

RESEARCH RESULTS DIGEST

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Business Needs for Pavement Engineering

This digest summarizes the primary thrust areas of “business needs” for pavement engineering adopted by the AASHTO Joint Task Force on Pavements. These needs were initially identified by a large number of pavement professionals through a consensus-building process in a workshop conducted as part of NCHRP Project 20-7(127), “A Strategic Plan (Road Map) for Pavement Research.”

The workshop was facilitated by a team of professionals from the Virginia Transportation Research Council.

INTRODUCTION

This digest summarizes the primary thrust areas of “business needs” for pavement engineering adopted by the American Association of State Highway and Transportation Officials (AASHTO) Joint Task Force on Pavements (JTTF) to guide in identifying, evaluating, and prioritizing research problem suggestions.

Recognizing the role of research in improving the nation’s highway system, the JTTF (Appendix A) strives to identify means to fulfill the pavement engineering business needs of the highway community. For this purpose, the JTTF periodically proposes problem statements for consideration by the AASHTO Standing Committee on Research (SCOR) for funding under the National Cooperative Highway Research Program (NCHRP). In addition, the task force, at the request of SCOR, annually reviews research problems dealing with the different aspects of pavement engineering that are being considered for funding under the NCHRP.

Traditionally, research topics have been selected on an individual basis, without systematic reference to the overall needs of the profession. Although this process has been effective in the past, a more structured procedure for prioritizing research needs that would help achieve the most return on the research dollars is needed. To address this need, the JTTF, under the leadership of Mr. Gary Carver

(the JTTF’s former chair and former chief engineer of the Wyoming Department of Transportation), requested SCOR’s support for programming an NCHRP project to develop a business plan for pavement engineering. NCHRP Project 20-7(127), “A Strategic Plan (Road Map) for Pavement Research,” was subsequently initiated to undertake this task.

To provide essential input into the strategic plan, a steering committee, chaired by Mr. Gary Sharpe, the JTTF chair and the director of the Division of Highway Design for the Kentucky Transportation Cabinet, was established to plan a workshop and select participants. The workshop was conducted October 1–3, 2000, at the National Academies’s Arnold and Mabel Beckman Center in Irvine, California. Participants included members of the JTTF and individuals from other state departments of transportation, the Federal Highway Administration (FHWA), academia, consulting firms, and the paving industry; a list of participants is provided in Appendix B. The information resulting from the workshop—a consensus of the thoughts and experiences of the participating pavement engineering professionals regarding the high-priority business needs for pavement engineering—was adopted by the JTTF to guide in identifying, evaluating, and prioritizing research problem suggestions. In this manner, research efforts will contribute to a quality-based research program aligned with the needs of the highway community.

RESEARCH NEEDS

Initially, workshop participants identified 17 potential topics for discussion; a list of these topics is provided as Appendix C. Through a consensus-building process, these topics were combined into four “business needs” for pavement engineering; each of these business needs is a thrust area for research on a specific aspect of pavement engineering. The four business needs, in no specific order, are as follows:

- Achieving Desired Performance Level and Life,
- Supporting Effective Management of Pavement Assets,
- Minimizing Adverse Impacts on Users, and
- Enhancing Practitioner Knowledge and User Understanding of Pavements.

The discussion of each business need begins with a brief description of related background, followed by a brief statement of the benefits that would result from satisfaction of this need. The broad objectives that must be accomplished to achieve the overall goal of the business need are then listed, followed by necessary “building blocks” (i.e., examples of information, data, products, or processes) that must be available to realistically fulfill the business need.

Achieving Desired Performance Level and Life

Because pavement performance and service life depend on traffic levels, climatic conditions, and material characteristics, a rational pavement design procedure must consider these factors. In addition, such a procedure will incorporate methods for estimating the effects of traffic and climate on material properties as well as methods for predicting performance and serviceability. Therefore, a design process that incorporates enhanced prediction methods will provide a better means for designing pavements that will provide the desired performance level and service life. When properly used, these improved prediction methods and design procedures will provide a means for designing pavements with superior performance and longer life, allowing efficient use of recycled materials, identifying optimum timing for maintenance and rehabilitation interventions, improving estimation of life-cycle costs, relating performance to specifications, and addressing materials durability issues.

Objectives

Achieving desired performance level and life will require the following:

- Accurate and reliable functional (e.g., ride, noise, and safety) pavement performance system prediction methodologies;
- Improved tools, materials, and processes to design, construct, maintain, and manage pavements that provide an

acceptable level of service over a longer service life than traditionally expected while reducing life-cycle costs; and

- A design process that considers the major factors of design (materials, construction, environment, and traffic) and their interaction.

Building Blocks

Accomplishing the objectives of this business need will require the implementation or delivery of certain actions, products, and processes. Although some of these products and processes may be readily available, others may require a research effort for their development. Some of resources needed for satisfying this business need are as follows:

- A mechanistic pavement response model,
- Distress and performance prediction models,
- Material characterization techniques,
- Durability-performance models,
- Databases and accurate calibration-validation procedures,
- Interactive design-construction processes,
- Trained personnel,
- Nondestructive testing techniques for in situ evaluation, and
- Information on construction variability and its effect on performance.

Supporting Effective Management of Pavement Assets

Pavement management involves formalizing decision-making procedures that optimize public investments in new and existing pavements. These decisions have significant impact on public mobility and safety and economic implications to the states and nation. Therefore, pavement program decisions should be based on sound data, effective analysis tools, and proper evaluation of tradeoffs of investment and resource allocations. To be truly effective and to improve decision making, a pavement management system needs to be integrated with other management systems and provide a means for validating and calibrating underlying assumptions.

The business need is aimed at improving existing practices in pavement management. Such improvements would be achieved through a comprehensive effort that includes the development of new technology, enhancements to existing technology, and improved use of system information throughout the transportation agency. This effort should be directed toward all phases of pavement management (i.e., from data collection to the management of pavement resources).

Objectives

Supporting effective management of pavement assets will require the following:

- Appropriate data collection and tools,
- Methodologies for cost-effectiveness analysis,
- Processes for improving future decision making,
- An integrated management system, and
- An integrated decision-making process.

Building Blocks

Accomplishing the objectives of this business need will require the implementation or delivery of certain actions, products, and processes. Although some of these products and processes may be readily available, others may require a research effort for their development. Some of the resources needed for satisfying this business need are as follows:

- Definition of data to be collected (e.g., climate, traffic, as-built, and material types);
- Methods for data collection (including quality, consistency, and standardization);
- Integration and development of new data collection tools;
- Improved management of databases;
- Guidelines for characterizing performance trends and predicting future performance;
- Definition and quantification of user costs;
- Methodologies for economic impact analysis;
- Education and training of decision makers and practitioners on cost analysis methods;
- Marketing and communication strategies for legislatures and the public;
- Procedures for the validation of predictions and assumptions;
- Procedures for calibration of national guidelines to a particular state or locality;
- Identification of critical performance measures;
- Guidelines for development of feedback loops;
- Approaches for linking systems at the network and project levels;
- An integrated management system that encompasses all major management systems (maintenance, safety, construction, and pavement); and
- Decision-making models, with training and awareness efforts for different levels within the organization.

Minimizing Adverse Impacts on Users

The economic impacts of the delays associated with the highway construction, rehabilitation, and maintenance work on highway users are tremendous. These impacts include lost wages, emotional stress, increased fuel consumption and emissions, and the potential for an increased number of accidents. Reducing delay during highway work should contribute to substantial economic and environmental advantages that would lead to substantial savings to highway agencies, taxpayers, and businesses that rely on just-in-time delivery.

The business need is aimed at minimizing the adverse impacts on the user during construction and maintenance activities through the development of improved design, specifications, and materials; innovative contracting practices; and construction methods.

Objectives

Minimizing adverse impacts on users will require the following:

- Traffic management strategies for reducing lane closure,
- Equipment that accelerates construction,
- Materials that provide required performance while reducing construction time,
- Contracting practices that support contractor initiatives for accelerating construction, and
- Nondestructive testing means that expedite project acceptance and opening to traffic.

Building Blocks

Accomplishing the objectives of this business need will require the implementation or delivery of certain actions, products, and processes. Although some of these products and processes may be readily available, others may require a research effort for their development. Some of the resources needed for satisfying this business need are as follows:

- A database on the costs borne by road users as a result of construction and maintenance operations,
- Life-cycle cost analysis methods,
- Contracting approaches that promote accelerated construction,
- An impact analysis process for nontraditional contracting procedures,
- Materials that allow early opening to traffic,
- Traffic management procedures for reducing lane closure,
- Performance-related specifications that ensure quality while allowing contractor innovation, and
- Quality-assurance procedures that provide realistic measures of suitability for opening to traffic.

Enhancing Practitioner Knowledge and User Understanding of Pavements

In order to improve the ability to design, construct, and preserve better performing pavements, it is essential that all pavement practitioners—designers, construction personnel, testing technicians, and maintenance workers—maintain a good level of knowledge of pavement issues that would affect their work (e.g., knowledge of how pavements perform and what factors enhance or detract from that performance). This knowledge could be developed or enhanced through on-the-job training and learning. To that end, it is essential that practitioners who have acquired extensive knowledge

through experience and learning be encouraged to maintain their active service; familiarize themselves with new developments; and help less experienced staff gain better understanding of the strategies, techniques, and methods that would improve pavements.

At the same time, in order to obtain the necessary support and funding, it is critical that highway users understand what it takes to have better pavements and what is needed to provide the user with good driving surfaces. Furthermore, it is important to develop and provide users with information on the basic factors involved in the design, construction, and preservation of pavements that influence the users' perspectives of acceptable performance. This goal may be accomplished through the development and delivery of broad-based public information programs that address what it takes to meet user needs. Such programs should be an active part of every department's outreach effort to answer the public's questions of why work is being done and what benefits the public will receive.

Objectives

Enhancing practitioner knowledge and user understanding of pavements will require the following:

- An increased knowledge base among pavement workforce (agency and industry);
- Better understanding of the significance that pavement design, construction, and preservation practices have in delivering a quality transportation program;
- Approaches for attracting and retaining a well-trained, technically competent workforce of suitable size to perform the tasks needed for delivering quality pavements; and
- Better information for pavement users.

Building Blocks

Accomplishing the objectives of this business need will require the implementation or delivery of certain actions, products, and processes. Although some of these products and processes may be readily available, others may require a research effort for their development. Some of the items needed for meeting this business need are as follows:

- Techniques for disseminating best practices;
- Interactive distance learning opportunities to enhance dissemination of technological advancements;
- Guidelines or criteria to review and update educational programs for pavement practitioners;
- Continuing education and training programs to increase practitioners' knowledge and understanding of pavements;

- Training programs to increase practitioners' knowledge of the impacts of pavement performance on user costs;
- Collaboration with universities, industry organizations, and other organizations to establish programs to deliver pavement engineering curricula and to attract future pavement professionals;
- Guidelines for scholarship programs targeted to improve expertise in pavements; and
- Guidelines for an outreach program, including public information packages to effectively inform decision makers, highway users, and the public on pavement needs and benefits.

CONCLUDING REMARKS

Through a consensus-building process, about 40 pavement professionals from state highway agencies, the FHWA, academic institutions, consulting firms, and the paving industry identified four thrust areas, or "business needs," as those of immediate importance. The JTFP adopted these four needs to guide in identifying, evaluating, and prioritizing research problem suggestions. Meeting these business needs will yield substantial benefit, but will require a major research effort, substantial funding, and coordination among interested parties. Portions of this research effort could be executed through coordination with other organizations and partnership with other research sponsors. The following actions are necessary for meeting the business needs for pavement engineering:

- A marketing effort to familiarize the transportation community with these needs,
- A mechanism for securing the funds needed to conduct related research,
- A means for ensuring coordination among interested parties, and
- A continuing involvement by AASHTO in assuming responsibility for this initiative.

The JTFP recognizes that these business needs must be continually reviewed and revised in light of advancements, innovations, constraints, and other changes resulting from research and development efforts, regulations, and other factors. The JTFP will maintain and improve the contents of this document and apply its contents to the identification, evaluation, and prioritization of research efforts. The JTFP also recognizes that this effort is expected to complement other broader efforts by AASHTO, the Transportation Research Board (TRB), and the FHWA to develop a new framework for coordinating highway research and technology activities among research sponsors, practitioners, researchers, and other stakeholders in highway transportation.

APPENDIX A—AASHTO JOINT TASK FORCE ON PAVEMENTS

The JTTF reports to the AASHTO Highway Subcommittee on Design of the AASHTO Standing Committee on Highways. When these business needs were developed and adopted by the JTTF, its membership included the following: chair: Gary W. Sharpe, Kentucky Transportation Cabinet; vice chair: Danny A. Dawood, Pennsylvania Department of Transportation; secretary: Tommy Beatty, Federal Highway Administration; members: J. F. Bledsoe, Missouri Department of Transportation; Kenneth W. Fults, Texas Department of Transportation; Andrew J. Gisi, Kansas Department of Transportation; Rick Harvey, Wyoming Department of Transportation; Thomas M. Hearne, North Carolina Department of Transportation; Kevin M. Herritt, California Department of Transportation; Andrew M. Johnson, South Carolina Department of Transportation; Colleen A. Kissane, Connecticut Department of Transportation; Aric A. Morse, Ohio Department of Transportation; Linda M. Pierce, Washington State Department of Transportation; Michael Pologruto, Vermont Agency of Transportation; William H. Temple, Louisiana Department of Transportation and Development; George B. Way, Arizona Department of Transportation; Wei-Shih Yang, New York State Department of Transportation; and Richard Zamora, Colorado Department of Transportation; AASHTO staff: Ken Kobetsky; NCHRP Liaison: Amir N. Hanna.

APPENDIX B—WORKSHOP PARTICIPANTS

Participants: Tommy Beatty, Federal Highway Administration; J. F. Bledsoe, Missouri Department of Transportation; Gary S. Carver, Wyoming Department of Transportation (retired); Charles Churilla, Federal Highway Administration; Lawrence W. Cole, American Concrete Pavement Association; Michael I. Darter, ERES Consultants, Inc.; Danny A. Dawood, Pennsylvania Department of Transportation; Kenneth W. Fulst, Texas Department of Transportation; Andrew J. Gisi, Kansas Department of Transportation; John P. Hallin, ERES Consultants, Inc.; Edward T. Harrigan, Transportation Research Board; Rick Harvey, Wyoming Department of Transportation; Kevin M. Herritt, California Department of Transportation; David L. Huft, South Dakota Department of Transportation; Andrew M. Johnson, South Carolina Department of Transportation; Roger M. Larson, Federal Highway Administration; David L. Lippert, Illinois Department of Transportation; Byron Lord, Federal Highway Administration; Samuel R. Miller, Maryland State Highway Administration; Carl L. Monismith, University of California – Berkeley; William H. Temple, Louisiana Department of Transportation and Development; Gonzalo R. Rada, LAW PCS; Jim St. Martin, Asphalt Pavement Association; Gary W. Sharpe, Kentucky Transportation Cabinet; Shiraz Tayabji, Construction Technology Laboratories; Gary Taylor, Michigan Department of Transportation; George B. Way, Arizona Department of Transportation; Matthew W. Witczak, Arizona State University; Wei-Shih Yang, New York State Department of Transportation; Richard Zamora, Colorado Department of Transportation; and Kathryn A. Zimmerman, Applied Pavement Technology, Inc.

Facilitators: Gary R. Allen, Carolyn D. Goodman, Kevin K. McGhee, William E. Kelsh, and Wallace T. McKeel, Jr., Virginia Transportation Research Council.

NCHRP Responsible Staff Officer: Amir N. Hanna, Transportation Research Board

APPENDIX C—POTENTIAL TOPICS IDENTIFIED BY WORKSHOP PARTICIPANTS

1. Achieving desired performance level and life
2. Predicting pavement performance
3. Achieving improved performance and reliability
4. Integrating performance-related factors into pavement designs
5. Improving structural design methods
6. Enhancing knowledge of the pavement community
7. Training and retaining pavement professionals
8. Producing better pavement management practices
9. Developing protocols for pavement condition evaluation
10. Reducing adverse impacts on users
11. Creating innovative materials and approaches for design, construction, and management
12. Identifying construction and maintenance strategies to reduce adverse impacts on users
13. Designing and constructing long-lasting pavements with lower life-cycle costs
14. Managing pavement assets cost-effectively
15. Using cost-effective and environmentally sensitive solutions
16. Considering customer expectations in investment decisions
17. Developing design methods for cost-effective pavements

These digests are issued in order to increase awareness of research results emanating from projects in the Cooperative Research Programs (CRP). Persons wanting to pursue the project subject matter in greater depth should contact the CRP Staff, Transportation Research Board of the National Academies, 500 Fifth Street, NW, Washington, DC 20001.

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