

IMPLEMENTING SHRP PRODUCTS

COORDINATION PAYS OFF

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Research is focus. Technology transfer is diffusion. In research, many facts are collected, examined, and systematically winnowed to a few significant conclusions. Everything is documented, compressed, and published in a few reports for a small audience. In technology transfer, the object is to reach a broad audience of practical users. Teachers teach others who will teach still others. The audience continually expands, and the message evolves to meet the needs of that ever-changing, ever-growing audience. Research seems to progress along well-planned lines; technology transfer and implementation seem unplanned and chaotic. But that chaos is only an illusion if a set of well-conceived plans underlies the implementation program.

The leaders and sponsors of the SHRP research effort understood this very well. Once that effort was under way, the National Research Council (NRC), the Federal Highway Administration, and the American Association of State Highway and Transportation Officials began planning for implementation. This planning began in 1988, about two years after the research effort began. By the end of 1991, most of the who and what decisions had been made, and an implementation support structure was in place. The cornerstone of this new structure was the cooperative relationship among AASHTO, FHWA, NRC, and the individual state transportation agencies. Each organization would assume responsibility for specific implementation tasks while maintaining connections with the other groups.

REDEFINING RESEARCH AS USABLE PRODUCTS

In everyday highway engineering and operations, products—not research results—are needed. These products are judged by their utility, not by the elegance of the research underlying them. Therefore the first task in charting a course for SHRP technology transfer was to redefine research results as potentially usable products. The prime responsibility for this task fell to the National

Research Council through its SHRP Executive Committee. The committee required SHRP researchers to provide evidence that particular research results were products that had reached the stage at which they could prove useful. In a bold move, the committee publicized these products in the *SHRP Product Catalog (1)*.

The catalog, with its concise, straightforward text and colorful pictures, has been extensively distributed. Although criticized by some as premature, publication of the catalog gave transportation engineers and managers their first look at the full array of SHRP products, allowing these professionals to identify those products with the greatest potential for improving agency and industry practice. This input energized the implementation effort and helped the Federal Highway Administration and the American Association of State Highway and Transportation Officials to focus their efforts on the products that mattered most.

The process of defining research results as usable products did not end with publication of the *SHRP Product Catalog*. The Federal Highway Administration and the Transportation Research Board asked groups of experts to assess the readiness of the products for use and evaluated additional information from early field trials. As a result of these efforts, approximately 60 percent of the 128 products listed in the *SHRP Product Catalog* are being actively promoted in technology transfer efforts. The remaining products have been assigned a lower priority because they require additional research and development or because they are too specialized for general application.

TRANSFERRING TECHNOLOGY

The Federal Highway Administration took the lead in technology transfer and in the training of highway professionals in the use of SHRP products. Throughout 1991 and 1992, the administration shared its ideas and plans for technology transfer with the American Association of State Highway and Transportation Officials and the National Research Council. A formal implementa-

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tion plan was published in 1993 (2). The administration's efforts were concentrated in its newly organized Office of Technology Applications, which remains the lead agency for SHRP technology transfer.

The centerpiece of the SHRP technology transfer program is the innovative "showcase" contract. In the past most technology transfer efforts have taken the form of publications or of training exercises in which small groups of individuals are taught the rudiments of new technologies. The Office of Technology Applications recognized that the volume of SHRP products and the wide demand for them precluded this traditional approach. Instead, the Federal Highway Administration packaged SHRP technologies into 10 showcases—comprehensive workshops presenting logical groupings of SHRP products to engineers and technicians in the public and private sectors. These workshops were developed under contract by experts, many of them SHRP researchers, in each field.

In the past 2 years, more than 50 regional workshops have been held. At these workshops state highway agencies have been given the opportunity to obtain loaner equipment, allowing them to try the equipment before they buy it and thus make better decisions about which SHRP products will suit their needs. Different agencies have chosen to move ahead in different areas, demonstrating the wisdom of this flexible approach to technology transfer.

Guided by technical working groups of volunteer experts, the Office of Technology Applications has also undertaken further development and substantial refinement of some of the SHRP products. When the Strategic Highway Research Program ended, many of its products were in prototype form. Some of the laboratory test equipment existed only in a single, handbuilt, research version. Without field-worthy production models, SHRP technology transfer could not proceed. The Federal Highway Administration set forth a process for developing production models of the Superpave test equipment, the hydraulic fracture test for concrete aggregate durability, and other devices.

The state departments of transportation did their part to ensure that manufacturers of this new field-worthy equipment would find ready buyers. Because the departments pooled their state planning and research funds, each state materials laboratory was able to purchase at least one complete set of the Superpave test equipment.

Where it was evident that private-sector development of SHRP products would take place, the Federal Highway Administration proposed, and American Association of State Highway and



Transportation Officials and the National Research Council concurred, that no federal implementation funds should be invested. The wisdom of this decision is evidenced by the commercial availability of six models of the flashing Stop/Slow paddle and seven versions of the work-zone intrusion alarm by the end of 1995.

SETTING THE STANDARDS

Standards and specifications are the language of engineers. Through rigorous application of standards, highway engineers build on common expectations of performance, ensure the consistency of practices and products, and control risks to public safety and public coffers. In the absence of standards and specifications, agencies are loath to adopt innovations. With no definition of consistency and no performance expectations, widespread, nonexperimental application of new materials and procedures is often too great a risk for public agencies to accept.

Through its Standing Committee on Highways, the American Association of State Highway and Transportation Officials undertook to resolve this predicament. The standing committee's various subcommittees accepted the task of developing consensus guide standards and specifications for those SHRP products that would be purchased or used by state transportation agencies. This burden fell principally on the Highway Subcommittee on Materials but also involved the subcommittees on traffic engineering, maintenance, and construction as well as the Joint Task Force on Pavements.

The drafting of consensus standards requires familiarity with the technology. The cooperative approach to SHRP implementation proved a real boon in this regard. Because the state transportation agencies were participating in the research

Showcase workshops provide hands-on training in the use of SHRP products. At the pilot workshop on alkali-silica reactivity (ASR) in Harrisburg, Pennsylvania, in 1994, transportation professionals examined a portable ultraviolet light box that makes ASR gel visible.

and because the SHRP staff and researchers met frequently with agency representatives and provided frequent progress reports to AASHTO subcommittees, some familiarity with SHRP products was established before the standards development process began. For a few products, this familiarity was sufficient to develop regular standards almost immediately. The flashing Stop/Slow paddle and other work-zone safety products were effectively standardized as early as 1992 through inclusion in the *Manual on Uniform Traffic Control Devices*. This rapid adoption allowed private-sector interests to market devices that met basic standards.

For most SHRP products, however, additional efforts were required. Although AASHTO member agencies might be familiar with the rationale or objective of the product, they did not know enough about critical details to prepare definitive standards, and the sheer volume of products requiring standards threatened to overwhelm traditional AASHTO procedures. This was particularly true for new materials specifications and test methods, such as those contained in the Superpave mix design and analysis system. The American Association of State Highway and Transportation Officials, and particularly the Highway Subcommittee on Materials, significantly changed its basic standards-development practices to cope with the volume of products and the absence of experience with them.

The Subcommittee on Materials proposed that the SHRP research teams deliver prototype standards for each test method or materials specification that would be considered by the subcommittee. The Strategic Highway Research Program complied, delivering the first 31 prototype standards to the American Association of State Highway and Transportation Officials, in September 1991. The number of prototype standards eventually grew to more than 90. Because many of the SHRP staff members, including those on loan from state departments of transportation, were experienced in standards writing, they were able to provide creditable prototypes to the subcommittee, giving it a head start on this daunting task.

In a typical year, the Subcommittee on Materials considers six or seven new standards. With SHRP delivering prototype standards at the rate of 30 per year, the workload threatened to overwhelm a committee composed of volunteers. The American Association of State Highway and Transportation Officials, with the support of the Federal Highway Administration and the National Research Council, took two major steps that would radically change the way in which the subcommittee managed standards development. In

1992 the association created a position for one individual to provide full-time staff support for standards development. The following year the association created a category of standards called provisional standards.

These standards have been adopted by the Highway Subcommittee on Materials on a temporary basis for a period of from 2 to 4 years (3). They give transportation agencies guidance on the uniform application of the new SHRP technologies. As an agency tries out equipment borrowed from FHWA showcases or purchased through the pooled fund, it does so in the same manner as other agencies. This uniformity accelerates the learning curve, promotes rapid establishment of the precision and biases of new procedures, and provides a common language for discussion of the equipment's merits and drawbacks with private test labs, equipment vendors, construction contractors, and materials suppliers as well as other agencies. Just as the Federal Highway Administration's development efforts expedited the evolution of the SHRP prototype equipment to reliable, widely available hardware, the provisional standards and FHWA equipment loans provide for the orderly evolution of consensus standards from SHRP prototypes.

PREPARING POTENTIAL USERS FOR NEW TECHNOLOGY

Even before the SHRP implementation effort began, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the National Research Council recognized that potential users of new technology must prepare to receive it, just as the technology transfer agents prepare to deliver it. To help agencies and other users in these preparations, FHWA, AASHTO, and NRC put together an impressive information campaign. Publications, multimedia presentations, and exhibits were used to inform key audiences about SHRP products and technology transfer plans. The first of many exhibits was held at the annual meeting of the American Association of State Highway and Transportation Officials in Milwaukee, Wisconsin, in 1991. From that point on, no major AASHTO national or regional meeting has been without exhibits or presentations updating the audience on the progress of SHRP implementation. Similar presentations and exhibits are regularly made to private-sector groups as well.

Beyond simple communications, AASHTO made other plans to prepare its member agencies for implementation. The association's board of directors created the Task Force on SHRP

Implementation to continually apprise the chief administrative and engineering officers of the state departments of transportation of the opportunities and obligations inherent in SHRP implementation. This task force recognized the opportunity for a pooled-fund purchase of the Superpave test equipment and sold the idea to the individual departments of transportation. More recently, the task force has initiated the lead-state concept, in which the first large-scale users of SHRP technologies are sharing their experiences with neighboring agencies, alleviating the need for every agency to repeat the same lessons. In general the task force is a vehicle for its members, all nine of whom are state DOT directors or chief engineers, to explain the value of the SHRP technologies to their colleagues within the American Association of State Highway and Transportation Officials. The task force coordinates its activities with its counterparts in the Federal Highway Administration and the Transportation Research Board.

Another bold move by the American Association of State Highway and Transportation Officials to assist the states in preparing to implement SHRP products was the publication of the *SHRP Implementation Catalog* (4). This catalog identifies manufacturers and vendors of SHRP products and services. It is keyed to the original *SHRP Product Catalog* and applicable AASHTO standards. A listing in this catalog does not imply endorsement by the American Association of State Highway and Transportation Officials, the Federal Highway Administration, or the National Research Council of any particular manufacturer or service provider, but it does inform the state departments of transportation about product availability.

KEEPING AN EYE ON THE BIG PICTURE

The National Research Council's involvement with SHRP did not end when the research program ended in March 1993. By mutual agreement among the council, the American Association of State Highway and Transportation Officials, and the Federal Highway Administration, the TRB-SHRP Committee was created. The function of this committee is to continue the same top-management input to SHRP implementation that characterized SHRP research. In this regard, the committee can be viewed as the successor to the SHRP Executive Committee. The new committee is not, however, engaged in active management of the program. Rather, it is an advisory body, charged with maintaining an overview of the entire implementation effort and recommending to the Federal Highway Administration and the

American Association of State Highway and Transportation Officials where the program can be strengthened.

As a National Research Council committee, the TRB-SHRP Committee is balanced to ensure that the voices of the major beneficiaries of successful implementation are heard. The membership is carefully structured to include senior administrative and engineering officers of state departments of transportation, prominent academics, highway users, and leaders in the private sector of the transportation community. The committee meets regularly with senior staff of the Federal Highway Administration and the American Association of State Highway and Transportation Officials to monitor progress and issue periodic reports to FHWA's administrator and AASHTO's executive director. Both organizations have acted positively on the recommendations of the TRB-SHRP Committee. Many of the coordinated plans of all three organizations originated in discussions with the TRB-SHRP Committee.

The committee also organizes expert task groups to provide more detailed technical advice. The SHRP Implementation Clearinghouse, an on-line data base of information maintained by the Federal Highway Administration, owes its existence to the recommendations of one such task group.

COORDINATING IMPLEMENTATION

Given the diffusion inherent in the technology implementation process, uncoordinated execution of even the best plans quickly leads to confusion. To avoid such confusion, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the Transportation Research Board have each appointed a SHRP implementation coordinator. These coordinators track the implementation activities within their own organizations and meet at least once a month to ensure that the advice of the TRB-SHRP Committee and the plans of AASHTO and FHWA are turned into effective, efficient action.

The early days of technology transfer are dominated by the technology deliverers. Over time, however, those receiving the technology become the dominant force, as they master the technology and encourage others to do the same. So it has been with SHRP. By developing sound plans and executing them in coordinated fashion, the American Association of State Highway and Transportation Officials, the Federal Highway Administration, and the National Research Council have ensured a successful technology transfer program.

SHRP INFORMATION CLEARINGHOUSE WEB SITE

Components of the SHRP implementation program include asphalt user-producer groups, Superpave regional centers, refined Superpave performance models, test and evaluation programs, demonstration trailers, and AASHTOWare. To learn about these and other components of the program, visit the SHRP Information Clearinghouse web site at <http://www.hend.com/shrp/>, the TRB home page at <http://www.nas.edu/trb/>, or the AASHTO home page at <http://www.aashto.org/main/>.



Nearly four years after the Strategic Highway Research Program ended, many of the program's products are beginning to be used by state highway agencies and their contractors and suppliers. During the past two years, the TRB-SHRP Committee has identified many SHRP success stories from state departments of transportation. In a recent survey of these departments, more than 100 case studies of applications of SHRP technologies were identified (see related article, page 42). While most of the case studies report small-scale trials, examples of large-scale projects employing SHRP technologies are also included. Major construction projects now under way are using the Superpave specifications developed under SHRP. The SHRP work-zone safety devices are becoming commonplace. Sophisticated highway maintenance programs and techniques that the Strategic Highway Research Program evaluated and refined are finding widespread acceptance among highway agencies and contractors.

Ultimately, the quality of the product will determine its acceptance among highway engineers and managers. But for many research products, the interval between initial development and widespread application is a long one. The principles of slipform concrete paving, for example, were first demonstrated by researchers at the Iowa State Highway Commission in 1947. Yet nine years elapsed before slipform paving was used in a regular construction project, and it was not until the mid-1960s that such paving became a generally accepted technology. The SHRP technologies are on a faster track, largely because of an innovative, well-planned, and well-coordinated implementation effort.

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