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1998 Executive Committee

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TRANSPORTATION RESEARCH BOARD
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

National Academy Press
ISBN 0-309-00000-0

Special Report 253

Review of the National Automated Highway System Research Program

Committee for a Review of the
National Automated Highway System
Consortium Research Program

Transportation Research Board
National Research Council

National Academy Press
Washington, D. C. 1998

Transportation Research Board Special Report 253

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NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competencies and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to the procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

This study was sponsored by the Federal Highway Administration of the U.S. Department of Transportation.

Library of Congress Cataloging-in-Publication Data

National Automated Highway System Research Program—A Review / Committee for a Review of the National Automated Highway System Consortium Research Program.
p. cm. — (Special report ; 253)
ISBN 0-309-06452-X
1. Highway research—United States. 2. Intelligent Vehicle Highway Systems—United States. 3. Traffic engineering—United States. 4. Traffic safety—United States. I. National Research Council (U.S.). Transportation Research Board. II. Series: Special report (National Research Council (U.S.). Transportation Research Board) ; 253.
TE192.R48 1998
625.7'072073—dc21 98-15309
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Committee for a Review of the National Automated Highway System Consortium Research Program

ARDEN L. BEMENT, JR., *Chairman,* Purdue University, West Lafayette, Indiana
HERBERT H. RICHARDSON, *Vice Chairman,* Texas A&M University System, College Station
LAWRENCE D. DAHMS, Metropolitan Transportation Commission, Oakland, California
THOMAS B. DEEN, independent consultant, Stevensville, Maryland
JOHN J. FEARNSIDES, MITRE Corporation, McLean, Virginia
MICHAEL M. FINKELSTEIN, Michael Finkelstein & Associates, Washington, D.C.
THOMAS D. LARSON, independent consultant, Lemont, Pennsylvania
NANCY G. LEVESON, Massachusetts Institute of Technology, Cambridge, and University of Washington, Seattle
JOHN E. MAJOR, QUALCOMM, Inc., San Diego, California
ROBERTA J. NICHOLS, Ford Motor Company (retired), Plymouth, Michigan
JEROME G. RIVARD, Global Technology and Business Development, Harrison Township, Michigan
DANIEL ROOS, Massachusetts Institute of Technology, Cambridge
WAYNE SHACKELFORD, Georgia Department of Transportation, Atlanta
THOMAS B. SHERIDAN, Massachusetts Institute of Technology, Cambridge
DAVID N. WORMLEY, Pennsylvania State University, University Park

Staff

THOMAS R. MENZIES, JR., Study Director, Transportation Research Board
ALAN S. INOUYE, Program Officer, Computer Science and Telecommunications Board
JAMESON M. WETMORE, Cornell University

Preface

The Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) significantly expanded the role of the U.S. Department of Transportation (DOT) in research and development of intelligent transportation systems (ITS). In so doing, ISTEA called upon DOT to "develop an automated highway and vehicle prototype from which future fully automated intelligent vehicle-highway systems can be developed."[1] DOT responded to this legislative mandate by budgeting approximately 10 percent of its ITS research and development funds for a National Automated Highway System research program aimed at evaluating and specifying a fully automated highway system for future deployment.

"Fully automated" driving—frequently characterized as "hands-off, feet-off" driving—has long been viewed by some researchers and technologists as an eventual outcome of developments in ITS. Full automation commonly is defined as requiring no control or very limited control by the driver; such automation would be accomplished through a combination of sensor, computer, and communications systems in vehicles and along the roadway. Fully automated driving would, in theory, allow closer vehicle spacing and higher speeds, which could enhance traffic capacity in places where additional road building is physically impossible, politically unacceptable, or prohibitively expensive. Automated controls also might enhance road safety by reducing the opportunity for driver error, which causes a large share of motor vehicle crashes. Other potential benefits include improved air quality (as a result of more-efficient traffic flows), increased fuel economy, and spin-off technologies generated during research and development related to automated highway systems.

The proposed benefits of full automation remain uncertain and continue to be the subject of debate, however. Some highway safety experts, for

[1] The complete language of the ISTEA provision appears in Chapter 1.

instance, believe that automated highway systems would have only marginal impact on overall highway safety, especially if these systems were deployed mainly on urban freeways and major commuter routes (which account for a relatively small share of the most serious motor vehicle crashes). Questions have been raised about the technical feasibility of implementing and maintaining automated systems that are tolerant to failure. Motorists' ability to use these technologies in a safe and effective manner also has been questioned. Some transportation planners and environmentalists have concerns about the secondary effects these systems might have: substantial increases in vehicle throughput could lead to higher total emissions and increased traffic congestion where automated and nonautomated roads merge. At another level, there are concerns about whether it would be fair and politically feasible to dedicate travel lanes to automated vehicles and whether the highway and automotive industries would accept the risk of developing and introducing automation technologies, given the liability uncertainties.

In response to the congressional mandate for prototyping and testing of an automated highway system by 1997, DOT research was focused in a consortium of public- and private-sector organizations drawn from academe and from the automotive, highway, electronics, and communications industries. Such a partnership was expected to offer a level of resources and range of perspectives necessary to address the many technical, economic, and societal issues raised by full automation and provide the leadership needed to build enthusiasm for the early selection of a preferred system configuration.

The National Automated Highway System Consortium (NAHSC) began work in October 1994 with nine core members: Bechtel Corporation, the California Department of Transportation, Carnegie Mellon University, Delco Electronics Company, General Motors Corporation, Hughes Electronics Corporation, Lockheed Martin Corporation, Parsons Brinckerhoff, Inc., and the University of California at Berkeley's Partnership for Advanced Transit and Highways (PATH) Program. This consortium was charged with evaluating alternative automated highway system concepts and specifying, prototyping, and testing a "preferred" automated highway system that would serve as the basis for the development of future automated highway systems.

The consortium staged a public demonstration of automated vehicle and highway technologies in August 1997. The next item on its agenda was completing the process of selecting and testing a preferred automated highway system. In the meantime, however, DOT had indicated its intention to deemphasize the selection of a system specification and focus instead on the development and deployment of nearer-term intelligent vehicle technologies, such as collision warning systems. This successor program, the Intelligent Vehicle Initiative (IVI), would reshape and further integrate several advanced vehicle, highway, and transit research and development programs under way

within the National Highway Traffic Safety Administration, the Federal Transit Administration, and the Federal Highway Administration.

STUDY CHARGE AND ORGANIZATION OF REPORT

As these changes were being debated, DOT's ITS Joint Program Office asked the National Research Council—under the auspices of the Transportation Research Board and with assistance from the Computer Science and Telecommunications Board—to convene a study committee to assess the appropriateness of the original vision and mission of the National Automated Highway System Research Program, the consortium's results and the effectiveness of the approach taken by NAHSC in carrying out its charge, and the role of the consortium in future research on intelligent vehicles. Specifically, the study committee was asked to address four questions:

1. Given what has been learned to date about the technical, societal, institutional, and economic feasibility of an automated highway system, is the National Automated Highway System Research Program vision and mission still appropriate and worthy of major research investment?
2. Are there elements of this research that should be continued in the Intelligent Vehicle Initiative, which focuses on a nearer-term horizon?
3. In representing a new approach for conducting research and development, has NAHSC been effective and efficient?
4. Is there an appropriate role for this consortium in the Intelligent Vehicle Initiative?

Under the leadership of Arden L. Bement, Jr., Basil S. Turner Distinguished Professor of Engineering at Purdue University, and Herbert H. Richardson, Associate Vice Chancellor for Engineering and Director of the Texas Transportation Institute at Texas A&M University, a committee of experts was convened from the fields of transportation planning and operations, communications and information systems, traffic safety and human factors, vehicle design and production, and transportation research policy and management. The study committee held its first meeting in conjunction with the NAHSC demonstration of technologies in San Diego, California, in August 1997. Two additional committee meetings were convened in the fall of 1997. During the course of its deliberations, the study committee heard from a number of individuals from the automotive, trucking, insurance, and highway industries, as well as the safety and environmental communities (see Appendix B). Committee members also interviewed program staff from several of the organizations in NAHSC and invited the consortium's management to brief the committee on its procedures, accomplishments, and work plan. These discussions were invaluable to the committee in respond-

ing to the questions DOT posed. At the outset of the study, the committee debated the study scope and whether it should go beyond the specific questions asked by DOT. The committee elected, however, to adhere closely to the charge set forth by the sponsor. The project's accelerated time schedule precluded a more complete evaluation of automated highway system technologies and options for furthering their development and implementation. This report, therefore, is intended to be a program review rather than a critique of specific technologies. Nevertheless, the committee anticipates that its conclusions concerning the National Automated Highway System Research Program will have broader application within the ITS program.

The committee's responses to the foregoing questions appear in Chapter 1 of this report. The remainder of the report provides support and background for these responses. Chapter 2 examines the history of interest in automated vehicle and highway systems, including the events leading up to the creation of the National Automated Highway System Research Program. Chapter 3 takes a closer look at two key transportation needs—reducing the number of motor vehicle crashes and relieving traffic congestion—that often serve as rationales for the development of automated vehicles and highways. This chapter also describes various vehicle and highway automation concepts, from partially to fully automated (hands-off, feet-off) driving. Chapter 4 reviews the history, organization, and accomplishments of NAHSC in carrying out its charge to demonstrate and specify an automated highway system. Key findings from the report, which provide the basis for the study committee's responses to DOT's questions, are summarized in Chapter 5.

This report has been independently reviewed according to the procedures of the National Research Council's Report Review Committee. Reviewers were chosen for their diverse perspectives and technical expertise; they were asked to provide candid and critical comments to assist the study committee and the Research Council in making the report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. (The contents of review comments and the draft manuscript remain confidential to protect the integrity of the deliberative process.) The study committee thanks the following individuals for their participation in the review: Barry W. Boehm, University of Southern California; Alexander H. Flax, Potomac, Maryland; Lester A. Hoel, University of Virginia; Craig Marks, Allied Signal, Inc. (retired); John L. McLucas, Alexandria, Virginia; Robert M. Nicholson, National Highway Traffic Safety Administration (retired); Joseph L. Schofer, Northwestern University; C. Michael Walton, University of Texas; David L. Winstead, Maryland Department of Transportation. Although these individuals have provided many constructive comments and suggestions, responsibility for the final content of this report rests solely with the study committee and the National Research Council.

ACKNOWLEDGMENTS

Thomas R. Menzies, Jr., managed the study and drafted this report, with direction and guidance from the study committee and under the supervision of Stephen R. Godwin, Director of Studies and Information Services for the Transportation Research Board (TRB). Alan S. Inouye and Jameson M. Wetmore provided assistance during committee meetings and in drafting sections of the report.

Suzanne Schneider, Assistant Executive Director of TRB, managed the report review process. The final manuscript was edited and prepared for publication by Martha Firestine and David M. Stearman under the supervision of Nancy A. Ackerman, Director of Reports and Editorial Services for TRB. Marguerite Schneider assisted with committee travel and meeting arrangements and provided word processing support for the preparation of the final manuscript.

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APPENDICES