

# **Review of NCHRP Study Implementation at the New Jersey Department of Transportation**

FINAL REPORT

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Submitted by

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16. Abstract <p>The NCHRP's quadrennial survey of its project board members is conducted every four years to measure the utility and applicability of individual NCHRP projects and NCHRP research. In early 2008, the completed project covered 83 reports from report numbers 456 to 558. After each member who was responsible for a specific project completed a separate survey, it was found that 258 full responses were received by the research team. In comparison, in 2004, the research team received 521 responses, which covered a total of 147 projects out of 159. Out of 251 respondents to that survey, 200 responses were reported as positive, indicating that approximately 84% of positive responders (categorized as successful respondents) were satisfied with their projects. In comparison, the unsuccessful rate for that particular survey was 4% (three projects) by all responding panel members. In total, 74 project responses were received for 81 projects, which demonstrated a 91% project response rate. Along with the results from an extensive literature review of NJ State DOT databases conducted to evaluate the benefits of attending TRB activities, the responses received from prior surveys and the output received from quarterly meetings was used by the NJIT research team in designing the 2012 NCHRP survey. The final survey design was developed using multiple choice questions, and after several modifications were made to the designed survey to ensure compatibility with the NJDOT website format requirements, the survey was officially launched on September 16, 2012. The results showed that the number of respondents who accessed the survey website, the number of respondents with complete responses, the number of reviews, the number of publications reviewed, and the number of implemented projects was 122, 14, 26, 24 and 19, respectively. A summary of the NCHRP and TCRP case studies implementation at NJDOT and NJ Transit (which was classified and sorted based on their status as: not implemented, partially implemented, or fully implemented) were found to be 31.0%, 48.3% and 20.7%, respectively. In this report, these survey findings are discussed, along with an analysis of ten case studies from the list of NCHRP projects, which were reviewed, investigated, and prepared by the NJIT research team as to their successful implementation status. Both the implemented and non-implemented projects were classified according to the study accomplishments of the NCHRP projects.</p>			
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## **EXECUTIVE SUMMARY**

It is important to measure the benefits of transportation research programs on a regular basis to determine if the projects produce useful guidance for transportation agencies, to ascertain whether research funding monies have been used effectively, and to provide evidence that helps maintain the support of management personnel and other stakeholders in the transportation research process. In support of these goals, the NJIT team reviewed, investigated and prepared a summary of ten case studies of selected NCHRP research projects (completed from 2000 to 2009) that emphasize a range of effective approaches to implementation. These selected case studies were drawn from an analysis of NCHRP projects that were previously evaluated by the New Jersey Department of Transportation (NJDOT), the New Jersey Motor Vehicle Commission (NJMVC), and NJ Transit, wherein both types of projects (implemented and non-implemented) were classified according to the study's accomplishment of NCHRP project goals. As a corollary to this project, the NJIT research team also completed an extensive literature search aimed at reviewing and identifying studies, research papers, reports, and other related publications that provided information relevant to this study. The implemented projects were analyzed on a case-by-case basis in order to understand the successful performance of the conducted projects, and were then compared to findings taken from prior surveys and research productions.

The NCHRP survey of its project panel members is conducted every four years to measure the utility and applicability of individual NCHRP projects and to assess the value of NCHRP research. The most recent survey was completed in early 2008, covering the projects that produced 83 NCHRP reports numbered 456 through 558. The survey response was 258 and the results indicated that the state of NCHRP research is exceedingly positive with project results frequently applied and often considered "definitive guidance." Subsequently, this information was used to help develop the 2012 NCHRP project implementation stakeholder survey.

The survey questionnaires designed by the NJIT research team were grounded on data taken from the NCHRP survey responses and on output received during NJDOT quarterly meetings. The draft survey, which was based on feedback from the meetings, was shaped by examiners who outlined and considered the question types that best reflected the content. The final website presentation of the questionnaire was then modified in response to the comments and suggestions of the Project Manager.

All completed NCHRP publications from 2010 and early 2011 that were found in the database of the Cooperative Research Programs (CRP) publications were considered for the survey purposes. The final survey design was constructed using multiple choice questions. After several additional modifications to the survey design to bring the survey into alignment with the NJDOT website format requirements, the survey was officially launched on September 16, 2012. The survey response database was regularly monitored and the results were summarized periodically.

The final response statistics are as follows:

- Number of respondents accessing the survey website: 122
- Number of respondents with complete responses: 14
- Number of NCHRP projects: 26
- Number of NCHRP publications reviewed: 24
- NCHRP projects implemented: 20

A selected summary of NCHRP and TCRP case studies that were previously implemented at NJDOT and NJ Transit were then classified according to the categories of not implemented, partially implemented and fully implemented, with results of 31.0%, 48.3% and 20.7%, respectively.

These case studies were then analyzed by the NJIT research team to provide insight into how the study results are used by transportation stakeholders to improve operations and planning.

## **INTRODUCTION**

The purpose of this report is two fold. First, it assesses the impact of implementing the findings of the National Cooperative Highway Research Program (NCHRP) projects in New Jersey, and second, it identifies benefits from transferring cutting edge technologies and knowledge from the Transportation Research Board Annual Meeting to the state Departments of Transportation.

The organization of the report is as follows. The “Background” gives a review of the NCHRP and outlines the impetus for this study. The literature review identifies and examines the previous implementation of NCHRP studies, panel survey results, projects and publications relevant to this research, and the evaluation of the usefulness of the implemented project results. The “Survey of NJDOT Research Customers” chapter presents the final survey response statistics, a detailed information about the survey responders and their answers. The last chapter presents an assortment of ten representative case studies to help readers understand how the information provided by NCHRP and TCRP research is implemented in NJDOT practice.

## **BACKGROUND**

The National Cooperative Highway Research Program (NCHRP) is a unique contract research effort designed to respond to the practical needs of the state departments of transportation (or equivalent agencies) across the United States. It is an applied research program with the goal to solve problems that are common in highway planning, design, construction, operation, and maintenance across the nation. The state

departments of transportation (or DOTs) select, fund, and oversee the NCHRP research program through the American Association of State Highway and Transportation Officials (AASHTO). The program is administered by the Transportation Research Board (TRB) of the National Academies and is operated in cooperation with the Federal Highway Administration (FHWA). At the New Jersey Department of Transportation (NJDOT), the liaison with TRB and NCHRP is the Bureau of Research which is also the focal point of transportation research efforts at the NJDOT.

As part of a continuous process to ensure that the research conducted through NCHRP is applicable and viable, the Bureau of Research initiated a review of the implementation of NCHRP research results at NJDOT. The study identifies the implementation in practice of these projects and estimates the usefulness of the projects' results in New Jersey. This is accomplished through a survey of research "customers" of the New Jersey Department of Transportation's (NJDOT) Bureau of Research. The survey includes potential and actual users of NCHRP research in NJDOT's Divisions and Bureaus, as well as research partners at New Jersey Transit and New Jersey Motor Vehicle Commission (NJMVC). The research also examines current criteria and procedures that were used in implementation of NCHRP project results, and summarizes NCHRP projects completed during a 12-year period between 2000 and 2011 that were applied in New Jersey.

## **OBJECTIVES**

The overall goal of the proposed research was to investigate whether NCHRP projects respond to the practical needs of NJDOT, NJMVC, and NJ Transit. Hence, the research focused on accomplishing the following objectives:

1. Review, investigate, and prepare a list of NCHRP projects that were completed during the period from year 2000 to year 2011.
2. Identify all NCHRP project results implemented in practice by NJDOT, NJMVC, and NJ Transit and evaluate the success of each.
3. Identify any NCHRP project considered (or reviewed) for application, but not implemented. Also, examine the reasons for not implementing it.
4. Investigate the key factors that contribute to the success of the reviewed projects.

## RESEARCH APPROACH

As illustrated in Figure 1, this section discusses the structure of the research approach, beginning with the research team conducting a comprehensive literature review. This step was followed by the team conducting a survey of the research customers, which then led to an analysis of the survey results and an assessment of the participation in the TRB activities.

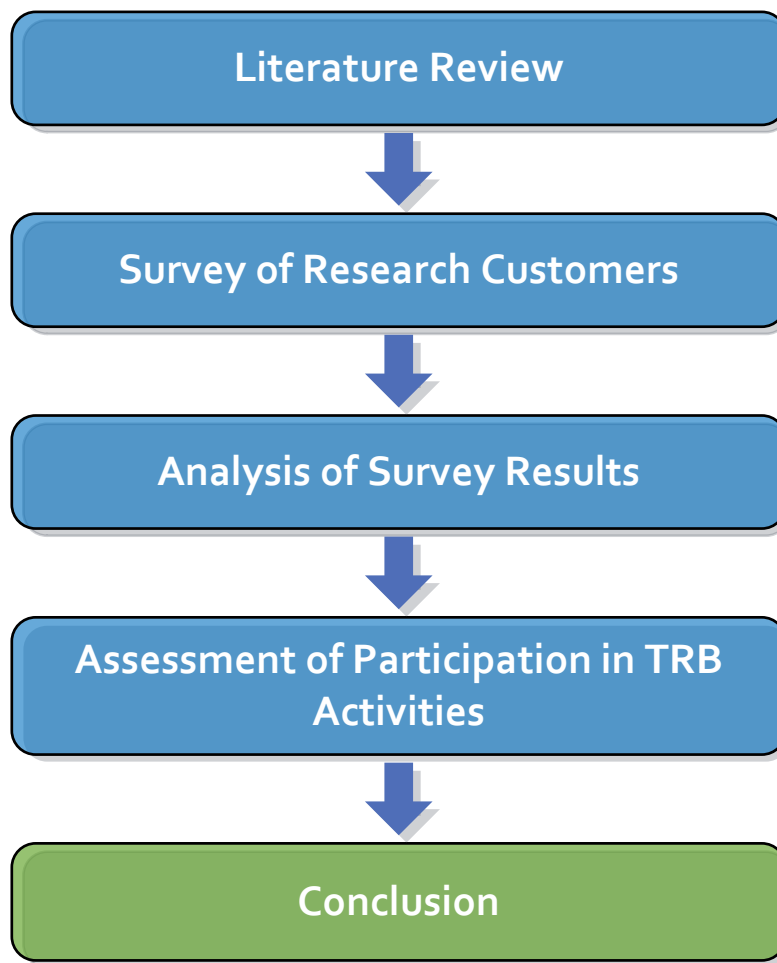


Figure 1. The Research Approach

## **LITERATURE REVIEW**

The NJIT research team conducted an extensive literature search to review and identify studies, research papers, reports, and other publications that provide information relevant to this study. The primary purpose of the literature review is to identify and examine the previous implementation of NCHRP studies, panel survey results, and projects and publications relevant to this research, and to evaluate the usefulness of the implemented project results. In this section, the review of the results from the NCHRP panel survey, the implemented projects and publications in state and national practices, an explanation on the category of the survey conducted at NJDOT, and participation in TRB activities are discussed and organized into five subsections.

### **Review of NCHRP Panel Survey**

The National Cooperative Highway Research Program is a unique contract research effort that responds to the needs of state DOTs by supporting the resolution of pressing transportation problems. Created in 1962 and funded voluntarily by each state DOT, NCHRP is administered by the Transportation Research Board of the National Academies (NCHRP 20-44G, 2008).

The NCHRP survey of its project panel members is conducted every four years to measure the utility and applicability of individual NCHRP projects and to assess the value of NCHRP research. The most recent survey was completed in early 2008, covering the projects that produced 83 NCHRP reports numbered 456 through 558. All panel members for these projects were asked to complete a separate survey for each project panel that they served on. The total number of responses completed was 258, with at least one panel member responding for nearly all of the covered projects. For comparison, a survey was also done in 2004 and that survey generated 521 responses covering 147 projects out of 159 solicited.



The overall results of this survey indicated that the state of NCHRP research is exceedingly positive with project results frequently applied and often considered “definitive guidance.” Overall, 200 positive responses were observed out of 251 respondents, and the total positive response rate was 84.5%. When considered by project instead of by individual response, 91% (74 out of 81 identified projects) were rated as “applied” or as having confirmed/advanced current practice by at least one panel member, as compared to only 4% (3 projects) rated as unsuccessful by all responding panel members.

Overall, the percentage of responses that rated other specific categories as “good” or “very good” was:

- NCHRP staff support: 96%
- Panel contributions: 91%
- Overall project panel experience: 91%

Ratings of the contractors that produced the research were classified as “good” or “very good” by 82% of the respondents, with only 3% selecting “poor” or “very poor.” The average ratings across all responses for the four categories were higher than those from the 2004 survey. The scores are as follows, with the number 4 being used as the numerical equivalent of “good” and the number 5 indicating “very good”:

Table 1 - NCHRP Panel Member Survey Results

Category	2004 Survey	2008 Survey
Contractor Performance	3.93 of 5	4.17 of 5
NCHRP staff support	4.49 of 5	4.64 of 5
Panel contributions	4.14 of 5	4.33 of 5
Overall panel experience	4.19 of 5	4.43 of 5

The survey also produced some specific ideas for the NCHRP to consider. For instance, one respondent postulated that the strict RFP deadlines may stifle competition as they ruled out a contractor that (in the respondent's opinion) would have produced better results than the team that was selected. Another comment made by one respondent was that whenever a project is extended, the research team that performed the initial study should not be as frequently selected to perform the extended project as presently occurs, particularly when the extended study has specific differences in scope from the initial study. A third respondent expressed the need for tighter review deadlines so that reviews are completed promptly.

The overall theme of the majority of the survey comments is that NCHRP plays a unique and valuable role in transportation research with its ability to identify and address state DOT research needs, and that its reach should be extended to facilitate a more thorough implementation of the valuable research that NCHRP produces.

## **Review of the Related Projects and Publications**

A variety of publications relevant to the research implementation practices, including NCHRP reports, peer exchange reports, research manuals, TRB Annual Meeting conference papers, and journal papers were reviewed.

*NCHRP Report 610 (2009), Communication Matters* <sup>(1)</sup>: *Communicating the Value of Transportation Research Guidebook*, provides tips, a model process, case studies and examples of good communication methods that can be used to integrate communication through the research process. In the report, the importance of effective communication in showcasing connections between the results and the return on investment of either a single project or an entire program was discussed. The report makes the connection between effective communication and successful implementation.

*NCHRP Report 355 (2005), Transportation Technology Transfer: Successes, Challenges, and Needs* <sup>(2)</sup>, introduced the topic of successful implementation practice,

and examined both private and public sector technology transfer efforts. It is curious that no processes that are currently in place within state DOTs were recognized as best practices at the time of the report's publication.

In 2005, Alabama Department of Transportation (ALDOT) <sup>(3)</sup> published a peer exchange final report: *Research & Development*. In the report, it was discussed that the peer exchange team observed that states do a better job of research implementation than the states might realize, and this finding is masked by the fact that there is no method in place to readily measure or track research implementation. They also recognize that the product of a research project is much more than a Final Report.

Alaska Department of Transportation and Public Facilities <sup>(4)</sup> published a peer exchange report, *Research Technology Transfer*, in 2006. Among the topics addressed in the report were discussions on implementation strategies that included the value of marketing for the completed research, the limit of project selection criteria for implementation, and the relationship between the active involvement of technical staff throughout the research process and the corresponding increase of successful implementation. The discussion also included the opinion that the designing and budgeting of projects at the outset results in products (such as specifications, drawings, standards and methods) that are fully ready to be used in normal practice. The discussions also included guidance on how to develop a formal process for technical committees to review research findings and recommend implementation steps.

New Jersey Department of Transportation (NJDOT, 2006) <sup>(5)</sup> published a peer exchange report, *Research Peer Exchange Report*, which discussed project implementation and technology transfer, and included the following steps:

- Start at the beginning for implementation.

- Develop and maintain a research implementation database.
- Periodically, ask the project champion to give the status of implementation and cost savings, and publish the benefits.
- Develop and use research project implementation status reports.

Iowa Department of Transportation published a peer exchange report, *Best Practices in Technology Transfer* <sup>(6)</sup>: *Research Peer Exchange, in 2007*. This peer exchange report focused on best practices in technology transfer, a topic closely tied to implementation. As participants examined technology transfer, their observations with regard to implementation included the following:

- There is a need for more complete implementation plans and regular assessments.
- Implementation products must be in a usable form, such as draft specifications, policies, legislation, ordinances, interagency agreements, pilot projects and training.
- The key to implementation is comfort—people must be comfortable with the ideas—which can come with familiarity and trust of the office or individuals.
- In-person meetings—not just paper forms—are needed to create handoffs from research to implementation, for identifying those responsible and the source of needed resources.

The Division of Research and Innovation (DRI) of the California Department of Transportation (Caltrans) <sup>(10)</sup> performs customer-focused transportation research for both internal and external customers. Orcutt and Larson (2010) discussed three research mechanisms used by DRI, which are: 1. 'in-house' research, 2. partnering with academia, and 3. partnerships with the private sector. Their study was intended for

transportation managers and practitioners interested in learning how current transportation research moves forward to become future innovation.

Elrahman and Giannopoulos (2011) examined the notion of transformative research, the high risk research that makes a radical difference and introduces fundamental changes in existing processes and systems <sup>(8)</sup>. They explored its application and implications in transportation. The authors note that the need to demonstrate the value and return on research investments can limit the willingness of research organizations to accept the risk-taking required for transformative research.

Rogers (2005) <sup>(9)</sup> investigated the diffusion-of-innovations model for strategies to achieve a higher degree of research utilization. The author notes that researchers are not rewarded for utilization of their findings and often lack the time, resources and expertise needed for the activities associated with implementing the research results. Strategies that might be used to foster implementation include 1) using champions to promote the innovations, 2) encouraging a high degree of community and practitioner participation in designing and conducting research, 3) capitalizing on peer networks to disseminate information about innovations, and 4) focusing considerable efforts in the early stages to identify early adopters of a new process or technology. Once a critical mass is achieved, less effort is needed to achieve widespread adoption.

Orcutt and Al-Kadri (2009) presented the results of a survey of 109 transportation professionals — primarily located in California — that queried the respondents about their experiences with innovation. It was found that researchers sought to determine the respondents' assessment of the significance of revolutionary and evolutionary innovation; how to rate common roadblocks and identify enablers for innovation processes; how innovations in safety, performance, cost-effectiveness, quality and environmental protection should be prioritized; and methods to improve the process of innovation.

Kwon et al. (2009) <sup>(11)</sup> investigated a dynamic research process for an adaptive management of research projects in a state Department of Transportation environment. The proposed process integrates the implementation planning into the research project development and management process, so that the innovative research products can be generated in a timely manner. Further, it combines research and knowledge management into one process, so that the results from the research can directly contribute to the increase of the organizational value. The development of a computerized management system based on the proposed process is currently in progress at the Minnesota Department of Transportation.

In 2004, The Pennsylvania Department of Transportation (PennDOT) responded to the need to address implementation programmatically with the development of its Research and Innovation Implementation System. Bonini et al. (2011) <sup>(12)</sup> discussed essential principles for building an effective Research and Innovation at PennDOT. These values include top management support, dedicated resources, effective communications, an implementation team with requisite skills and credibility, broad involvement of the field, and a supportive innovation culture. It was found that as PennDOT continues to learn to use the Implementation System, it continues to adapt to PennDOT's changing needs and priorities. Adaptability and responsiveness are keys to the Implementation System's future success.

## Categories of the Survey Performed at NJDOT

With an initial review on the Cooperative Research Programs (CRP) Division of the TRB, it was identified that there were more than a thousand research reports from NCHRP, Transit Cooperative Research Programs (TCRP), Airport Cooperative Research Programs (ACRP), National Cooperative Freight Research Program (NCFRP), and Hazardous Materials Cooperative Research Program (HMCRP) that were conducted between 2000 and 2010. In addition, publications of each research program are divided into five categories, including project reports, synthesis reports, research results digests (RRD), legal results digests (LRD), and Web-only documents. Thus, the effort of developing a web based survey was concentrated on categorizing the completed CRP projects.

In order to expedite the survey process, the list of projects on the survey were categorized and itemized with the type of cooperative research (e.g., NCHRP, TCRP, ACRP, NCFRP, HMCRP), subprogram (i.e., project reports, synthesis report, RRD, LRD, web-only documents), title, completion date, and subject area as shown below.

- |                      |                        |
|----------------------|------------------------|
| 1. Project Number    | 10. Publication Number |
| 2. Project Title     | 11. Publication Date   |
| 3. Completion Date   |                        |
| 4. Report Number     |                        |
| 5. Subject Area 1    |                        |
| 6. Subject Area 2    |                        |
| 7. Subject Area 3    |                        |
| 8. Subject Area 4    |                        |
| 9. Publication Title |                        |

In addition, the subject areas were categorized and presented based on the CRP classification system, as shown in Table 2.

Table 2 - CRP Classification System - Problem Areas Grouped by Research Field

Area #	Research Area / Field	Area #	Research Area / Field
<b>Research Field A – Administration</b>		<b>Research Field B – Transportation Planning</b>	
2	Economics	8	Forecasting
11	Law	25	Impact Analysis
19	Finance		
<b>Research Field C – Design</b>		<b>Research Field D – Materials and Construction</b>	
1	Pavements	4	General Materials
12	Bridges	9	Bituminous Materials
15	General Design	10	Specifications, Procedures, and Practices
16	Roadside Development	18	Concrete Materials
22	Vehicle Barrier Systems		
<b>Research Field E – Soils and Geology</b>		<b>Research Field F – Maintenance</b>	
21	Testing and Instrumentation	6	Snow and Ice Control
23	Properties	13	Equipment
24	Mechanics and Foundations	14	Maintenance of Way and Structures
<b>Research Field G – Traffic</b>		<b>Research Field SP – Special Projects</b>	
3	Operations and Control	20	Projects not readily identified with another problem area or encompassing several areas
5	Illumination and Visibility		
7	Traffic Planning		
17	Safety		



## **Research Implementation Results: Case Studies**

After reviewing a number of research implementations in state and national practices, it was found that successful implementation of research requires a shared attitude – an institutional mind-set that most transportation agencies are always working toward. In this section, two successful research implementation examples (e.g., NCHRP and TRB Annual Meeting) are presented and summarized <sup>(7)</sup>.

### **Iowa Department of Transportation (Iowa DOT)**

The Iowa Department of Transportation (Iowa DOT) is committed to getting the full value out of research projects to help improve the state's transportation system. Since the Iowa DOT <sup>(13)</sup> is aware of the value of applying research results into practice, the Iowa DOT seeks to implement applicable research wherever it can be found, whether from neighboring states, the Transportation Pooled Fund Program or the NCHRP that the Iowa DOT voluntarily funds (Iowa DOT Research and Technology Bureau, 2012).

Three examples of structures, safety, and winter maintenance areas help the Iowa DOT use NCHRP results to have the works completed. Guided by NCHRP research, the Iowa DOT saves time and money by using prefabricated bridge components and Iowa DOT's Office of Bridges and Structures frequently draws upon NCHRP research results to support the state's efforts. For example, Iowa engineers used NCHRP Report 584 (Full-Depth Precast Concrete Bridge Deck Panel Systems) <sup>(19)</sup> and NCHRP Synthesis Report 324 (Prefabricated Bridge Elements and Systems to Limit Traffic Disruption During Construction) <sup>(20)</sup> as a reference for the agency's federally funded prefabricated bridge projects in Boone County and Council Bluffs. The Iowa DOT has also incorporated findings from other NCHRP reports in its bridge projects, including NCHRP Synthesis Report 345 (Steel Bridge Erection Practices) and NCHRP Report 503 (Application of Fiber Reinforced Polymer Composites to the Highway Infrastructure) <sup>(18)</sup>. Other NCHRP Report 672 (Roundabouts: An Informational Guide) <sup>(17)</sup>, was implemented to address such topics as pavement markings and intersection design.

To help support the overall institutional commitment to safety, the Iowa DOT has used NCHRP Report 667 (Model Curriculum for Highway Safety Core Competencies) to strengthen highway designers' understanding of highway safety principles and help them improve how they integrate safety into the design process.

Having partnered in Transportation Pooled Fund snow and ice research for years, Iowa DOT knows the value of cooperative state research for winter maintenance <sup>(13)</sup>. The agency similarly looks to NCHRP research products to address winter maintenance challenges. NCHRP Report 577 (Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts) <sup>(16)</sup> and the user-friendly software decision tool together help public and private agencies consider impacts to the receiving environment as they weigh their snow and ice control options

Overall, it was found that the Iowa DOT applies NCHRP research to advance the state of practice and improve its transportation system. Iowa DOT makes use of NCHRP research; and, it gives research results back to the other states.

### **Utah Department of Transportation (Utah DOT)**

Between 2003 and 2009, Utah DOT has sent 49 individuals to the TRB Annual Meeting. These attendees have introduced a total of 269 initiatives stemming from ideas gained at the Annual Meeting, and Utah DOT has implemented 136 of these as of October 2009. The benefits of implementing cost-saving ideas from the TRB Annual Meeting have surpassed the cost to Utah DOT of sending a relatively small group of people to the event. Since the tracking process began in 2003, Utah DOT has realized a cost savings of more than \$189 million by implementing initiatives in contracting methods, safety improvements, accelerated bridge construction, and other areas (Lindsey, Utah TR News 2009).

Two key examples of beneficial projects based on Annual Meeting initiatives are cable median barriers and accelerated bridge construction with self-propelled modular transporters (SPMTs).

Reduced Crossover Crashes - Applying the information gathered at a 2003 TRB Annual Meeting session on road safety features promoted the installation of cable median barriers along Utah highway corridors that had a significant history of crossover crashes. Utah DOT has installed cable median barriers at several locations along I-15 and I-215 to decrease the number of injuries and fatalities from crossover crashes. Moreover, by using cable barriers instead of concrete barriers, Utah DOT was able to stretch its safety funds as far as possible - the cable barriers can be installed for approximately one-third the cost of concrete barriers. In 2004, Utah DOT installed its first cable median barrier system on two sections of I-15 in Utah County, totaling approximately 18 miles and \$3.08 million in project costs. Between 2002 and 2004, before installation of the barriers, a total of 35 crossover crashes with fatal or serious injuries occurred in these freeway sections; the total dropped to 4 between 2005 and 2007 after barrier installation. The estimated benefit–cost ratios for these projects range from 23:1 to 35:1. Cable median barriers have been successful in Utah in preventing crossover crashes and serious injuries and even deaths.

Utah DOT has used several contracting methods and construction technologies to accelerate project delivery and to minimize the impacts of construction. Accelerated bridge construction methods were introduced to Utah DOT at the 2007 and 2008 TRB Annual Meetings. In particular, the Annual Meeting sessions on the accelerated construction of bridges made Utah DOT aware of the benefits of a key technology, the self-propelled modular transporter (SPMT). Utah DOT has used SPMTs on bridge replacement projects, to remove bridges without the need for in-place demolition, and then to move entire prefabricated spans from the staging area to the bridge site. This process limits the interruption of service during a bridge replacement to days or hours, by eliminating the need for onsite, months-long construction.

Replacing bridges with SPMTs has also increased worker and traffic safety and has improved construction and durability. Drawing from the successes and lessons learned from the projects, Utah DOT has developed an SPMT manual with guidelines for designers and contractors involved in moving bridge spans.

Since 2007, Utah DOT has used SPMTs on six projects to replace a total of 21 bridges. With off-site fabrication and SPMTs, bridge spans often can be replaced in a weekend. For example, construction time on the 4500 South crossing of I-215 in Salt Lake City was reduced by 120 days, saving drivers approximately \$4 million in user costs. The total value added from the deployment of SPMTs on the six Utah DOT projects was approximately \$55.16 million, including user cost savings. The total cost of the SPMT moves and the associated staging was approximately \$10.59 million. This technology, combined with other accelerated bridge construction methods - such as sliding and deck panels - has benefited Utah DOT and the traveling public.

## **SURVEY OF NJDOT RESEARCH CUSTOMERS**

The survey questionnaires designed by the NJIT research team were grounded on data taken from the NCHRP survey responses and on output received during NJDOT quarterly meetings. A series of meetings with NJDOT further assisted the NJIT research team in designing the survey questionnaire. The feedback obtained in these meetings was used primarily to identify the areas of inquiry that the survey should focus upon, as well as the types of questions that all survey participants should be asked. Changes were made in the final website design in response to the comments and suggestions of the Project Manager. For the survey purposes, the database of the Cooperative Research Programs (CRP) publications has been expanded to include all publications completed in 2010 and in the first half of 2011. The final questionnaire consisted of a combination of multiple choice questions. After several modifications to the survey design that were made to conform to the NJDOT website format requirements, the survey was officially launched on September 16. The following hyperlink provides the web address for the survey:

<http://www.state.nj.us/transportation/refdata/research/survey/>. The design of the survey screens is provided in Appendix A. It was originally planned for the survey to conclude by October 31, 2011. However, due to a low response rate, the survey still remains accessible at the internet address.

## Analysis of Survey Results

The survey response database was regularly monitored and periodically summarized.

The final response statistics are as follows:

- Number of respondents accessing the survey website: 122
- Number of respondents with complete responses: 14
- Number of NCHRP projects: 26
- Number of NCHRP publications reviewed: 24
- NCHRP projects implemented: 20

A detailed information about the survey responders and their answers is summarized in Table 4.

Table 3 - NCHRP Research Implementation Survey Results

No.	Responder	Division/Bureau	Project #	Publication Title	Implemented
1	X. Hannah Cheng	Design Services	NP 307	Development of a Precast Bent Cap System for Seismic Regions	NO
2	Eileen Sheehy	Construction Services and Materials	NP023	Recommended Performance-Related Specification for Hot-Mix Asphalt Construction	NO
3	Camille Crichton-Sumners	Statewide Planning	NP062	Summary Report: Interim Planning for a Future Strategic Highway Research Program (F-SHRP)	NO
4	X. Hannah Cheng	Design Services	NS040	Bridge Deck Joint Performance	NO
5	James Bennett	Maintenance Electrical	NW035	Research for Customer-Driven Benchmarking of Maintenance Activities	NO
6	Todd Kropilak	Multimodal Services	NA001	How Transportation and Community Partnerships Are Shaping America Part II: Streets and Roads	Yes, FULLY

No.	Responder	Division/Bureau	Project #	Publication Title	Implemented
7	Dan Doyle	South	NA051	Highway Construction Coordination to Minimize Traffic Impacts	Yes, FULLY
8	Eileen Sheehy	Construction Services and Materials	NP021	The Restricted Zone in the Superpave Aggregate Gradation Specification	Yes, FULLY
9	X. Hannah Cheng	Design Services	NP053	Structural Supports for Highway Signs, Luminaires, and Traffic Signals	Yes, FULLY
10	Gregory Maryak	Construction and Materials	NP225	Traffic Safety Evaluation of Nighttime and Daytime Work Zones	Yes, FULLY
11	John Gerbino	Region Central	NP225	Traffic Safety Evaluation of Nighttime and Daytime Work Zones	Yes, FULLY
12	Clifford Cornell	Accounting and Auditing	NP265	Recommended Design Specifications for Live Load Distribution to Buried Structures	Yes, FULLY
13	X. Hannah Cheng	Design Services	NP281	Design of Roadside Barrier Systems Placed on MSE Retaining Walls	Yes, FULLY
14	Eileen Sheehy	Construction Services and Materials	NW054	Precision Estimates for AASHTO Test Method T308 and the Test Methods for Performance-Graded Asphalt Binder in AASHTO Specification M320	Yes, FULLY
15	Manmohan Singh	construction & maintenance	NP 299	A Manual for Design of Hot-Mix Asphalt with Commentary	Yes, PARTIALLY
16	Eileen Sheehy	Construction Services and Materials	NP003	Segregation in Hot-Mix Asphalt Pavements	Yes, PARTIALLY
17	Todd Hirt	Bridge Engineering & Infrastructure Management	NP029	Traffic-Control Devices for Passive Railroad-Highway Grade Crossings.	Yes, PARTIALLY
18	Robert Harris	Capital Investment Planning and Development	NP138	Performance Measures and Targets for Transportation Asset Management	Yes, PARTIALLY

No.	Responder	Division/Bureau	Project #	Publication Title	Implemented
19	Eileen Sheehy	Construction Services and Materials	NP226	Ruggedness Testing of the Dynamic Modulus and Flow Number Tests with the Simple Performance Tester	Yes, PARTIALLY
20	Eileen Sheehy	Construction Services and Materials	NP240	Self-Consolidating Concrete for Precast, Pre-stressed Concrete Bridge Elements	Yes, PARTIALLY
21	John Jamerson	Bridge Engineering & Infrastructure Management	NP275	Guidebook for Implementing Passenger Rail Service on Shared Passenger and Freight Corridors	Yes, PARTIALLY
22	Eileen Sheehy	Construction Services and Materials	NR077	Simulating the Effects of Hot-Mix Asphalt Aging for Performance Testing and Pavement Structural Design	Yes, PARTIALLY
23	Robert Harris	Capital Investment Planning and Development	NS033	Performance Measures for Highway Segments and Systems	Yes, PARTIALLY
24	William Bialowasz	Right of Way	NW029	Incorporating ITS Into the Transportation Planning Process: An Integrated Planning Framework (ITS, M&O, Infrastructure) Executive Guidebook	Yes, PARTIALLY
25	Eileen Sheehy	Construction Services and Materials	NW063	Supplementary Cementitious Materials to Enhance Durability of Concrete Bridge Decks	Yes, PARTIALLY
26	Kaushik Chokshi	Construction	NL006	Liability of Contractors to State Transportation Departments for Latent Defects in Construction after Project Acceptance	NO

Given the less than expected amount of feedback to the survey, NJIT proposed to conduct a series of interviews with current and recently retired NJDOT employees who have had active roles in TRB committees and who regularly attend TRB meetings and conferences. They were asked to meet with NJIT and discuss the following:

- Benefit of TRB Cooperative Research Program (CRP) to NJDOT

- Examples of CRP research implementation at NJDOT
- If possible, estimated monetary savings resulting from implemented CRP research
- Benefits of participating at TRB Annual Meeting
- Benefits of participating in other TRB activities (committees, meetings, conferences)

The project team prepared a list of current and recently retired NJDOT employees that may provide valuable information about NCHRP research implementation at NJDOT in the past 5-10 years. The list was submitted to the Bureau of Research for review and approval. The list was approved with small revisions on March 21, 2012.

NJIT provided a draft invitation e-mail to be sent to everyone from the approved list requesting their participation in interviews with the project team. The e-mail invitation was sent out by the Manager of the Bureau of Research. In addition, NJIT drafted an invitation to Principal Investigators from the university partners. A separate e-mail was sent to them inviting them to provide feedback online using the survey website.



## **CASE STUDIES OF NCHRP IMPLEMENTATION AT NJDOT**

This section of the final report presents an assortment of ten representative case studies to help readers understand how the information provided by NCHRP and TCRP research is implemented in NJDOT practice. By using a standard format that provides an overview of the project, a brief discussion of how the findings were applied and a summary of the benefits derived from the research, readers are provided with the information needed to evaluate the effectiveness of each of the selected case study projects.

The selected case studies cover a variety of several major areas of transportation-related research, such as: Intelligent Transportation Systems (ITS), Systems Planning, Materials, Construction, and Transit, along with a discussion of how each area has been impacted by the findings.

The 1<sup>st</sup> case study falls under the category of ITS performance, as it impacts and applies to planning, management and operations. The 2<sup>nd</sup> and 3<sup>rd</sup> case studies are related and look at Planning and Operations improvements. Both the 4<sup>th</sup> and 5<sup>th</sup> case studies deal with the benefits of Materials research and can be used to illustrate the benefit of such research to NJDOT. Case studies #6 and #7 focus on improvements in Construction practices, particularly as they are applied to materials in highway construction projects and for the advancement of practices by incorporating the use of ITS, respectively. The 8<sup>th</sup> and 9<sup>th</sup> case studies are related in their focus areas, as both cases deal with Transit concerns, particularly as they are applied in planning, operations and the consumer experience. And finally, the 10<sup>th</sup> case study uses ITS technologies to identify reliable sources of data that can be used in part for transit analysis.

## **Case Study 1: Incorporating ITS into the Transportation Planning Process**

Project Title: Incorporating ITS into the Transportation Planning Process: An Integrated Planning Framework (ITS, Maintenance and Operations (M&O), Infrastructure)

Executive Guidebook

Project Number: NCHRP 08-351

Project ID: NW029

- Publication #: NCHRP 118-PART I/IINCHRP Web-Only Document 118, Part I: Incorporating ITS Into the Transportation Planning Process: An Integrated Planning Framework (ITS, M&O, Infrastructure) Executive Guidebook<sup>2</sup>
- NCHRP Web-Only Document 118, Part II: Incorporating ITS Into the Transportation Planning Process: An Integrated Planning Framework (ITS, M&O, Infrastructure) Practitioner's Guidebook<sup>3</sup>

Category: ITS

Status: Partially Implemented

### **Project Overview**

The objective for this project was to create a written guidance on how to integrate the Intelligent Transportation Systems (ITS) into the metropolitan and statewide planning and environmental processes. ITS has an operations-oriented focus that provides real-time information on the performance of traffic infrastructure to those entities that are in charge of transportation systems as well as to the users of the transportation systems, such as travelling public – passengers, as well as private and public carriers that provide transit services to the passengers. ITS components (especially as integration occurs) begin to have noticeable system-wide impacts on various elements that serve the overall transportation management system (e.g., communications, traffic operations centers). Case Study 1 demonstrates how the ITS technologies were applied to bridge the gap between operations and planning, and how the deployment of ITS technologies

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<sup>1</sup> <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=908>

<sup>2</sup> <http://www.trb.org/Main/Public/Blurbs/159671.aspx>

<sup>3</sup> <http://www.trb.org/Main/Public/Blurbs/159672.aspx>

in transportation-related research works to alter the characteristics of “operations” decisions.

In integrating ITS into planning, the conceptual and historic differences in operations and planning must also be overcome. Operating and maintaining the transportation system, and planning to meet future infrastructure and service needs have been traditionally carried out by two distinct organizational units with State DOT, each having different perspectives, measures, staff, policy makers, support organizations, funding support, and time horizons:

- Operations:

Decisions for operating and maintaining the system have traditionally focused on short-term day-to-day issues on how to operate and manage the existing transportation network as efficiently as possible. They historically have been separable, short-term, localized, and responsive to conditions.

- Planning:

In contrast, transportation planning has focused on expanding and modifying the facilities and services to meet long-term system performance under average conditions. Regional system performance is assessed against the overall goals of the region and fiscal/environmental requirements.

The findings from NCHRP project 08-35 resulted in the deliverable of an executive guidebook which was developed to provide a “practitioner’s” guide on how to incorporate ITS and operations into transportation planning and decision making. In addition, the research demonstrated that ITS components were found to have a much longer planning cycle, larger budget, and higher Operations & Maintenance (O&M) costs than traditional operational improvements which require shared resources, scheduling, and budget coordination, i.e. “planning”. Therefore, in order to reach their full potential, the guidebook stresses that ITS systems and their components must be “planned” through the use of collaboration, coordination, and cooperation strategies with others.

Successful ITS planning depends on the creation of a longer-term vision of the entire system (this is referred to as system architecture), and all parts must also be integrated and coordinated to work together effectively with the traditional operations on one hand and with the long range plans for infrastructure, on the other hand. This relationship is shown in Figure 2, below.

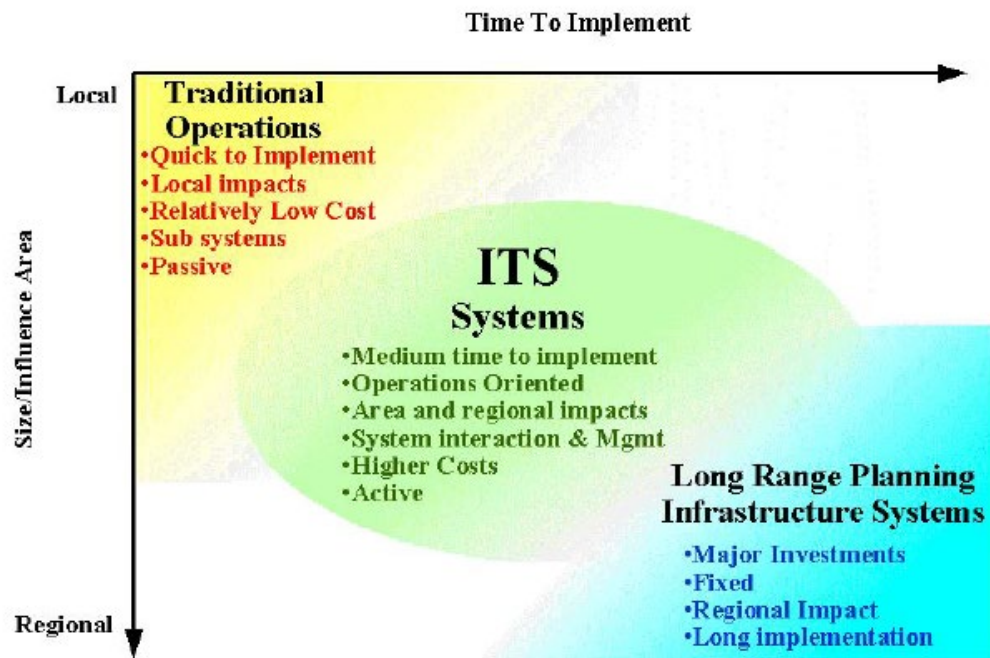


Figure 2. Traditional Operations and Planning versus ITS

The research objectives in this project were found to be clear and useful, and corresponded to agency need, and clearly summarized the best application of the research findings, recommendations and implementation guidelines. While ITS does have characteristics of both operations and planning, it also changes the nature of the transportation system and its decision making in at least two ways. First, ITS integration depends upon successful communications and protocols to function, meaning that the different elements of the system require coordinated effort to work together effectively. In any implementation of ITS, the emphasis on coordination of activities causes the various elements of the transportation system to become more inter-dependent. Second, ITS provides the ability to respond to changing conditions in order to manage

the transportation system and its performance. Overall, the project outcomes were deemed to be satisfactory and the project can be considered successful.

### Application

The results of this NCHRP research project were partially implemented by NJDOT. NJDOT adopted the following two recommendations:

1. It produced an overall statewide ITS architecture. Within this framework, any ITS project going forward will have its project level architecture be consistent with the statewide ITS architecture.
2. It created a process similar to the one in Figure 3 to integrate ITS into the short term and long term planning decisions. This process resulted in the ITS projects being formally given a specific procedure in moving them through the NJDOT capital programming pipeline from their inception to design and construction.

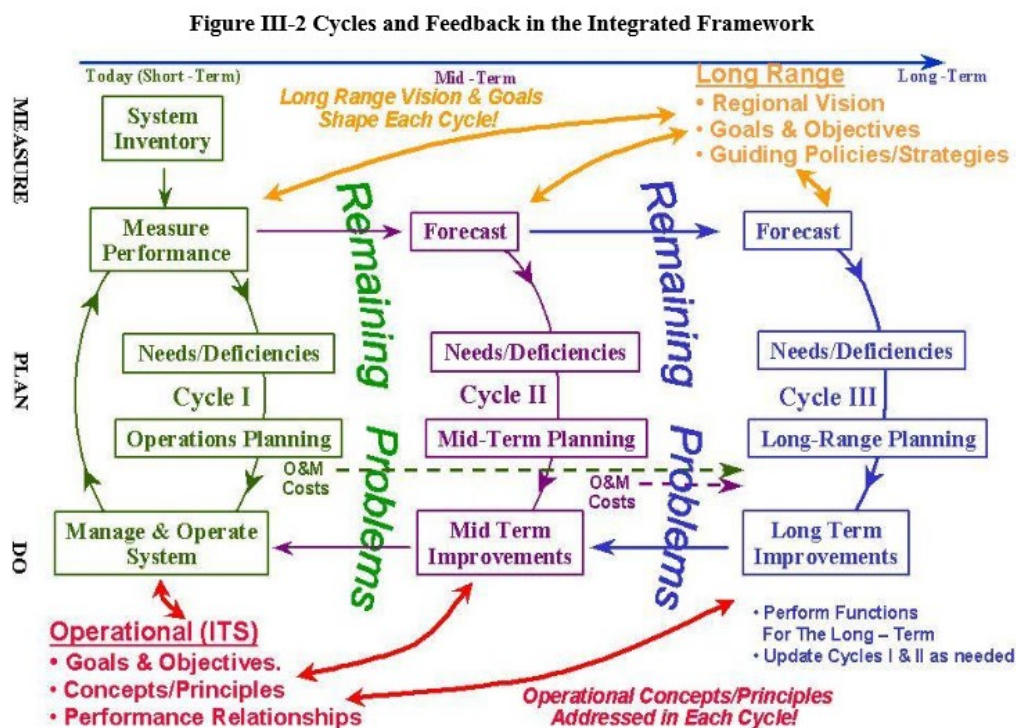


Figure 3. Integrated Framework

## **Benefit**

The benefits of integrating projects or programs are as follows:

- Improved communication between parties,
- Improved workforce productivity,
- Seamless process of advancing projects,
- Better capital planning and budgeting,
- Efficient use of scarce resources through the tailoring of projects (and their phases) to the available state and federal-aid funds by source type.
- Customer benefits in terms of safer travel with increased mobility

While these benefits may be obvious, they are difficult to quantify in terms of dollars, but the savings in terms of improved safety and congestion relief resulting from more efficient and effective implementation of ITS can top hundreds of millions of dollars.

## **Case Study 2: Incorporating Safety into Long-Range Transportation Planning**

Project Title: Incorporating Safety into Long-Range Transportation Planning

Project Number: NCHRP 08-44

<http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=920>

Project ID: NP135

Publication #: NCHRP 546 <http://www.trb.org/Main/Public/Blurbs/156716.aspx>

Category: Planning

Status: Partially Implemented

## **Project Overview**

This report describes the transportation planning process and discusses where and how safety can be effectively addressed and integrated into long-range planning at the state and metropolitan levels.

The development of performance measures and target values are critical to the principles of asset management in terms of setting objectives, identifying goals,



### **Application**

The results of this NCHRP research project were partially implemented by NJDOT. NJDOT incorporated Safety into the Long-Range Transportation Planning and into System Performance Measures. For example, some of those Performance Measures are:

- Mileage death rate (deaths per 100 million VMT)
- Vehicular traffic accident rate/100 million VMT
- Traffic accident injury rate/100 million VMT

NJDOT developed a system called the **Plan4Safety**. This is a multi-layered decision support program for transportation engineers, planners, enforcement, and decision makers in New Jersey. The Plan4Safety integrates statewide crash data, roadway characteristic data, calculates statistical analyses, incorporates network screening layers and models, and presents them visually via GIS analytical tools.

NJDOT Incorporated Safety into Technical Analysis

- NJDOT uses the safety data crash statistics when ranking the projects for inclusion in the capital programming plan.

### **Benefit**

This research provided NJDOT with guidance to state and metropolitan transportation planning organizations for improving their ability to more accurately forecast safety outcomes using socio-demographic data and the impact of investing in safety response measures, to better predict the likelihood of crashes and other safety concerns. The research products of this NCHRP project were found to be clear and useful, corresponded to agency needs, and clearly summarized the best application of the research findings, recommendations and implementation guidelines.

The benefit from safety improvement can be expressed as hundreds of millions of dollars in saved lives, alleviated personal and property damage.



### **Case Study 3: Performance Measures for Highway Segments and Systems**

Project Title: Performance Measures of Operational Effectiveness for Highway Segments and Systems

Project Number: NCHRP 20-05 <http://www.trb.org/Publications/Blurbs/152681.aspx>

Project ID: NS033

Publication: NCHRP Synthesis 311 Performance Measures of Operational Effectiveness for Highway Segments and Systems

[http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp\\_syn\\_311.pdf](http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_syn_311.pdf)

Category: Planning, Operations

Status: Partially implemented

#### **Project Overview**

The project objective was to examine the use of performance measures in assessing strategies for monitoring and managing operations of highway segments and systems. Performance measurements for various asset categories are extremely important in helping to develop an organization's capital investment strategy each year. This project looked at over 70 types of performance measures and evaluated them for problem solving methods, current research gaps, and usefulness of the available documentation. There are three basic categories of infrastructure performance measures which can be applied to all asset types as a way to measure current and future performance: they relate to condition, use, and functional sufficiency.

In this research project, an assessment of the relative strengths and weaknesses of these measures was performed. The application of these measures helps to identify the gaps in funding and the amount of financial investment needed to achieve particular goals.

The NCHRP synthesis 311 "Performance Measures of Operational Effectiveness for Highway Segments and Systems" summarizes the practices used by state DOTs, MPOs, and local governments concerning highway operational performance measures and associated data collection. These measurements were used to determine how much improvement can be achieved by applying different investment levels. These

types of measurements have been used in bridge deck programs and bridge rehabilitation, both of which are good examples of initial asset categories where performance measures could be easily measured. As an added feature, performance curves were developed to help determine the impact of the investments in specific project categories, such as assessing how many square feet of bridge deck has to be repaired in order to achieve a certain level of condition, i.e. bridge performance.

### **Application**

The results of the NCHRP synthesis 311 have been partially implemented by NJDOT.

NJDOT implemented the New Jersey Congestion Managements System (NJCMS), which calculates the recurring and non-recurring (or incident-related) delay on selected New Jersey roads. NJDOT uses the NJCMS to identify and report mobility hot spots – the locations that have compromised mobility. These locations are then subject to further analysis.

NJDOT uses the CMS to calculate the cost of congestion on individual roadway segment level. It can aggregate it up to a specific geographic or political area as well as by roadway functional class.

### **Benefits**

The report findings and applications have resulted in the following benefits to NJDOT:

1. Aided NJDOT in determining which performance measure to use
2. Helped NJDOT identify which targets are appropriate
3. Cost savings for NJDOT from improved asset management capabilities
4. Improved NJDOT's compliance with legal and regulatory requirements
5. Improved NJDOT's assets management capabilities and performance
6. Heightened NJDOT's overall performance through the use of advanced new technologies.

In addition to the benefits noted above, the findings in the NCHRP report assisted NJDOT by discovering the connection between highway link performance and highway (as an asset) usage.

An example of this type of linkage can be seen in an illustration of engineering and safety considerations that may arise from the design of a new intersection in response to the prevention of drunk-driving fatalities. The design for this specific purpose may provide a new level of awareness of various factors involved that could result in cost savings and improved safety. In conclusion, the project report, along with the products that resulted from the report, were considered suitable and effectively focused on the research objectives, and were deemed to be a fitting application of the findings.

NJDOT estimated the annual cost of non-recurring and recurring congestion to \$7Billion. Strategic investment in transportation improvement projects are seen as an offset of this cost.

#### **Case Study 4: Ruggedness Testing**

Project Title: Simple Performance Tester for SuperPave Mix Design

Project Number: NCHRP 09-29<sup>4</sup>

Project ID: NP226

Publication #: NCHRP 629, Ruggedness Testing of the Dynamic Modulus and Flow Number Tests with the Simple Performance Tester <sup>5</sup>

Category: Materials

Status: Fully Implemented

#### **Project Overview**

The objectives of this research were to (1) design, procure, and evaluate simple performance testers for use in Superpave mix design and in HMA materials characterization for pavement structural design and (2) evaluate and refine the indirect tensile test (IDT) procedures proposed for use as the simple performance test for low-temperature cracking and as the materials characterization test for low-temperature

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<sup>4</sup> <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=963>

<sup>5</sup> [http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_rpt\\_629.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_629.pdf)

cracking in the Mechanistic-Empirical Pavement Design Guide developed in NCHRP Project 1-37A

This research focused on assessing simple performance tester's designs, in order to encourage the creation of equipment that can be used in SuperPave volumetric design and for asphalt concrete material design, as well as other designs. The report includes an evaluation of the performance of the Simple Performance Test System (SPT), a computer controlled hydraulic testing machine that was designed to conduct NCHRP compressive tests on cylindrical asphalt concrete specimens. The testing used Dynamic Modulus Tests to measure the rutting and cracking deformation tendency of asphalt concrete and Flow Number Tests to assess rutting deformation tendency in repeated load testing of asphalt concrete mixtures.

The NCHRP Report 629, "Ruggedness Testing of the Dynamic Modulus and Flow Number Tests with the Simple Performance Tester" presents the two experiments that were included in the SPT ruggedness testing. The first was a formal ruggedness experiment designed, conducted, and analyzed in accordance with ASTM E1169, Standard Guide for Conducting Ruggedness Tests. The second was an experiment designed to investigate whether there are significant differences in SPT data collected with equipment from the three manufacturers: Interlaken Technology Corporation (ITC); IPC Global, Ltd. (IPC); and Medical Device Testing Services (MDTS). The ruggedness and equipment effects experiments were performed separately for the dynamic modulus and flow number tests.

The evaluation outlined in the report concluded that the SPT is a reasonably priced, user-friendly machine for the purpose of testing stiffness and permanent deformation properties of asphalt concrete.

### **Application**

The results of this NCHRP research project were fully implemented by NJDOT.

### **Benefit**

The application of the findings resulted in the following benefits for NJDOT:

1. Cost savings resulting from improved asphalt testing procedures
2. Enhanced compliance with legal and regulatory requirements
3. Improved assets management performance
4. The achievement of developing new advanced technologies

The NCHRP report findings caused additional modifications to the NJDOT specifications to reflect the improved standards for a higher quality of asphalt mix. Changing the standards led to the development of improvements in asset management practices, such as extending the service life of the equipment and reducing the costs associated with device maintenance requirements. Further, quality standards were enhanced due to the adoption of new testing methods through the use of advanced technologies. This change resulted in improved testing for hot mix asphalt, which consequently improved testing for HMA and overall asphalt quality.

### **Case Study 5: Self-Consolidating Concrete**

Project Title: Self-Consolidating Concrete for Precast, Pre-stressed Concrete Bridge Elements

Project Number: NCHRP 18-12, Self-Consolidating Concrete for Precast, Prestressed Concrete Bridge Elements<sup>6</sup>  
Project ID: NP240

Publication #: NCHRP 628<sup>7</sup>  
Category: Materials

Status: Fully Implemented

### **Project Overview**

The project developed guidelines for the use of self-consolidating concrete (SCC) for precast and pre-stressed bridge elements and bridge substructures. SCC is a specially proportioned hydraulic cement concrete that enables the fresh concrete to flow easily into forms and around reinforcement and pre-stressing steel without segregation. Use of this type of concrete for the manufacture of precast, pre-stressed concrete bridge elements provides the benefits of increased rates of production and safety, reduced

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<sup>6</sup> <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=478>

<sup>7</sup> [http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp\\_rpt\\_628.pdf](http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_rpt_628.pdf)

labor needs, and lower noise levels at manufacturing plants. SCC was generally expected to perform in similar fashion to its conventional counterparts, with the exception of the high workability factor present in the equivalent material. An appropriate mixture of the material constituents is needed for workability and overall functioning of the SCC concrete, and is defined in terms of passing ability, filling ability, and stability.

The report details a new method that was developed for fabricating SCC which employs the use of a new admixture, and this change resulted in the implementation of advanced new technologies. In addition, the new method increased the quality of the precast elements which are generally known to be more difficult to fabricate, and which typically have higher percentages of defects. The new method has proven to provide lower defect rates, which in turn helps to lower costs by decreasing the amount and frequency of follow-up repairs or replacements, thus resulting in additional cost savings through the reduction of labor requirements. The findings presented in the report include a recommendation for changes to the AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications and LRFD Bridge Construction Specifications.

### **Application**

The results of this NCHRP research project were fully implemented by NJDOT. The findings presented in the report include a recommendation for changes to the AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications and LRFD Bridge Construction Specifications. These guidelines provided NJDOT with the necessary information that is required when considering SCC mixtures that are expected to produce a uniform product, expedite construction, and yield economic and other benefits.

### **Benefit**

The new method outlined in the NCHRP report resulted in NJDOT gaining a better understanding of testing outcomes as it pertains to asphalt binders, and so led to the use of higher quality pavement materials. The findings in this report were fully

implemented by NJDOT for precast concrete but not for pre-stressed elements. Implementation resulted in the following benefits:

1. Provided cost savings for NJDOT resulting from increased organizational efficiency
2. Improved NJDOT's compliance with legal and regulatory requirements
3. Improved NJDOT's assets management performance
4. Enhanced improvements in the AASHTO standards used for materials testing.
5. The new admixture constitutes the use of a new technology method for NJDOT

The project objectives were found to be well-defined, and corresponded to agency needs. The report was deemed to be useful, and clearly summarized research findings, recommendations and implementation guidelines. The project report and products were timely and adequately addressed the research objectives. Overall, the project outcomes were satisfactory and the projects can be considered successful.

### **Case Study 6: Structural Supports for Highway Signs, Luminaries, and Traffic Signals**

Project Title: Structural Supports for Highway Signs, Luminaries, and Traffic Signals

Program: NCHRP

Project Number: NCHRP 17-10(2)<sup>8</sup>

Project ID: NP053

Publication #: NCHRP 494 Structural Supports for Highway Signs, Luminaires, and Traffic Signals<sup>9</sup>

Category: Construction

Status: Fully Implemented

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<sup>8</sup> <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=424>

<sup>9</sup> [http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_rpt\\_494.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_494.pdf)

## **Project Overview**

This project was designed to evaluate the current state and future design needs of New Jersey highway structural supports used for traffic control directional signage. The report that was generated from this project, NCHRP report 494 "Structural Supports for Highway Signs, Luminaires, and Traffic Signals," provided major modifications to the 1994 edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals Design Manual Green Book. The modifications dealt with discoveries related to the operational integrity of the specified signage structures, strength and fatigue factors, and considerations of load and resistance parameters.

## **Application**

In addition to the modifications, the report provided new data on wind maps and wind loading criteria, and introduced a new section to the AASHTO design guide containing information on fiber-reinforced composites, wood structures, and fatigue design. Along with the changes to the design manual, a strategic plan for future enhancements to the Supports Specifications template was developed, and this plan included a proposal for converting the specifications to a Load and Resistance Factor Design LRFD format. The guidelines provided in these reports were fully implemented by NJDOT and resulted in cost savings and enhanced productivity attributed to the following improvements:

1. Enhanced NJDOT's ability to critically evaluate the fatigue and strength factors for the purpose of material and design improvement
2. Improved NJDOT's compliance with legal and regulatory requirements
3. Increased NJDOT's organizational efficiency by providing guidance on best practices in materials and design construction factors
4. Improved NJDOT's asset management capabilities
5. Upgraded NJDOT's industry responsiveness performance by the implementation of advanced new technologies

The project findings resulted in major revisions to the updated version of the AASHTO specifications and design of structures design manual. These improvements led to



better- informed decisions by NJDOT in the areas of fatigue and strength design for different types of structures, and this in turn led to enhanced structural integrity and cost/benefit savings.

### **Benefit**

The full implementation of the recommendations in this study also helped standardize the design requirements for the applicable categories of structures, made it easier to identify and install the correct type of structure, and helped make possible better maintenance decisions in terms of efficiency and cost (using standardized designs produced in bulk rather than a special design per project). The new advanced technologies identified in the study were adapted by materials manufacturers as they upgraded their fabrication processes and machinery to meet the new standards, along with related production processes such as welding and other associated tools that had to be developed to adequately fabricate the structures.

A prospective implementation of the report recommendations for additional proposed changes would require a major revision of the specifications and design manual for NJDOT. That degree of revision presents a significant barrier in terms of increased time investment cost factors. The obstacles presented by those concerned about the cost consideration was supported by the perception that, although the improved designs noted in the report would result in more robust structures, the structures currently in use have not failed operationally; thus, this attitude of “if it’s not broke, don’t fix it”, makes it difficult to justify increased spending. However, the report was very useful in providing information that supports future cost-effective changes which can be implemented in a timelier and less cost-prohibitive manner in areas such as inspection and repair of stress-damaged structures, and simplified procedures for concrete anchorage.

## **Case Study 7: Traffic Safety Evaluation of Nighttime and Daytime Work Zones**

Project Title: Traffic Safety Evaluation of Nighttime and Daytime Work Zones

Program: NCHRP

Project Number: NCHRP 17-30<sup>10</sup>

Project ID: NP225

Publication #: NCHRP 627<sup>11</sup>

Category: Construction & ITS

Status: Fully Implemented

### **Project Overview**

This research determined how the organization of nighttime and daytime related work zones compare in terms of crash risk and rates. It evaluated how each time period affects the likelihood of crash rates. Because the documentation procedures that are presently used to evaluate and track crashes in work zones for daytime and nighttime operations are viewed as flawed, researchers sought to determine similarities and differences in the characteristics between types of traffic crashes.

The research also identified and evaluated various management practices that promote safety and mobility in nighttime and daytime work zones. The research also recognizes a fundamental need to improve the data in terms of its typology, analysis, collection, and archiving, especially in regards to work zone traffic crashes. The report was based on analysis of data from five states (New York, California, North Carolina, Ohio, and Washington).and an examination of the data discovered various strategies which were shown to have the potential for significant impact towards lowering crash rates in work zones.

By reducing the rates of crash accidents and improving safety, it resulted in lowered costs. Some examples of the various methods tested that were found to be more effective in reducing crash risk included full road closures instead of partial lane

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<sup>10</sup> <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=456>

<sup>11</sup> [http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_rpt\\_627.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_627.pdf)

closures, and detours using directional guidance. In addition, decreasing and consolidating the number of projects and the number of workforce personnel needed in work zones was also found to be effective strategies for reducing crash rates. The following steps were also used to help better regulate crash risk: regulating the linking of project payments to the timely completion of jobs, scheduling higher risk/ more complex work at lower traffic times, and enforcing stronger compliance of traffic laws.

### **Application**

The guidelines provided in the report were fully implemented by NJDOT and resulted in cost savings and enhanced productivity attributed to the following improvements:

1. Enhanced NJDOT's ability to critically evaluate the risk and rates of crashes in work zones for the purpose of improving safety
2. Improved NJDOT's ability to critically evaluate the risk and rates of crashes in work zones for the purpose of lowering construction costs
3. Increased NJDOT's organizational efficiency by changing work flow patterns to reduce risk and speed job completion
4. Improved NJDOT's compliance with legal and regulatory requirements
5. Improved NJDOT's asset management capabilities.

### **Benefit**

The project findings resulted in major shifts in industry awareness that, in fact, differences do exist in the rates of the type of crash that is more likely to occur in day versus night work zones, but those risks and rates are dependent on many factors, such as complexity of job, length of project, safety measures that were used, and the presence of legal notices and enforcement. These advances led to better-informed decisions by NJDOT in the areas of scheduling, payment schedules, job complexity, and job consolidation considerations. The implementation of the recommendations in this study also helped reduce misconceptions regarding traffic crashes and road use risk for night time workers when compared to daytime workers. Among the new technologies and benefits that arose from this research is the development of an abundant multi-state database of information on work zone, roadway, and crash data.

The project is considered as both valuable and supportive of the research findings, recommendations and implementation guidelines. The project intentions matched agency needs.

### **Case Study 8: Transit Oriented Development Practice**

Project Title: Transit-Oriented Development: State of the Practice, and Future Benefits

Program: TCRP

Project Number: TCRP H-27

Project ID: TP055

Publications: TCRP #102

Category: Transit

Status: Partially Implemented

### **Project Overview**

For this project, the researchers looked at transit-oriented development (TOD) concerns, obstacles, and accomplishments from New Jersey to California, while keeping in mind variations in populations across the country in terms of location-driven behavior and community generated factors.

TCRP report 102 was issued on the findings presented in TCRP Project H-27, with research objectives that focused on encouraging increased transit ridership for residents of responsibly-planned, more livable and mixed-use communities. As the most densely populated state in the U.S., New Jersey has a critical role to play in linking transportation infrastructure development and community outreach initiatives that are designed to meet the needs of an ever-expanding and increasingly on-the-move state population. Building a responsive and flexible transit system that easily adapts to the changing needs of the community and stays on pace with state and federal objectives towards areas of shared responsibility, such as environmental, mobility and energy initiatives, depends on a steady supply of resources. Drawing on the efforts put forth by the many dedicated members of the transit workforce, including the researchers who strive to supply data that helps to solve problems and supply new technologies, NJDOT

and NJ Transit used the findings from this report to bring innovation to the transit system planning practice.

### **Application**

The results of this TCRP research project were partially implemented by NJDOT and NJ Transit. The main way the goals of the research was accomplished was by helping stakeholders stay abreast of the latest findings produced in a meta-analysis of research reports, project studies and synthesis reports, then analyzing the results, and finally, implementing them as practice or guiding documents to be used as part of a proactive needs-responsive system. Through the use of interviews with Transit authorities, it is possible to see how the results of this exploration are put into practice.

Tom Marchwinski, Senior Director of Forecasting & Research at New Jersey Transit, explained: “We looked at these reports to discover recommendations for how TODs can reduce vehicle trip generation, and using that as a model for our trip to work scenarios. We began to explore how the many types of stations (there are at least 20 types) influence customer preference for access options. This, in turn, led to benefits to New Jersey Transit, such as an “improved ability to use the data generated in the report to analyze the impact of transit or its development on potential ridership and revenue. “ Mr. Marchwinski describes how the reports helped support an analysis of community housing and development projects in Morristown, NJ and Bound Brook, NJ and how the research provided benefit through the use of the some of the techniques that were laid out in the report, such as the ability to “estimate what the impact the development had on NJ Transit’s revenue in these two towns”.

### **Benefit**

The study proved to be relevant and applicable to the needs of transit authorities, the housing industry, and the community, and implementation of the findings resulted in:

1. The provision of more receptive transportation choices
2. Quantitative support for the development of equitable housing and development
3. Coordinated investment policies
4. Greater responsiveness to existing communities

## 5. Enhanced compliance with legal and regulatory directives

The report highlights a need to create customer profiles for riders that can be used for more effective marketing strategies and for meeting the expectations and needs of clients. One way of doing this is to use the implementation of the research as NJ Transit did, by instituting an online survey tool targeted toward improving customer service. As Janice Pepper, VP of Marketing (then Director of Research) at NJ Transit noted, the introduction of the online surveys “are a fast and inexpensive way of determining your customer base and for assessing the customer satisfaction needs” of your ridership. Ms. Pepper also notes that the research that helped inform the development of NJ Transit survey tools also enabled the Agency to bring this aspect of consumer relations in-house, and eliminated the need for using outside contractors. This resulted in cost savings and improved use of resources.

### **Case Study 9: Market Research Panels in Transit Systems**

Project Title: Use of Customer Market Research Panels in Transit

Program: TCRP

Project Number: Project J-7, Topic SB-22

Publications: TCRP #105

Category: Transit

Status: Partially Implemented

#### **Project Overview**

For this project, the researchers’ goals were to analyze and document the state of the practice concerning matters of public participation strategies for informing and engaging the transit-oriented public. The research team focused on uncovering challenges in engaging the public ridership and on which types of practices and strategies were most useful for this purpose. The research team conducted a meta-analysis of transportation agencies by asking them to complete a survey about the practices they employ to increase public participation in transit concerns. Out of 61 agencies which initially expressed interest, a total of 82% of the agencies, including NJ Transit and NJDOT, participated in the survey. The breakdown of the respondents by transportation

category included 66% public transportation service agencies, 8% local or state DOTs, and 32% regional or metropolitan planning organizations.

### **Application**

The results of this TCRP research project were partially implemented by NJDOT and NJ Transit. The main way the goals of the research was accomplished was by helping transit authorities and the public stay up-to-date on the best practices in the field for engaging public ridership investment in transit concerns.

Performed under Project J-7, Topic SH-13, as a synthesis of transit practice, the results of the analysis revealed that there is a wide range of practices employed by transportation agencies seeking to inform and engage the public in transit awareness matters. Too, the survey found that public engagement strategies are constantly evolving and diverse and this wide range of applications means that the methodologies that work for one agency may not work for another. However, these disparate methods and lack of standardization can offer flexibility for other agencies by offering a sampling of ideas and approaches that can be modified and adapted to meet the distinct needs of any transit ridership by taking into account specifics of population development, employment, and regional infrastructure characteristics. For example, NJ Transit has used the information contained in this report to modify their approach for assessing customer satisfaction by creating an online customer satisfaction survey for all transit services that looks at the customer metrics, such as customer experience, financial accountability, safety and security, and employee engagement through the use of an online scorecard system.

### **Benefit**

Numerous benefits to transit agency operations have resulted from greater rates of participation by customers in providing feedback on their rider experiences. Public participation in transportation decision-making and policy enactments has been shown to produce benefits in the following areas:

1. Increases the engagement of the public in terms of “ownership” of Transit practices

2. Results in improved decision-making practices which are workable and acceptable
3. Increases public perception of Transit agency credibility
4. Engages the community by supporting community values

In addition to these categories, there are also benefits to organizational operations. In an interview conducted with Janice Pepper, VP of Marketing, and formerly Director of Research at NJ Transit, Ms. Pepper outlines several of the benefits that have derived from incorporating the use of many the varying methodologies outlined in this report aimed at improving the customer satisfaction experience: the use of this information “helped in our creation of the scorecard system by allowing NJ Transit to focus our time and talent resources on meeting the expectations of our customers by understanding what area of services are most important to them”. The scorecard system is fueled by data that comes from transit customers’ answers that were provided when approached by Transit officials and given a card with an online web address for a customer satisfaction survey. According to Ms. Pepper, this allowed NJ Transit to design a responsive, effective, and efficient survey via the scorecard system by using the respondents as “data collectors”, thereby eliminating the need to send the survey concept out to a data house, resulting in savings in terms of personnel management and cost-effectiveness. The use of the scorecard system to identify both areas of customer satisfaction AND areas of customer concern provides the agencies involved in transit operations with “quicker delivery of results, which provides faster turnaround to management, customers, and transit organizations and stakeholders”. However, Ms. Pepper noted that the research also identified ways to improve customer responsiveness in those areas that lack reliable access to online portals, by “using iPads with already loaded surveys to approach those customers who revealed that they did not have reliable access to the online surveys in transit service areas”, and having them complete the survey on the iPads “in situ”, thus providing a more representative sample of customer concerns to be identified.



## **Case Study 10: Using American Community Survey Data in Transit Demand Modeling**

Project Title: Enhancing the American Community Survey Data as a Source for Home-to-Work Flows

Project Number: AASHTO/ NCHRP 08-36/Task 81

Project ID: NA118

Publication #: N/A

Category: Transit, ITS

Status: Partially Implemented

### **Project Overview**

NCHRP project 08-36/Task 81 was created to examine how American Community Survey (ACS) data could be paired with a new data product of the Census Bureau, the Longitudinal Employment Household Dynamics (LEHD), to identify differences in the two data sets.

The purpose of identifying and developing ways to overcome the differences is so the data can be merged and used as a more reliable source of statistics than only the ACS data (which is statistically less reliable due to smaller sample sizes and its 3-5 year data collection occurrences).

The more reliable joint data source can then be used to answer such transportation planning problems as journey-to-work (JTW) flow data. Developing a more accurate source of journey to work data allows researchers to consider factors that include worker characteristics, household characteristics, travel mode, and flow patterns, such as time of departure, mean travel time to work, and other pertinent data points.

The scope of the project findings was to display the need for the development of a custom tabulation tool similar to the Census Transportation Planning Product (CTPP) that could help to measure JTW data.

### **Application**

Thomas Marchwinski, Senior Director of Forecasting & Research at New Jersey Transit, and Janice Pepper, Director of Research at NJ Transit, (currently VP of Marketing)

offered implementation details in use of some of the ACS data for transit analysis. According to Mr. Marchwinski and Ms. Pepper, the techniques that were outlined for combining the data sources and for filtering the data to increase reliability permitted NJ Transit the use of “LEHD data to do trip distribution data [for] analyzing the impact on transit of new development” and was also used to “analyze characteristics such as origin of commuter to determine where people were traveling from in reverse commute trips, such as from Newark, NJ to Hackensack, NJ”.

### **Benefit**

A primary benefit of the study demonstrated that resources were conserved by a judicious rendering of the new existing data stream, thereby preventing a need for expensive and time-consuming processing.

An analysis of other benefits of the report showed that the findings also contributed to:

1. Improved data collection strategies
2. Greater reliability in traffic flow analysis
3. A higher degree of compliance in regulatory requirement measures
4. Potential future development of advanced technologies to measure JTW data

In addition, the research also supported greater quality standards by tightening the reliability measures for ACS and LEDH data use. Transportation officials used the models developed in this project to better inform their daily practices, and this application aligned with the project objectives and corresponded to agency needs.

## **ASSESSMENT OF BENEFITS FROM PARTICIPATING IN TRB ACTIVITIES**

This section identifies the benefits accrued to a typical state DOT from attending the TRB Annual Meeting.

A comprehensive literature search has been conducted to examine practices at State DOTs nationwide as they relate to evaluating the benefit of participating in the TRB

activities. It was found that the participation of state DOT staffs in TRB committees and attendance at TRB annual meetings and conferences are beneficial as they provide venues for formulating problems that require research, prioritizing research needs, and learning about the latest technologies and solutions for previously identified issues facing the State DOTs. Networking with other transportation professionals, contributing to the work of technical standing committees, and gaining insights from an array of program sessions at the Transportation Research Board (TRB) Annual Meetings have greatly benefited representatives of the state DOT personnel. In addition, those who attended have been instrumental in implementing cost-saving ideas brought back from the TRB Annual Meetings. This review will help frame the assessment method that will be applied in evaluating benefits for the purposes of NJDOT.

It was determined that the best way of assessing the benefits of participating in TRB activities for NJDOT is to relate them to the improvements in technology and business processes that were achieved at NJDOT's sister DOTs. In that respect, the results of the survey and subsequent interviews provide information about the types of benefits and importance the participation in the TRB activities has for a state Department of Transportation. The benefits are expressed in terms of monetary savings if such estimates exist, as well as in terms of increased efficiency, safety, and better asset management across the Department. The assessment is illustrated by the case studies of Utah DOT and Washington DOT summarized in the Literature Review section.

According to the TRB News (2011) <sup>(14)</sup>, the Utah DOT developed and implemented a process for tracking benefits that accrue to the department as a result of Utah DOT personnel attending the Annual Meeting of the Transportation Research Board. The research division of UDOT's Project Development Group coordinates and tracks the progress of the implementation of key ideas acquired from the Annual Meeting by UDOT personnel. Since the beginning of the tracking process in 2003, UDOT has realized millions of dollars in savings by implementing innovative ideas for contracting methods, safety improvements, accelerated bridge construction, and other areas, proving the value (both in terms of funds and progress) of regularly sending a small team of UDOT leaders to the Annual Meeting (TRB News, 2011).

Leni Oman (2011) <sup>(15)</sup>, director of Office of Research & Library Services, at the Washington State Department of Transportation (WSDOT) presented the benefits of attending TRB Annual Meetings. All TRB Annual Meeting attendees of WSDOT presented what they learned and observed during the meeting to all invited agency executives and research committee members.

Detailed information about the TRB Annual Meeting activity and benefits to these two DOTs are summarized in Table 3.

Table 4 - Benefits of Attending TRB Annual Meeting

Agency: Utah DOT		
<b>Attendees</b>	Between 2003 and 2009, Utah DOT has sent 49 individuals (5 to 20 each year) to the TRB annual meeting.	
<b>Emerging Issues and Ideas</b>	The individuals that attended the Annual Meeting have introduced a total of 269 initiatives stemming from ideas gained at the Annual Meeting	
<b>Implementation</b>	Utah DOT has implemented 136 of the introduced ideas as of October 2009	
<b>Benefits</b>	<ul style="list-style-type: none"> <li>• The benefits of implementing cost-saving ideas from the TRB Annual Meeting have surpassed the cost of sending people to the event</li> <li>• Cost savings of more than \$189 M by implementing initiatives in contracting methods, safety improvements, accelerated bridge construction, and other areas</li> <li>• Some attendees have reported difficult-to-quantify, intangible benefits from the Annual Meeting: <ul style="list-style-type: none"> <li>○ information transfer</li> <li>○ networking</li> <li>○ attending lectern and poster presentations at technical sessions</li> </ul> </li> </ul>	
<b>Example 1</b>	<i>Attendees</i>	Tracy Conti, Director of Operations for Utah DOT
	<i>Emerging Issues and Ideas</i>	Installation of cable median barriers along Utah highway corridors
	<i>Implementation</i>	<ul style="list-style-type: none"> <li>• Utah DOT has installed cable median barriers at several locations along I-15 and I-215 to</li> </ul>

		<p>decrease the number of injuries and fatalities from crossover crashes</p> <ul style="list-style-type: none"> <li>• Moreover, by using cable barriers instead of concrete barriers, Utah DOT was able to stretch its safety funds as far as possible – the cable barriers can be installed for approximately one-third the cost of concrete barriers</li> <li>• In 2004, Utah DOT installed its first cable median barrier system on two sections of I-15 in Utah County, totaling approximately 18 miles and \$3.08 million in project costs</li> </ul>
	<i>Benefits</i>	<ul style="list-style-type: none"> <li>• Between 2002 and 2004, before installation of the barriers, a total of 35 crossover crashes with fatal or serious injuries occurred in these freeway sections; the total dropped to 4 between 2005 and 2007 after barrier installation.</li> <li>• The estimated benefit–cost ratios for these projects range from 23:1 to 35:1. Cable median barriers have been successful in Utah in preventing crossover crashes and serious injuries and even deaths</li> </ul>
<b>Example 2</b>	<i>Attendees</i>	Jim McMinimee, Director of Project Development & Rukhsana Lindsey, Director of Research and Bridge Operations
	<i>Emerging Issues and Ideas</i>	Accelerated bridge construction methods to Utah DOT, applying information collected at the 2007 and 2008 TRB Annual Meetings.
	<i>Implementation</i>	<ul style="list-style-type: none"> <li>• Utah DOT has used Self Propelled Modular Transporters (SPMTs) on bridge replacement projects, to remove bridges without the need for in-place demolition, and then to move entire prefabricated spans from the staging area to the bridge site.</li> <li>• Since 2007, Utah DOT has used SPMTs on six projects to replace a total of 21 bridges. With off-site fabrication and SPMTs, bridge spans often can be replaced in a weekend.</li> </ul>
	<i>Benefits</i>	<ul style="list-style-type: none"> <li>• The total value added from the deployment of SPMTs on the six Utah DOT projects was about \$55.16 million, including user cost savings.</li> </ul>

		<ul style="list-style-type: none"> <li>The total cost of the SPMT moves and the associated staging was approximately \$10.59 million. This technology, combined with other accelerated bridge construction methods such as sliding and deck panels, has benefited Utah DOT and the traveling public.</li> </ul>
<b>Agency: Washington State DOT</b>		
<b>Example 1</b>	<i>Attendees</i>	John Milton, Director, Enterprise Risk Management
	<i>Emerging Issues and Ideas</i>	<ul style="list-style-type: none"> <li>Development of AASHTO Strategic Safety Plan</li> <li>AASHTO Safety Research Plan</li> <li>AASHTO Safety Performance Measures</li> <li>AASHTO Highway Safety Manual</li> <li>FHWA Highway Safety Implementation Plan</li> <li>Safety Edge</li> </ul>
	<i>Research Proposals</i>	<ul style="list-style-type: none"> <li>Development of Serious Injury Performance Measures</li> <li>Two Lane Rural Highways</li> <li>Freeways and Interchanges</li> <li>Development of Simulation Models in Road Safety</li> <li>Human Factors in Road Safety Development of Crash Modification Factors</li> </ul>
	<i>Implementation</i>	<ul style="list-style-type: none"> <li>Identify Additional Funding Opportunities with FHWA</li> <li>Evaluate Policy on HSM and Sustainable Safety Implementation</li> </ul>
	<i>Benefits</i>	<ul style="list-style-type: none"> <li>Ability to influence national priorities and policy related to highway safety</li> <li>Potential Funding for WSDOT efforts, Influenced National Research Priorities</li> </ul>
<b>Example 2</b>	<i>Attendees</i>	Tim Sexton, Air Quality, Noise, Energy Policy Manager
	<i>Emerging Issues and Ideas</i>	<ul style="list-style-type: none"> <li>New and proposed air quality standards and potential affects to WSDOT</li> <li>New state noise policies required by FHWA</li> </ul>
	<i>Research Proposals</i>	<ul style="list-style-type: none"> <li>Advocated for noise research focus on noise wall alternatives applied quieter pavement research</li> <li>Connected ADC20 to AASHTO AQ</li> </ul>

		subcommittee research priorities (shared by WSDOT)
	<i>Implementation</i>	<ul style="list-style-type: none"> <li>• DRAFT streamlining strategy prepared and discussing with FHWA</li> <li>• Worked with FHWA stakeholders to understand needs, they have requested \$100,000 for pooled fund</li> </ul>
	<i>Benefits</i>	<ul style="list-style-type: none"> <li>• Additional funding and cost savings potential (below)</li> <li>• State DOT perspective in mostly academic/federal government/consultant audience</li> </ul>

## CONCLUSIONS AND RECOMMENDATIONS

As part of a continuous practice to ascertain whether the research conducted through the NCHRP is applicable and viable, the Bureau of Research initiated a review of implementation procedures of the NCHRP research results at NJDOT. This report began with an examination of the results taken from the most recent NCHRP survey that was completed in early 2008, which looked at on-going research project reports that were finalized by the Transit Cooperative Research Programs (TCRP), Airport Cooperative Research Programs (ACRP), National Cooperative Freight Research Program (NCFRP), Hazardous Materials Cooperative Research Program (HMCRRP) and NCHRP programs through 2012, and which were broken down into the following five classifications of reports: project reports, synthesis reports, research result digests (RRD), legal results digests (LRD), and web-only documents. This study helped us design a survey what was conducted at NJDOT.

To better disseminate the information contained in these publications, the NJIT research team focused its efforts on creating a web-based survey designed to better categorize the completed CRP projects.

The latest 2012 version of the NJIT research team survey questionnaire (designed in compliance with NJDOT website format requirements) was officially launched on September 16, 2012 and featured multiple choice questions.

The findings were as follows:

- 122 respondents accessed the survey website,
- 14 of those gave a complete response.
- 29 NCHRP publications were identifies as being implemented to some degree.
- Only 20 % (6 out of 29) of the publications were fully implemented, 48% of the publications (14 of 29) were found to be partially implemented, while 31% of the publications (9 of 29) were found to be not implemented at all.

In summary, after a careful analysis of the project findings, the NJIT research team confirmed that overall, NCHRP research was successful in applying the outputs of the



research projects; however, there were several areas within the findings where improvements to the process are needed to improve stakeholder responsiveness and a wider dissemination of the research findings. Therefore, the research team strongly recommends the following actions to increase the usefulness of NCHRP research findings for practical applications in the transportation field:

- Due to the number of projects that failed to be implemented (either partially or fully), it is recommended that all projects which were classified as not implemented undergo a second review, in order to determine if there are potential benefits from the studies that can be applied by the agencies.
- Further, after making the determination that fully 48% of the reviewed case studies were classified as only partially implemented, the NJIT research team concluded that this finding revealed a large deficit between the number of completed projects and the anticipated benefits to the state DOT. Consequently, the research team strongly recommends that NJDOT uncover possible solutions to this problem.
- Another promising avenue of benefit is expected to result from incorporating regularly scheduled reviews and dissemination of the TRB newsletter content to the transportation community. The TRB newsletter is a valuable source of up-to-date activities and transportation research news that is targeted to federal and state officials, the national and international transportation community, and members of the academic world. Electronically published on a weekly basis, the newsletter is a free and easily accessible resource that serves as a virtual “meeting room” where stakeholders can discover (and contribute) to federal research information that advances the goals of the transportation community by providing a more comprehensive understanding of the collected data.

Therefore, the research team categorically endorses selecting a point-person(s) from the NJDOT Bureau of Research to review the contents of the newsletter on a regular basis and disseminate the more relevant findings to the appropriate NJDOT/NJ

Transit/MVC units and personnel. The newsletter can be accessed by clicking on the following link to access the site, [TRB Newsletter](http://www.trb.org/Publications/PubsTRBENewsletter.aspx), or by copying and pasting the newsletter's URL @: (<http://www.trb.org/Publications/PubsTRBENewsletter.aspx>) into a web browser, as shown above.

The research team also advocates encouraging greater participation by principal investigators in the NJIT survey, which should retroactively include prior research projects. By persuading the PIs to become more engaged in the survey process, it is expected to yield greater benefits by increasing the level of implementation of the research findings.

Finally, the results of all reviewed survey activities found that DOT staff participation in TRB committees, conferences, and attendance during TRB annual meetings was deemed to be very useful, due to the skill sets of DOT staff members in prioritizing research needs, highlighting specific areas and problems that require further research, and in learning more about the latest technologies and solutions that can be used for previously identified issues.

The annual benefit from implementing innovative ideas for contracting methods, safety improvements, accelerated bridge construction of regularly sending a small team of UDOT leaders to the Annual Meeting (TRB News, 2011) is measured in approximately \$60 million. The benefit cost ratio on a typical innovation project that WSDOT brought from the TRB attendance was approximately 5, which means that the benefits outweigh the cost fivefold.


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## APPENDIX A: FINAL DESIGN OF THE SURVEY INSTRUMENT

### Opening Page



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# ReferenceData

Survey of National Cooperative Highway Research Program  
Project Implementation in New Jersey

Dear Research Partner:

New Jersey Department of Transportation (NJDOT) Bureau of Research is conducting this survey to evaluate implementation of the National Cooperative Highway Research Program (NCHRP) and Transit Cooperative Research Program (TCRP) research projects in New Jersey. The main objective is to determine the extent to which the results of this research respond to the practical needs of NJDOT, New Jersey Motor Vehicle Commission (NJMVC), and New Jersey Transit (NJ TRANSIT). This survey is part of the continuous process of ensuring the research conducted or funded through the NJDOT Bureau of Research is viable and applicable.

As someone who has been involved in reviewing and/or implementing NCHRP and TCRP research results in the past, your participation in the survey is greatly appreciated. Please take just a few minutes to answer the survey questions. Proceed to the survey by clicking "Continue" below.

Thank you,  
NJDOT Bureau of Research

**[Continue on to the Survey](#)**

The survey is being conducted by the New Jersey Institute of Technology (NJIT), Department of Civil and Environmental Engineering, for the New Jersey Department of Transportation.

If you have any questions regarding the survey, please contact NJIT research team at [dimitrijevic@njit.edu](mailto:dimitrijevic@njit.edu) or 973.596.6463.





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## Reference Data

### Survey of National Cooperative Highway Research Program Project Implementation in New Jersey

PROGRESS:



Please provide your contact information and agency affiliation.

**Name:**

**Phone:**

**E-mail:**

**Organization/Agency**

☒ NJDOT      Division:   
                                  Bureau:

☐ NJ TRANSIT

☐ NJ MVC

☐ Other      Please Specify:

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### Survey of National Cooperative Highway Research Program Project Implementation in New Jersey

PROGRESS:



Please use the lists below to search the National Cooperative Highway Research Program (NCHRP) or Transit Cooperative Research Program (TCRP) study that you reviewed or were involved in the implementation of in New Jersey. (If you would like to rate additional study/studies, you will be able to do so later in the survey.)

<b>Search by Project Number:</b>	<input type="text"/>
----- OR -----	
<b>Search by Publication Number:</b>	<input type="text"/>
----- OR -----	
<b>Search by Title Keyword:</b>	<input type="text"/>
----- OR -----	
<b>Search by Program, Publication Type, Mode, and/or Subject Area</b>	
<b>Specify Program:</b>	
<a href="#">Select All</a> <input checked="" type="checkbox"/> NCHRP	<input type="checkbox"/> TCRP
<b>Specify Publication Type:</b>	
<a href="#">Select All</a> <input type="checkbox"/> AASHTO Report	<input type="checkbox"/> Legal Research Digest
<input checked="" type="checkbox"/> Project Report	<input checked="" type="checkbox"/> Research Results Digest
<input checked="" type="checkbox"/> Synthesis Report	<input type="checkbox"/> Web-only Documents

**Specify Mode:**[Select All](#)

- |  |  |
|--|--|
| <input type="checkbox"/> Aviation                | <input checked="" type="checkbox"/> Highways |
| <input type="checkbox"/> Marine Transportation   | <input type="checkbox"/> Motor Carriers      |
| <input type="checkbox"/> Pedestrian and Bicycles | <input type="checkbox"/> Pipelines           |
| <input type="checkbox"/> Public Transportation   | <input type="checkbox"/> Railroads           |

**Specify Subject Area:**[Select All](#)

- |  |  |
|--|--|
| <input type="checkbox"/> Administration and Management | <input checked="" type="checkbox"/> Bridges and Other Structures |
| <input type="checkbox"/> Construction                  | <input type="checkbox"/> Data and Information Technology         |
| <input type="checkbox"/> Design                        | <input type="checkbox"/> Economics                               |
| <input type="checkbox"/> Education and Training        | <input type="checkbox"/> Energy                                  |
| <input type="checkbox"/> Environment                   | <input type="checkbox"/> Finance                                 |
| <input type="checkbox"/> Freight Transportation        | <input type="checkbox"/> Geotechnology                           |
| <input type="checkbox"/> History                       | <input type="checkbox"/> Hydraulics and Hydrology                |
| <input type="checkbox"/> Law                           | <input type="checkbox"/> Maintenance and Preservation            |
| <input type="checkbox"/> Materials                     | <input type="checkbox"/> Operations and Traffic Management       |
| <input type="checkbox"/> Passenger Transportation      | <input type="checkbox"/> Pavements                               |
| <input type="checkbox"/> Planning and Forecasting      | <input type="checkbox"/> Policy                                  |
| <input type="checkbox"/> Research                      | <input type="checkbox"/> Safety and Human Factors                |
| <input type="checkbox"/> Security and Emergencies      | <input type="checkbox"/> Society                                 |
| <input type="checkbox"/> Terminals and Facilities      | <input type="checkbox"/> Transportation (general)                |
| <input type="checkbox"/> Vehicles and Equipment        |  |

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### Survey of National Cooperative Highway Research Program Project Implementation in New Jersey

PROGRESS:

**Search returned 28 publications.**

**Please choose the publication you wish to grade by selecting the record.**

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	Project	Publication	Publication Title	Publication Year
<input type="button" value="Select"/>	NCHRP 24-28	Project Report 675	LRFD Metal Loss And Service-Life Strength Reduction Factors For Metal-Reinforced Systems	2011
<input type="button" value="Select"/>	NCHRP 12-77	Project Report 679	Design Of Concrete Structures Using High-Strength Steel Reinforcement	2011
<input type="button" value="Select"/>	NCHRP 12-74	Project Report 681	Development Of A Precast Bent Cap System For Seismic Regions	2011
<input type="button" value="Select"/>	NCHRP 12-76	Project Report 683	Protocols For Collecting And Using Traffic Data In Bridge Design	2011
<input type="button" value="Select"/>	NCHRP 14-15	Project Report 668	Framework For A National Database System For Maintenance Actions On Highway Bridges	2011
<input type="button" value="Select"/>	NCHRP 10-71 [	Research Results Digest 355	Summary Of Cast-In-Place Concrete Connections For Precast Deck Systems	2011
<input type="button" value="Select"/>	NCHRP 12-72	Project Report 645	Blast-Resistant Highway Bridges: Design And Detailing Guidelines	2010
<input type="button" value="Select"/>	NCHRP 15-29	Project Report 647	Recommended Design Specifications For Live Load Distribution To Buried Structures	2010
<input type="button" value="Select"/>	NCHRP 22-23	Project Report 656	Criteria For Restoration Of Longitudinal Barriers	2010
<input type="button" value="Select"/>	NCHRP 22-20	Project Report 663	Design Of Roadside Barrier Systems Placed On MSE Retaining Walls	2010
1 2 3				

## Publication Selection Confirmation Page



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### Survey of National Cooperative Highway Research Program Project Implementation in New Jersey

**PROGRESS:**  


**Search returned 28 publications.**  
 Please click "CONFIRM" to grade the selected publication, or "CANCEL" to select a different one.

**Selected Publication**

Project Report 647 :  
  
 Recommended Design Specifications For Live Load Distribution To Buried Structures (2010 )  
  
 NCHRP 15-29

	Project	Publication	Publication Title	Publication Year
<input type="button" value="Select"/>	NCHRP 24-28	Project Report 675	LRFD Metal Loss And Service-Life Strength Reduction Factors For Metal-Reinforced Systems	2011
<input type="button" value="Select"/>	NCHRP 12-77	Project Report 679	Design Of Concrete Structures Using High-Strength Steel Reinforcement	2011
<input type="button" value="Select"/>	NCHRP 12-74	Project Report 681	Development Of A Precast Bent Cap System For Seismic Regions	2011
<input type="button" value="Select"/>	NCHRP 12-76	Project Report 682	Protocols For Collecting And Using Traffic Data In Bridge Design	2011

## Project Implementation Feedback Page (Option #1)



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PROGRESS:

**Recommended Design Specifications for Live Load Distribution to Buried Structures**  
( NCHRP 15-29 Project Report 647 2010 )

**Please select the statement that best describes the project's outcome as it relates to your organization.**

☒ The results of the project have been FULLY applied/implemented.

☐ The results of the project have been PARTIALLY applied/implemented.

☐ The research was considered/reviewed, but was NOT implemented.

**Please select all statements that describe the benefits of the project to your organization.**

☐ Implementation resulted in cost savings.

☐ Implementation helped to meet regulation and law compliance.

☐ Implementation resulted in increased organizational efficiency.

☐ Implementation resulted in improved asset management.

☐ The project resulted in implementation of new advanced technologies.

☐ Implementation resulted in other benefits - please explain (Max.500 characters)

CONTINUE

## Project Implementation Feedback Page (Option #2)



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PROGRESS:



**Recommended Design Specifications for Live Load Distribution to Buried Structures**  
( NCHRP 15-29 Project Report 647 2010 )

**Please select the statement that best describes the project's outcome as it relates to your organization.**

- ☐ The results of the project have been FULLY applied/implemented.
- ☐ The results of the project have been PARTIALLY applied/implemented.
- ☒ The research was considered/reviewed, but was NOT implemented.
  - ☐ The research results did not address the corresponding practical needs of the organization.
  - ☐ Other reasons - please explain in the text box below. (Max.500 characters)

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## Reference Data



PROGRESS:



### Recommended Design Specifications for Live Load Distribution to Buried Structures ( NCHRP 15-29 Project Report 647 2010 )

**Please rate the following aspects of this project report and products as they relate to your organization:**

1) Project objectives were clear and corresponded to agency needs.

☐ Agree ☐ Somewhat Agree ☐ Disagree ☐ Undecided/Not Sure

2) Project report was useful and clearly summarized research findings, recommendations, and implementation guidelines.

☐ Agree ☐ Somewhat Agree ☐ Disagree ☐ Undecided/Not Sure

3) Project report and products were timely.

☐ Agree ☐ Somewhat Agree ☐ Disagree ☐ Undecided/Not Sure

4) Project report and products adequately addressed the research objectives.

☐ Agree ☐ Somewhat Agree ☐ Disagree ☐ Undecided/Not Sure

5) Overall, project outcomes were satisfactory and the project can be considered successful.

☐ Agree ☐ Somewhat Agree ☐ Disagree ☐ Undecided/Not Sure

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## “Rate Another Project/Publication” Selection Page



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PROGRESS:



**Would you like to rate another project?**

☐ Yes

☒ No

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**Thank you for your participation in the National Cooperative Highway Research Program and Transit Cooperative Research Program implementation survey.**

Your feedback is greatly appreciated and will help New Jersey Department of Transportation Bureau of Research to continue providing an effective research program focused on improving New Jersey's transportation system.