extensive experience working with observational (usually, videotaped) data and in pairing the observational method with experimental ones. Ongoing research in her lab includes studies of both verbal and nonverbal representations of numbers and arithmetic. Part of her research is focused on the task of developing the kind of theory of learning that accommodates both the early learning that occurs on the fly and the later learning that requires effort and a protracted period of time. Before moving to Rutgers, Dr. Gelman was on the faculties of the University of Pennsylvania and the University of California, Los Angeles. She received a Ph.D. degree in psychology from UCLA. Dr. Gelman was elected to the National Academy of Sciences in 2006.

Dorothy J. Glancy is a professor of law at the Santa Clara Law School of Santa Clara University. Her academic research interests include policy issues regarding privacy and advanced transportation programs known as intelligent transportation systems. Professor Glancy has served as a privacy auditor for the Metropolitan Transportation Commission in the San Francisco Bay Area, worked with the U.S. Department of Transportation regarding privacy policy issues, and

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served as a consultant regarding legal and regulatory issues for US DOT's Rural Interstate Corridor Communications Study Report to Congress (2007). She received a J.D. degree from Harvard Law School and a B.A. degree from Wellesley College.

Joanne L. Harbluk is a human factors specialist with the Ergonomics and Crash Avoidance Division of Transport Canada, which is responsible for transportation policies and programs within the Canadian government. She is active in research investigating the interaction of the driver, vehicle, and road systems. Her current work is focused on the safety of in-vehicle information and communication systems and the efficacy of crash avoidance and mitigation systems for drivers. She is involved with the Canadian Naturalistic Driving Study, which was undertaken with the goal of obtaining data on driver performance and behavior in the moments leading up to a crash. Dr. Harbluk is an adjunct research professor in the Psychology Department at Carleton University and an associate member of the Center for Applied Cognitive Research (Carleton University). She is chair of the Transportation Research Board's Technical Expert Task Group on Data Access for the Naturalistic Driving Study. She earned a Ph.D. degree in cognitive psychology from the University of Western Ontario and was a Fogarty International Research Fellow at the National Institutes of Health, Laboratory of Clinical Studies, in the Cognitive Neurosciences Section.

Julia I. Lane is a senior managing economist at the American Institutes for Research in Washington, D.C. Previously, she served as a program director at the National Science Foundation, where she led a program to document the outcomes of science investments. Dr. Lane also served as a senior vice president at the National Opinion Research Center at the University of Chicago, where she developed and managed a data enclave to provide a protected environment within which authorized researchers could access sensitive data remotely. She was a senior research fellow at the U.S. Census Bureau. Dr. Lane's specialties are science policy; innovation policy; development and analysis of large scale databases; administrative, transaction, and survey data; confidentiality; and workforce and economic development. She received a Ph.D. degree in economics and an M.A. degree in statistics from the University of Missouri at Columbia.

Daryl Pregibon is a research scientist at Google, Inc. His work focuses on data mining, the interdisciplinary field that combines statistics, artificial intelligence, and database research. From 1981 to 2004, he worked at Bell Labs and AT&T Labs and served as head of statistics research for 15 years. He is a past member of the NRC Committee on National Statistics, NRC Committee on Applied and Theoretical Statistics (past chair), and NRC Committee on Technical and Privacy Dimensions of Information for Terrorism Prevention and Other National Goals. He also served on the National Advisory Committee for the Statistical and Applied Mathematical Sciences Institute, and he is a former director of the Association for Computer Machinery's Special Interest Group on Knowledge Development and Data Mining. In 1985, he co-founded the Society for Artificial Intelligence and Statistics. Dr. Pregibon received a Ph.D. degree in statistics from the University of Toronto.

Jerome P. Reiter is the Mrs. Alexander Hehmeyer Professor of Statistical Science in the Department of Statistical Science at Duke University. Dr. Reiter participates in both applied and methodological research in statistics. He is most interested in applications involving social science and public policy. His methodological research focuses mainly on statistical methods for protecting data confidentiality, for handling missing data, and for making causal inferences. Dr. Reiter served as a member of the NRC Panel on Collecting, Storing, Accessing, and Protecting Biological Specimens and Biodata in Social Surveys. He also served on the NRC Panel on

Confidentiality Issues Arising from the Integration of Remotely Sensed and Self-Identifying Data. Dr. Reiter received a Ph. D. degree in statistics from Harvard University.

Johanna P. Zmud is director of the RAND Transportation, Space, and Technology Program. She has 24 years of experience in survey research design, implementation, and statistical analysis. Before joining RAND, she served as founding owner and president of NuStats, a U.S.-based survey science consultancy specializing in complex and large-scale social research studies. She has used social science and survey science practices in many areas of transportation research. Currently, she is co-chair of the International Steering Committee for Travel Survey Conferences. Dr. Zmud served on the NRC Committee on Equity Implications of Alternative Transportation Finance Mechanisms. She also served on the NRC Committee on Strategies for Improved Passenger and Freight Travel Data. She earned a Ph.D. degree from the Annenberg School for Communication at the University of Southern California.

Appendix C

Information-Gathering by the Committee

In the course of preparing this report, the committee held a public session as part of its meeting on July 31, 2013 to hear presentations from representatives of organizations involved in driving-safety research. The committee wishes to thank the following individuals for making presentations: Karin Bauer, MRIGlobal; Tony Furst, Federal Highway Administration of the U.S. Department of Transportation; Clark Gaylord and Jon Hankey, Virginia Tech Transportation Institute; Pamela Hutton, American Association of State Highway and Transportation Officials; Dan McGehee, University of Iowa; Omar Smadi, Center for Transportation Research and Education at Iowa State University; and Trent Victor, Chalmers University.

Appendix D

Acknowledgement of Reviewers

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise in accordance with procedures approved by the National Research Council Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report: Thomas Cole, Idaho Transportation Department; Cynthia Dwork, Microsoft; Gerald W. Gates, privacy consultant; Jurek G. Grabowski, AAA Foundation for Traffic Safety; Nancy Y. McGovern, Massachusetts Institute of Technology Libraries; and Michael Perel, safety knowledge engineer.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Louis J. Lanzerotti, New Jersey Institute of Technology, and Susan Hanson, Clark University. Appointed by the National Research Council, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the author committee and the institution.