

# SHRP-IDEA Program

## Successful Activity To Have Wider Focus at TRB

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**T**he Strategic Highway Research Program Innovations Deserving Exploratory Analysis (SHRP-IDEA) program was set up to develop and test innovative concepts for solving critical technical problems in the program areas addressed by SHRP: pavement performance, asphalt, concrete and structures, highway operations, and highway construction. The IDEA program funded innovative projects that offered the potential to be "leapfrog" technologies or significant improvements in highway practice. Typically, the first phase of an IDEA project involved a feasibility study of the concept under a fixed-price contract of less than \$100,000. The technical tasks for the feasibility research were arranged in two or more sequential segments to reduce the risk of failure. Feasibility studies on IDEA concepts were generally completed within a year.

Several of the IDEA concept evaluations proved to be highly successful and were given subsequent IDEA awards for prototype testing of products in near-to-field operating conditions, carried out in cooperation with, or with the cost shared by, product users or highway agencies. After an IDEA concept proved successful, SHRP worked with the investigators to identify potential users for the product and to initiate cooperative projects for field trials.

The SHRP-IDEA program incorporated several unique features to attract scientific and engineering talent and to assist innovators unfamiliar with technology requirements for highway practice. The IDEA proposals were first reviewed by a panel of impartial technical experts to select concepts on the basis of their technical merit for highway ap-

plication. The selected proposals were then examined by a separate team of experts knowledgeable in highway practice. During a four-year period, technical panels reviewed more than 400 proposals to select those with applicable concepts; 40 IDEA projects were awarded. IDEA projects thus far have resulted in 12 key products, several of which represent emerging technologies. After conceptual evaluation, 7 of the IDEA concepts proved not to be feasible and were discontinued. Eighteen IDEA concepts resulted in usable products, and 13 other concepts proved feasible but required a longer-term investigation to produce a product for highway application.

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emerged from projects performed by investigators with no prior experience in highway research or with the highway industry. IDEA concepts originated from a wide range of technical disciplines, including areas such as genetic engineering, advanced experimental and analytical mechanics, laser optics, surface layer physics, nondestructive evaluation (NDE), and electronic systems. The IDEA program approach made feasible new tech-

nologies that would not otherwise have emerged or been tested for highway application. The SHRP staff maintained close contact with the investigators on IDEA projects to help increase the chance that the project would result in a product for highway application.

Examples of successes in developing innovative technologies and products through IDEA projects are discussed in the following sections.

### **New Sensor Technologies To Determine Pavement Performance**

A strip-type weigh-in-motion (WIM) system and a noncontact pavement thickness measurement technology were developed through the SHRP-IDEA program.

#### **Strip-Type WIM System**

In the strip-type WIM system project, Chris Winkler of the University of Michigan Transportation Research Institute, in cooperation with David Cebon of Cambridge University and the Golden River Corporation in the United Kingdom, successfully tested the applicability of a new capacitance-type transducer to measure dynamic loads on pavements under vehicle operating speeds. The transducer system is currently being marketed by the Golden River Corporation and has been used in SHRP test sections of several states.

#### **Ground-Penetrating Radar Technology**

A new noncontact pavement thickness measurement technology using the ground-penetrating radar (GPR) technology was developed and tested by Kenneth Maser of Infrasense, Inc. The concept uses innovative GPR data analysis schemes and software. Extensive field tests have proved the method's

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applicability for determination of asphalt and base layer thickness in pavements, and it is now available for highway use.

## **Quality Control Technology for Asphalt Construction**

The SHRP-IDEA program developed and trial-tested innovative technologies with the potential to significantly enhance quality control in asphalt construction.

### **Asphalt Processing**

A new investigator, R. M. Pearson of Tri-Valley Research, successfully proved the applicability of the physical principles of nuclear magnetic resonance (NMR) technology to the quantitative measurement of the asphalt content in asphalt-aggregate mixtures. The evaluation also demonstrated the possibility of using NMR relaxation data to determine rheological characteristics of both neat asphalt and asphalt in aggregate mixtures. NMR technology offers the potential for design and construction of automated monitoring and quality control systems for asphalt processing. Bench scale testing is now in progress to determine the potential applicability of the technology to such monitoring.

### **Aggregate Processing**

Another new investigator, Felix Alba Consultants, successfully combined computer image processing, statistical modeling, and geometric analysis of video images. Images made from aggregates moving on a conveyor belt were used to achieve real-time estimates of aggregate gradation within an error range of about 5 percent. This IDEA technology offers a workable approach to achieve on-line and real-time measurement and control of aggregate size distributions and to precisely proportion the distributions for asphalt construction. Testing of a prototype system is currently under way in a follow-up IDEA investigation through the newly established NCHRP-IDEA project in TRB.

## **Corrosion Measurement and Control Technologies for Concrete and Structures**

The SHRP-IDEA program helped to advance new technology for corrosion control of

marine substructures and developed an innovative electrochemical method to measure the corrosion rate of rebars in bridge decks.

### **Corrosion Control of Marine Substructures**

Alberto Sagues of the University of South Florida, in cooperation with the Florida Department of Transportation, tested a sprayed zinc anode coating system for controlling corrosion in marine substructures. A flame-sprayed zinc coating was applied for cathodic protection after the corroded structural sections had been cleaned to generate adequate current delivery (about 1 mA/ft<sup>2</sup>). The investigating team is now developing application guidelines for this technology through an NCHRP-IDEA project in TRB.

### **Measurement of Corrosion Rate of Rebars**

D. McDonald and Bruce Pound of Stanford Research International successfully demonstrated that electrochemical impedance spectroscopy can be used to reliably determine the corrosion rate in reinforced concrete by passing an ultra-low-frequency current through the concrete and measuring its polarization resistance. The impedance was shown to be sensitive to the presence and extent of rebar corrosion. The method identifies the spatial resolution of corroding areas in concrete structures and is currently being tested on a bridge deck in a second-phase IDEA project funded in cooperation with, and with the cost shared by, the California Department of Transportation.

## **Technologies for Highway Operations**

The SHRP-IDEA program produced a powerful weather prediction technology to provide site-specific snow forecasts and an innovative, maintenance-free crash cushion that uses new materials designed for highway operations.

### **Weather Prediction Technology**

Elmar Reiter of Wels Research Corporation, with no prior experience in highway research, produced a microcomputer-based, user-friendly snow predictor with graphical user interface for accurately forecasting snow. The system incorporates localized and site-specific temperature, topography, and wind velocity conditions. This weather prediction technology

has been estimated to save about 10 percent of the agency cost for the removal of snow in highway operations by state agencies. The IDEA product was successfully field tested in a second-phase IDEA project in cooperation with, and with the cost shared by, the Colorado Department of Transportation. The product is now ready for marketing by Wels Research Corporation. The technology has the general

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potential for site-specific applicability to the prediction of other hazardous conditions or catastrophic events such as floods.

### **Maintenance-Free Crash Cushion**

John F. Carney of Vanderbilt University successfully experimented in the laboratory with the applicability of high-molecular-weight-high-density polyethylene (HMW/HDPE) to the design of shape-recoverable crash cushions.

The cylindrical geometry of the material showed near to complete recovery after a simulated impact. Truck-mounted attenuator designs have been developed to withstand 45- to 60-mph impacts. The Washington State Department of Transportation plans to field test the new crash cushion design at vehicle operating speeds. This IDEA product is expected to start a new trend for cost-effective crash cushion design and application.

## **Emerging Technology Issues for Waste Utilization in Highway Construction**

The Intermodal Surface Transportation Efficiency Act of 1991 (Public Law 102-240, Section 1038) requires increased use of recycled material and used rubber products in pavement construction. In response to the issue of enhancing waste utilization in

highway construction, IDEA innovations were solicited on waste materials characterization and measurement. Innovative analytical and experimental techniques were developed for boosting the technology base available to predict potential performance of waste products in pavement construction.

#### **Model of Asphalt Chemical Structure**

An IDEA project by Paul Painter of Penn State University tested a new approach for predicting the phase behavior of asphalt in the presence of recycled material. Detailed knowledge of the chemistry and aromaticity of the asphalt binder was used to model the asphalt's chemical structure and determine its compatibility with the recycled material.

#### **Measurement of Oxidation Characteristics of Crumb Rubber To Determine Weathering of Asphalt-Rubber Mixtures**

Used rubber is a thermoset material and the oxidation of rubber particles may result in structural breakdown and vastly reduced recyclability. In this IDEA project, Anthony Andrady of Research Triangle Institute successfully developed experimental techniques for measurement of the oxidation of crumb rubber particles to determine the weathering characteristics of asphalt-rubber mixtures. Andrady found it feasible to estimate the recyclability of asphalt rubber by measuring the oxidation and to potentially select appropriate additives for improved recyclability.

#### **Transition to Broader IDEA Program in TRB**

A broader IDEA program has been under development since July 1992. From January 1, 1993, SHRP-IDEA has made the transition to a new IDEA program managed by TRB. The new program uses the basic approach that was highly successful in SHRP-IDEA and will expand to broader areas of transportation technology in support of the National Cooperative Highway Research Program (NCHRP-IDEA), Intelligent Vehicle-Highway Systems (IVHS-IDEA), and the Transit Cooperative Research Program (Transit-IDEA).

The IDEA projects in TRB, in general, have the following key characteristics:

- Technical concepts for which success may be highly risky but which, if successful, offer the potential for significant technological breakthrough and a large payoff.

- Innovations with potential for advancing state-of-the-art transportation technologies or with promise for cost-effective application to highway and intermodal surface transportation, IVHS, and transit.

- Advanced, cost-effective, and user-friendly technologies developed in engi-

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### **The IVHS-IDEA component, supported by the Federal Highway Administration, will develop cost-effective innovations for potential application to IVHS practice.**

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neering sectors other than transportation but not yet tested or applied to transportation practice, including new technologies and concepts originating overseas.

The new IDEA program will evaluate the feasibility of new technological concepts and examine the potential application of cross-cutting technological advances. Each IDEA investigation will be conducted with a fixed-price contract not to exceed \$100,000, will be completed within about a year, and will be structured to effectively develop the technology base necessary to produce products for practice. The program is envisioned as a conduit for the transfer of promising, proven, and tested concepts to other agency or industry programs for larger-scale development and implementation.

Proposals to perform feasibility evaluations of innovative technical concepts and to test proven IDEA products under actual or simulated highway operating conditions will be considered. The IDEA program will thus provide an opportunity for testing both new concepts and concepts developed from other sources that may have progressed beyond the conceptual stage but have not been tested for application. Key areas for inno-

vation will be identified, but there will be flexibility for the innovator to submit proposals in broad technology areas in each IDEA program component. Proposals will be permitted for each component at any time while the program is active. New IDEA program announcements may be issued periodically (annually or biannually) in each IDEA program component.

The review and approval process may vary in each program component and will be carried out through the consensus and recommendation of a technical panel.

The IDEA program will operate under the newly created TRB Special Programs Division and will have the following three major components.

#### **NCHRP-IDEA**

The NCHRP-IDEA component is jointly funded by the Federal Highway Administration and state highway agencies in cooperation with the American Association of State Highway and Transportation Officials. NCHRP-IDEA seeks innovations in all areas of highway and intermodal surface transportation technology, particularly

- Pavement materials, construction, and performance, with emphasis on quality control, pavement performance monitoring, and utilization of recycled and waste materials for pavement construction;

- Pavement maintenance, repair, and rehabilitation, with emphasis on the development of new material systems and advanced technologies for pavement maintenance;

- Structural materials, with emphasis on improvement of structural performance and on increased resistance of structures to earthquakes and natural hazards; and

- Safety, with emphasis on improvement of the safety of the traveling public and highway maintenance crews by applying advanced barrier concepts, warning systems, and innovative traffic control devices.

An NCHRP-IDEA committee has been established by TRB and is providing guidance for the formulation and conduct of the NCHRP-IDEA component. An NCHRP-IDEA program announcement was released in January 1993.

## IVHS-IDEA

The IVHS-IDEA component, supported by the Federal Highway Administration and the National Highway Traffic Safety Administration, develops cost-effective innovations for potential application to IVHS practice. IVHS-IDEA fosters innovations by using interdisciplinary technical talent and by applying unique developments from high-technology advances, such as those in robotics, communications, electronics, and aerospace engineering. The technical project areas selected support the broad objectives of the national IVHS program and focus on innovative technologies, methods, and processes that accomplish the following potential goals (1):

- Improve safety of surface transportation, including private vehicles, transit fleets, commercial vehicles, and hazardous materials transporters, by significantly reducing fatalities and injuries and hazards created by highway crashes;
- Increase the capacity and operational efficiency of the surface transportation system cost-effectively by increasing vehicle occupancy levels and the volume of people and goods that can be moved on existing facilities and in highly traveled corridors;
- Enhance the mobility of travelers, including persons with disabilities, by improving accessibility to the surface transportation system and information on travel options for travel time management, and by reducing stress associated with travel;
- Reduce environmental and energy effects of surface transportation by increasing the use of transit and ridesharing, and by reducing harmful vehicle emissions and fuel wasted by congestion and navigational inefficiencies; and

- Enhance the productivity of surface transportation systems, operating agencies, fleet operators, and individuals by making better use of existing facilities and by increasing the cost-effectiveness of collection and use of data

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necessary for transportation planning, operations management, roadway construction, and maintenance services and user fee purposes.

A program announcement on IVHS-IDEA was released in May 1993. The award of the first group of IVHS-IDEA contracts is targeted for September 1993.

### Transit-IDEA

The Transit-IDEA component is part of the Transit Cooperative Research Program (TCRP), funded by the Federal Transit Administration (FTA) and managed by TRB through a cooperative agreement among FTA, the National Research Council, and the Transit Development Corporation, a nonprofit transit educational and research arm of the American Public Transit Association.

Transit-IDEA focuses on broad areas for developing cost-effective and user-friendly technologies for transit practice. The selected

Transit-IDEA technology areas include but are not limited to the following:

- Improvement of the performance of transit systems, including customer services, vehicles, equipment, maintenance, and operations, through the application of advanced technologies, methods, materials, or processes;
- Enhancement of transit safety by incorporating modern advances, such as automated vehicle control systems, hazard detection and mitigation, and improved safety systems;
- Increasing the effectiveness of transit service operations by applying advanced communications and delivery systems to improve ridership and service management;
- Developing cost-effective design, construction, and rehabilitation methods, technologies, and procedures for critical transit facilities; and
- Development of innovative management techniques applied to human resources, labor relations, customer outreach, marketing, ridership, and other nontechnological areas to improve the efficiency and effectiveness of transit systems.

Some of the innovations for the Transit-IDEA project may also be applicable to the IVHS-IDEA component. A Transit-IDEA committee has been established by TRB. The announcement for Transit-IDEA project will be released in June 1993. The award of the first group of Transit-IDEA contracts is targeted for fall 1993.

### Reference

1. *IVHS Strategic Plan: Report to Congress*. U.S. Department of Transportation, Dec. 18, 1992, 87 pp.